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# Final Program

## Forty Ninth Annual Virtual Meeting

### International Neuropsychological Society

February 2-5, 2021

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TUESDAY, FEBRUARY 2, 2021

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| <b>8:00 AM - 11:00 AM</b> | <b>CE Workshop 01: Before the Cure: Cognitive Rehabilitation for Mild Cognitive Impairment</b><br><b>Presenters:</b> Anthony Y. Stringer, Benjamin M. Hampstead, Margo Adams Larsen  |
| 1. STRINGER, AY           | Before the Cure: Cognitive Rehabilitation for Mild Cognitive Impairment  |
| <b>8:00 AM - 11:00 AM</b> | <b>CE Workshop 02: Update on Vascular Contributions to Cognitive Impairment and Dementia</b><br><b>Presenter:</b> Daniel A. Nation   |
| 1. NATION, DA             | Update on Vascular Contributions to Cognitive Impairment and Dementia  |
| <b>12:00 PM - 1:30 PM</b> | <b>CE Workshop 03: At the Intersection of Poverty, Dialect, and Literacy: Assessment of Language and Reading of Low-Income African American Children</b><br><b>Presenter:</b> Julie A. Washington  |
| 1. WASHINGTON, JA         | At the Intersection of Poverty, Dialect, and Literacy: Assessment of Language and Reading of Low-Income African American Children  |
| <b>12:00 PM - 1:30 PM</b> | <b>CE Workshop 04: A Model for Extending Neuropsychological Assessment and Research into other Disciplines: Examples from the Perioperative Cognitive Anesthesia Network (PeCAN) for Neurodegenerative Disorders</b><br><b>Presenter:</b> Catherine C. Price |
| 1. PRICE, CC              | A Model for Extending Neuropsychological Assessment and Research into other Disciplines: Examples from the Perioperative Cognitive Anesthesia Network (PeCAN) for Neurodegenerative Disorders  |

**12:00 PM - 1:30 PM****CE Workshop 05: Introduction to the Neuropsychology of COVID-19****Presenters:** Lucette Adeline Cysique, Emilia Łojek

Introduction to the Neuropsychology of COVID-19

1. CYSIQUE, LA

WEDNESDAY, FEBRUARY 3, 2021

**8:00 AM - 9:00 AM****A Tribute to Dr. Alfredo Ardila**

Alfredo Ardila Tribute

1. INS

**8:00 AM - 9:00 AM****Paper Session 01: Parkinson's Disease and Other Dementias**

1. VAN PATTEN, R

REM Sleep Behavior Disorder in Parkinson's Disease: Baseline Effects on Cognitive, Psychiatric, and Functional Outcomes at 16-47-Month Follow-up

2. CROWLEY, S

Free Water Fraction Predicts Decline in Mental Flexibility for Individuals with Tremor Dominant Parkinson's Disease

3. RATAJSKA, A

Differential Contributions of Depression, Apathy, and Anxiety to Neuropsychological Performance in Parkinson's Disease vs Essential Tremor

4. WERTZ, C

Dopaminergic Deficits and Cortical Thinning in Parkinson's Disease Patients Who Develop Psychosis

5. RYMAN, S

Cardiovascular Risk, White Matter, and Cognition in Parkinson's Disease

6. KUMFOR, F

Delusions in dementia: A transdiagnostic examination of prevalence, nature and neurocognitive mechanisms

**8:00 AM - 9:30 AM****CE Workshop 06: Cognitive and Behavioral Phenotypes Associated with Neurogenetic Syndromes****Presenter:** Nancy Raitano Lee

1. LEE, N

Cognitive and Behavioral Phenotypes Associated with Neurogenetic Syndromes

**8:00 AM - 9:30 AM****CE Workshop 07: Poverty and the Developing Brain****Presenter:** Pilyoung Kim

1. KIM, P

Poverty and the Developing Brain

**8:00 AM - 9:30 AM****CE Workshop 08: Cognitive Assessment among Diverse Latinos in SOL-INCA (Study of Latinos-Investigation of Cognition Aging)****Presenters:** Hector M. González, Wassim Tarraf

1. GONZÁLEZ, HM

Cognitive Assessment among Diverse Latinos in SOL-INCA (Study of Latinos-Investigation of Cognition Aging)

**8:30 AM - 9:30 AM****Poster Session 1: Medical and Other Neurological Disorders**

1. SIRCUS, H A Literature Review on Resilience and Posttraumatic Growth in Cancer Patients
2. GUPTA, S Cortical Gray Matter Alterations in Breast Cancer Patients Undergoing Hormone Therapy
3. JEBABI, F Effects of Tamoxifen on Cognition and Language in Women with Breast Cancer: A Systematic Review
4. HANTLA, R A Case Series and Conversation Regarding the Integration of Psychosocial Support After a Brain Tumor Diagnosis
5. SHARMA, S Tamoxifen effects on Cognition and Language in women with Breast cancer
6. RACHES, D Investigating Severity of Symptoms Associated with Posterior Fossa Syndrome as Predictors of Long-Term Cognitive and Functional Outcomes: A Case Series
7. THIBODAUX, L Cognitive Functioning in Pediatric Brain Tumor Survivors with Hearing Loss
8. WARREN, E Verbal Memory Predicts Peer Relations in Pediatric Brain Tumor Survivors
9. IQBAL, S Sex Differences in Cognition and Associations with Quality of Life in Patients with Brain Tumors
10. OLSTHOORN, I Neurocognitive Outcome and its Relationship with Social Engagement in a Mixed Sample of Pediatric Brain Tumor Survivors
11. OLSTHOORN, I Sleep Disturbance as a Predictor of Cognitive Functioning in a Mixed Sample of Pediatric Brain Tumor Survivors
12. WEISMAN, H Externalizing Problems and Working Memory: Comparing Pediatric Cancer Survivors and Children with Neurodevelopmental ADHD
13. HANEDA, A Examining Comorbidities and Cognition in Older Adult's Pre-Stem Cell Transplant
14. ALI, J The Impact of Hearing Loss on Cognitive Outcomes among Children Treated with Radiation Therapy for Ependymoma
15. PETERSON, R Sluggish Cognitive Tempo in Survivors of Pediatric Brain Tumor Compared to ADHD-Inattentive Presentation
16. HASLER, H NIH Toolbox for Cognitive Screening in Survivors of Childhood Cancer
17. MCCURDY, M Executive Control and Emotional/Behavioral Functioning Partially Mediate the Effects of Tumor- and Treatment-Related Risk Factors on Psychosocial Health-Related Quality of Life in Survivors of Pediatric Brain Tumor
18. SEMMEL, E Graph Theoretical Analysis of Brain Network Characteristics in Brain Tumor: A Review
19. BURSTEIN, S Long Term Attention, Intelligence, and Processing Speed Outcomes Following Proton Radiation for Pediatric Brain Tumor Survivors

20. CHIANG, J Insufficient Sleep Duration and Adaptive Functioning Deficits in Patients with Pediatric Brain Tumor
21. CHIANG, J Sleep Disturbance and Executive Dysfunction in Patients with Pediatric Brain Tumor
22. GIMBEL, B Group and Individual Level Changes in Neuropsychological Functioning After Epilepsy Surgery in a Pediatric Sample
23. BARNARD, E Semantic and Phonemic Fluency in Pediatric Temporal Lobe Epilepsy
24. MONCRIEF, G Self-Rated Executive Dysfunction in Adults with Epilepsy and Effects of a Cognitive-Behavioral Intervention (HOBSCOTCH)
25. BOSCH, C Distinguishing Psychogenic Nonepileptic Seizures from Epilepsy Using the Personality Assessment Inventory: A Meta-Analysis
26. GONZALEZ, J Changes in Cognition Following Surgical Resection for MRI Negative Temporal Lobe Epilepsy
27. TSAI, P The Executive Function Characteristics of School-Aged Epileptic Children with a History of Febrile Convulsions
28. SCHNEIDER, B The Neural Correlates of Social Cognition Deficits in Temporal Lobe Epilepsy
29. HANEDA, A Laser Ablation for Epilepsy Surgery: Impact on Executive Function
30. HAGUE, C Prevalence of Suicidality in Pediatric Patients with Epilepsy and Psychiatric Disorders
31. COHEN, M Unexpected Wada Results, SEEG Mapping, and Pre-Surgical Neuropsychological Findings in Relation to Functional Post-Surgical Outcome: A Case Study of a Patient with Medically Refractory Epilepsy
32. TETI, A Lateralization in Phonemic Fluency, not Semantic Fluency in Temporal Lobe Epilepsy
33. IBARRA, N Predictors of Quality of Life after Anterior Temporal Lobectomy
34. LOKAI, A Cultural Perspectives on the Neurosurgical Plan, Interventions, and Outcomes in a South-East Asian Patient with Epilepsy: A Case Study
35. JACOBSON, T Stimulation Identified Naming Sites in Patients with and Without Focal Cortical Dysplasia
36. GRABYAN, J Patients with Psychogenic Non-Epileptic Events vs. Epileptic Seizures Do Not Differentially Report Emotional Distress When Controlling for Symptom Validity Test Performance
37. OLEJNIK, A Quality of life in patients with drug resistant epilepsy – clinical and neuropsychological correlations
38. OLEJNIK, A Social cognition deficits and how patients with TLE perceive it
39. CAUGHERTY HAN, N Relationship Between Epilepsy Risk Factors and Academic Achievement
40. SAAD, A Clinical Characteristics of Bilateral Memory Failure on Intracarotid Amobarbital Procedure

41. TURNER, S Relationship between medial temporal lobe volume and object recognition performance in epilepsy
42. RETTIG, E The Relationship Between Language and Memory Lateralization in Youth and Young Adults with Intractable Epilepsy: A Wada Study
43. SPEELMAN, C Impact of Race-Based Norms on Lateralization of Expressive Language in TLE Patients: A Pilot Study
44. KULKARNI, A Compensatory Cognitive Contributions in Healthy APOE- $\epsilon$ 4 Carriers: A Stopgap to Potential Amnesic Decline
45. KAUTIAINEN, R MTHFR Single Nucleotide Polymorphism Associated with Working Memory in Pediatric Medulloblastoma Survivors
46. ZATKALIK, A Associations Between Genotype, Seizure Presentation, and Adaptive Functioning in Individuals with Cardiofaciocutaneous Syndrome
47. WHITMARSH, A Neurodevelopmental Characterization of CFC Syndrome, an Epilepsy-Associated Neurogenetic Disorder
48. LY, A Exploring Associations Between Child Traumatic Stress, Depressive Symptoms, Metabolic Syndrome, and Working Memory in a National Sample of Young Adults
49. PAVOL, M Cognition Predicts Days-Alive-Out-Of-Hospital After Implantation of Left Ventricular Assistive Device (LVAD)
50. PAVOL, M Cognitive Profile of Patients with Stroke or Death After Implantation of Left Ventricular Assistive Device (LVAD)
51. HAMMOND, J Posterior Reversible Encephalopathy Syndrome (PRES) in a Recovered COVID-19 Patient with Sickle Cell Anemia: A Neuropsychological Case Study
52. FERNANDES, M Contributions of Attention to Memory Deficits in Patients with Cushing's Syndrome
53. WISINGER, A The Role of Cognition in the Functional Assessment of Daily Living Abilities in Older Adults with Spinal Cord Injuries: A Narrative Literature Review
54. HEPPNER, H Postoperative Cognitive Dysfunction after Aortic Valve Surgery
55. POLLNER, E Neurocognitive Change over the Course of a 3-day External Lumbar Drain Trial in Patients with Suspected Normal Pressure Hydrocephalus
56. CARSON, B Processing Speed in Patients with Heart Failure: A Meta-Analysis and Research Synthesis
57. LACKEY, N Comparison of the Mini-Mental Status Examination Versus the Montreal Cognitive-Assessment in Patients with Heart Failure
58. KELLY, D Cerebrovascular Risk Factors and Cognition in Idiopathic Normal Pressure Hydrocephalus
59. KANGAS, KJ Neuropsychological functioning and outcomes among heart failure patients referred for mechanical support and transplant:

- Insights from the Transplant Neuropsychology and Intervention Clinic
60. HEITZER, A Neurocognitive Performance from School Age to Young Adulthood in Sickle Cell Disease
61. MERRILL, C Predicting Attention Performance in Children with Sickle Cell Disease Using Parent Report of Physical and Psychological Functioning
62. GRADONE, A Executive and Adaptive Functioning in Children with Kidney Disease
63. TURNER, E Daytime Oxygen Saturation as A Marker of Cognitive Function in Pediatric Sickle Cell Disease
64. JASSAL, Y Specific Patterns of Executive Functioning Weaknesses Amongst Children After Heart Transplant
65. SHIELDS, C Adolescent Eating in the Absence of Hunger: The Contributing Influence of Executive Functions
66. GRANT, J Cognitive Enrichment and Education Quality Predict Cognitive Dysfunction in Multiple Sclerosis
67. MILLER, J Cognition and Handedness in Multiple Sclerosis
68. BRADSON, M Effects of ApoE- $\epsilon$ 4 Allele on White Matter Structure in Multiple Sclerosis
69. BERRIGAN, L EEG and ERP Correlates of Cognitive Functioning in Relapsing-Remitting Multiple Sclerosis
70. ZICCARDI, S Social Cognition Deficits in Newly Diagnosed Multiple Sclerosis Patients: a Preliminary Investigation
71. GUANDALINI, M Automatic vs. controlled processing in Verbal Fluency tests in MS patients: a pilot study
72. WEICK, M Military Spouses: The Vicarious Impact of a Service Member's Neurological Deficits
73. DRAKE, J Reduced Fronto-Striatal Activity during a Working Memory Task in Middle-Aged Apolipoprotein E  $\epsilon$ 4 Carriers with Overweight/Obesity
74. HO, B Cytokines may be Related to Brain N-acetylaspartate Levels in Patients with Obesity
75. PAREDES, J Neuropsychological Performance and MRI White-Matter Hyperintensities in a Clinical Sample
76. DILLAHUNT, AK Case-control Differences in Neural Activation During Processing of Subliminal and Supraliminal Emotional Faces
77. MORALES, CD MRI Markers of Brain Health Across Race and Ethnicity in Middle Age
78. FERNANDEZ, D Electrophysiological Effects of Transcranial Infrared Laser Stimulation
79. WALKER, AD Performance on Tasks of Inhibition in Heart Failure: A Meta-Analysis and Research Synthesis

80. POLLARD, AA Assessing Cognitive Flexibility in Heart Failure Using the Trails Making Test Part B
81. NEMANIM, N Comparison of Phonemic Versus Semantic Fluency in Patients with Heart Failure
82. ZHANG, E Verbal Memory Impairment in Heart Failure: A Meta-Analysis and Research Synthesis
83. O'NEAL, AG Pre-Operative Memory Performance Predicts BMI Change in Individuals with Chronic Obesity
84. KELLEHER, S Cerebral Infarction and Processing Speed Predict Executive Function in Patients with Sickle Cell Disease
85. SZYMKOWICZ, SM Optimal Cut-Off Score of the Montreal Cognitive Assessment (MoCA) in Assessing Cognitive Dysfunction in Inpatient Liver Transplant Candidates: A Retrospective Chart Review
86. TURMAN, ML Toward a Standardized Pre-Organ Transplant Neuropsychological Assessment Battery: Cognitive, Adaptive, and Emotional Functioning Insights from a Presurgical Cardiothoracic Transplant Evaluation Case.
87. HAVLIK, E WAIS-IV Prorated Verbal Comprehension Index Composite Scores in an Epilepsy Sample
88. RHOADS, TW Racial/Ethnic Differences in Chronic Pain Experience: Implications for Assessment and Intervention Among Presurgical Spinal Cord Stimulator Candidates
89. FUSCO-GESSICK, B Night-to-Night Variation in Sleep Quality and Quantity Is Not Associated With Executive Functioning in Healthy Young Adults
90. CHAPIN, BA Vertical Pseudoneglect: Attentional Versus Action-Intentional
91. CHILDERS, L Visual Working Memory and Learning and Recall of a Meal Preparation Task in Virtual Reality
92. LEE, DC Differences by Age Cohort and Gender on a Meal Preparation Task in Virtual Reality

**9:00 AM - 10:00 AM**

- Paper Session 02: Aging, Physical Activity and Lifestyle Factors**
1. MENDEZ COLMENARES, A Aerobic exercise increases T1w/T2w in the aging white matter
2. MEMEL, M Resistance versus Resilience – Effects of objectively measured physical activity on neuropathology and cognitive outcomes in older adults
3. SMITH, EE Lifestyle Factors Predicting Cognition in Elderly Adults With and Without Cognitive Impairment
4. SOLDAN, AF Lifestyle activity engagement and resting-state functional connectivity among older adults
5. SIBLE, I Visit-To-Visit Blood Pressure Variability Predicts Cerebral Perfusion Decline in Older Adults
6. KYTOMAA, S Carotid Artery Atherosclerosis, Coronary Heart Disease Risk, and Cognitive Impairment: The Framingham Heart Study

**9:45 AM - 10:55 AM****Program Chair Welcome & Plenary A: Presidential Address: Memory for News Events: What Will We Remember from 2020?**  
**Presenter:** Margaret O'Connor

1. O'CONNOR, M

Presidential Address: Memory for News Events: What Will We Remember from 2020?

**11:00 AM - 11:55 AM****Invited Symposia 1: Strategies for Staving off Dementia - A Dynamic Conversation****Chair and Presenter:** Vonetta Dotson**Presenters:** Glenn Smith, Sarah Garcia

1. DOTSON, V

Exercise for Cognitive Enhancement and Dementia Prevention

2. SMITH, G

Cognitive Strategies to Delay Dementia

3. GARCIA, S

Sleep and Diet: A Pathway to Positive Cognitive Aging

**11:00 AM - 12:00 PM****Paper Session 03: Pediatric Traumatic Brain Injury**

1. URUSOV, A

A Systematic Review of Psychological Interventions for Child and Adolescent Aggression Following Traumatic Brain Injury

2. MARBIL, MG

Posttraumatic Headache After Pediatric Mild Traumatic Brain Injury: Incidence and Classification Rates

3. GUO, S

Cognitive Functioning Following Pediatric Mild Traumatic Brain Injury: An A-CAP Study

4. CHADWICK, L

Classification Criteria and Rates of Persistent Post-Concussive Symptoms in Children: A Systematic Review and Meta-Analysis

5. SVINGOS, AM

What's Happening to our Healthy Controls? A Preliminary Study of the Effect of the COVID19 Pandemic on Depressive Symptomatology in Youth Recently Recovered from Concussion and Healthy Controls

6. REMPE, G

Trajectories of Executive Functions After Early Childhood Traumatic Brain Injury (TBI): Comparing Teacher and Parent Ratings in the Initial 82 Months Post-Injury

**11:00 AM - 12:00 PM****Poster Session 2: Aging & MCI**

1. GEREAU, M

Sex Differences in Self-Appraisal During Instrumental Activities of Daily Living in Community-Dwelling Older Adults

2. MEISTER, LM

Prospective Associations Between Social Network Components and Cognitive Domains in Older Adults

3. GOGNIAT, M

Physical Activity Moderates the Association Between Functional Connectivity and Executive Function in Older Adults

4. RUSHIA, S

The Relationship Between Cortical Thickness and Cognition in Older Adults with Comorbid Depression and Cognitive Impairment

5. CASALETTO, KB

Synaptic Markers Moderate the Adverse Effects of Alzheimer's Disease Proteinopathy in Older Adults

6. HALPIN, A Are Adverse Childhood Experiences Associated with Worse Cognitive Function in Older Adults?
7. OBERMEIT, LC Exploring the impact of sex, cognition, and age on driving safety
8. DIXON, JS Practice Effects Associated with Sociodemographic and Health Factors in a Multiracial Sample of Midlife Women
9. JEAN, K The Effect of Bilingualism on Executive Functions in Older Adults: A Systematic Review and Meta-Analysis
10. SLAVAT, N Using Virtual Reality to Examine memory and the Active Navigation Effect in Younger and Older Adults
11. EVANS, SA Vascular Risk Factors and Sex Alter the Relationship Between Objective Memory and Subjective Memory Complaint Endorsement in Cognitively Intact Older Adults
12. BALLARD, ZB Emotional Suppression Interacts with Apolipoprotein-E  $\epsilon$ 4, Reducing Executive Speed and Memory Performance in Cognitively Intact Older Adults
13. KIM, B Development and validation of mobile based neuropsychological cognitive tests
14. CORNWELL, MA Integrating Affect Perception Tasks from the New York Emotion Battery into a Comprehensive Measure of Neuropsychological Change across the Lifespan
15. ROHL, B Effects of nonpharmacological sleep interventions on cognitive performance in older adults: A systematic PRISMA review
16. MCVEIGH, K Loneliness and aging: Manifestations of loneliness in everyday conversations among older adults
17. RANGER, V Social Support, Cognition, and Post-Traumatic Stress Disorder: Findings from the Canadian Longitudinal Study on Aging
18. ESCHER, CE The Roles of Physical Activity and Diet for Cognitive Aging: Is More Better?
19. DION, C Quantifying Clock Drawing Number Placement Accuracy in Participants with Mild Cognitive Impairment
20. MEWBORN, CM Differential Predictors of Caregiver Burden in Caregivers of Veterans with Newly Diagnosed vs. Established Neurocognitive Disorders
21. BOUTZOUKAS, EM Effects of frontal white matter hyperintensities on executive function tasks in older adults
22. HAUSMAN, HK COVID-19 Concerns in Older Adults and Mental Health Outcomes During the Pandemic
23. HEPPNER, H Worried Well or Rightfully Worried? A Coming of Old Age Story.
24. SMITH, SG Age-Related Regional Network Covariance Pattern of Gray to White Matter Contrast in Healthy Middle-Aged to Older Adults
25. LANGER, K Factors Predicting Chronological vs Brain Age Discrepancies in Healthy Older Adults
26. SANZ SIMON, S Leisure Activity Engagement Predicts Cognitive Trajectories over 5 Years: Evidence Across Adulthood

27. RODMAN, S Impact of Depression on Cognitive Decline Across Lifespan using non-linear Models
28. RODRIGUEZ, K Pseudoneglect in Clock Drawing: Changes in Digit Placement with Increased Age
29. TASSONI, MB Contextual Factors Influencing Self-Reported Prospective Memory Performance
30. MOLL, AC Measures of Obesity Predict Executive Function Performance in Older Adults
31. HACKETT, K Relationship Between Cognition, Social Support, and Susceptibility to Fraud Among Two Groups of Older Adults Before and During COVID-19
32. MINTO, L Interactive Effect of Age, Cardiovascular Risk, and Physical Activity on Affective Symptoms and Cognitive Functioning in a Diverse Sample of Middle Aged to Older Adults
33. GREGG, TA Compensatory P200 Amplitude in Cognitively Intact APOE  $\epsilon$ 4+ Older Adults on a Semantic Memory Task Discriminating Famous Names.
34. DIVERS, R The Role of Anxiety Sensitivity, Dementia Worry, and Health Anxiety on Everyday Function in Older Adults
35. USSUI ANZAI, J Associations Between Purpose in Life and Subjective Cognitive Decline in Ethnically Diverse Older Adults
36. OWENS, JH The effects of occupational complexity on late life cognition in ACTIVE: Examining the mediating and moderating effects of race
37. KNIGHT, A Cognitive Function is Associated with Activities of Daily Living in Older Adults
38. CLARK, AL Elevated Inflammatory Markers and Arterial Stiffening Exacerbate Tau but not Amyloid Pathology in Older Adults with MCI
39. MULHAUSER, K Using CogState to Differentiate Normal Aging, Mild Cognitive Impairment, and Dementia
40. PATEL, R Inflammatory Biomarkers in Long Lived Families with Exceptional Cognition
41. DUDA, B Frontoparietal Coherence Mediates Cerebrovascular Risk and Executive Functioning in Older Adults
42. FELLOWS, RP Cognitive and Functional Correlates of Symptom Profiles in Midlife and Older Adults
43. MILLER, L Understanding Predictors of Everyday Functional Ability in Older Adults: A Bidimensional Mental Health Approach
44. HAYS, C Cerebral Metabolic Rate of Oxygen Consumption During Object Naming is Associated with Worse Language Performance Among APOE  $\epsilon$ 4 Carriers
45. FINEGAN, J APOE Modifies the Relationship Between Longitudinal Changes in Subjective and Objective Cognitive Decline

46. POHL, D The Relationship of Residential Segregation and Memory Across Race/Ethnicity
47. SIMONE, SM Relations Between Vascular Burden and Cognition in the Context of Demographic Factors in Older Adults with Cardiovascular Disease
48. FERRARA, MJ Frequency of Self-Report of Traumatic Childhood Experiences and Impact on Cognition and Mood in Older Adults
49. EMRANI, S ICAM-1 Moderates the Relationship Between Visual Episodic Memory and Triglycerides in both Men and Women
50. TWAMLEY, EW A Comparison of Cognition and Functional Capacity Between Independently Living Veteran and Non-Veteran Older Adults
51. BEECH, BF The Influence of Personality on Compensatory Strategy Use in Community Dwelling Older Adults
52. SAURMAN, J Sensitivity and Specificity of the Montreal Cognitive Assessment - Blind Conversion Score in the Alzheimer's Disease Neuroimaging Initiative
53. ROBINSON, TL Cardiovascular Risk Partially Explains Apparent Racial Differences in Executive Performance
54. CHANG, H Obstructive Sleep Apnea, Blood Oxygen Saturation, and Cognitive Functions Among Middle-Aged and Elderly Individuals: A Preliminary Study in Central Taiwan
55. MACIVER, PH Interactive Relations of Body Mass Index, Maximal Oxygen Consumption, and Sex on Cognitive Function in Older Adults
56. LEESE, ML Passive Activity Monitoring Detects Everyday IADL Changes in Older Adults with Intact Cognition and Mild Cognitive Impairment during the COVID-19 Pandemic
57. ROTBLATT, L Do Associations Between Vascular Risk and Mild Cognitive Impairment Vary by Race?
58. DENNY, A Predicting the Course of Mild Cognitive Impairment in a Memory Disorder Clinic Sample
59. STARK, JH Partial Least Squares Analysis of Alzheimer's Disease Biomarkers, Modifiable Health Variables, and Cognition in Older Adults with Mild Cognitive Impairment
60. JOHNSON, K The Effects of Depression on Semantic Word Generation in a Nationally-Representative Sample of Ageing Adults with MCI
61. SULLIVAN, KL Compensatory Strategy Use in Mild Cognitive Impairment
62. CHAPMAN, KR Executive Dysfunction Mediates the Relationship between Functional Impairment and Caregiver Burden in Mild Cognitive Impairment
63. MATUSZ, E Dissociating Statistically Determined Non-MCI and MCI Subtypes with DTClock
64. CAMPBELL, EB Cognitive Improvement Following Combined Intervention for Older Adults with MCI

65. NAYARES, C The Impact of Memory and Executive Functioning on Semantic Clustering in Mild Cognitive Impairment
66. BOEVE, A Impact of Demographic and Health Factors on Simple and Dual-Task Gait Speed
67. EDMONDS, E Actuarial Neuropsychological Criteria for MCI Predict Progression to Dementia Without the Need for Subjective Informant-Report
68. MACOMBER, AJ Effects of arterial stiffness on verbal learning in nondemented older adults
69. KAIRYS, A Evaluation of Diagnostic Differentiation using the Tablet-Administered NIH Toolbox Cognitive Battery
70. VICKERS, KL Self-Reported Cognitive Barriers to Behavioral Regimen Adherence in Mild Cognitive Impairment (MCI)
71. BRENNER, EK Examining the Effect of Cognitive Reserve on Dynamic Connectivity in Individuals with Mild Cognitive Impairment
72. WEITZNER, D Baseline Serial Position Effects Predict Functioning at 10-Year Follow Up
73. PETTIGREW, C Computerized Paired Associate Learning Task is Sensitive to Cortical Amyloid Burden
74. GRAVES, LV Differences in the Degree of Discrepancy Between Consensus and Actuarial Diagnoses of Mild Cognitive Impairment and Dementia in Older Non-Hispanic White and Underrepresented Minority Individuals
75. MAPLE, K Cognitive Functioning Moderates the Relationship Between Sleep Quality and Medication Management in Older Adults
76. PATERSON, TS Comparison of Predictive Power of Three Cognitive Screening Measures for the Prediction of Amnesic Mild Cognitive Impairment
77. WILLIAMS, ME Novel midlife Alzheimer's disease brain signature aids 12-year prediction of mild cognitive impairment
78. POMMY, J Neuropsychologically-Driven Cognitive Subtypes in MCI Using a Graph Theoretic Approach
79. RUSSELL-GILLER, S Impact of Unilateral Stroke on Right Hemisphere Superiority in Executive Control of Attention
80. EGGLEFIELD, DA Disentangling the relationship between vascular depression and mild cognitive impairment
81. DULAY, M Cognitive Difficulties Contribute to Post-Stroke Depression
82. LOPEZ PALACIOS, D Effects of Multiple Cerebral Vascular Accidents on an Executive Functioning Task
83. DEVAUGHN, S Verbal Fluency and Processing Speed are Associated with White Matter Burden Beyond Vascular Disease in a Heterogenous Sample of Older Adults
84. ANDERSON, JR Using machine learning to predict caregiver communication patterns in a geriatric clinic

85. SANDLIN, AM Validation of the Virtual Kitchen Protocol: Correlations Between Verbal Memory and Procedural Learning in Virtual Reality Among Older Adults
86. DUTT, S Memory Dysfunction is Linked to Medial Temporal Hypoperfusion in APOE4 Carriers
87. VAN ETEN, EJ Body Mass Index-related regional covariance patterns of white matter microstructure in healthy older adults
88. LI, Y Regional Cerebral Perfusion Correlates with Semantic Fluency in Older Adults
89. LENGU, K Effects of HD-tDCS on Local Glutamate and GABA Levels among Older Adults with and without Mild Cognitive Impairment
90. EDWARDS, K Examining the Relationship Between Regional Brain Volumes and HD-tDCS Field Measures in a Mixed Sample of Older Adults
91. AXELROD, J Memory and Economic Status in Older Age
92. DE WIT, L Parahippocampal and Temporal Neocortical Thickness as Predictors of Word-Stem Completion Priming in Individuals with Amnesic Mild Cognitive Impairment
93. KOAY, J Pseudoneglect in Clock Hands Drawing in Adults Age 55+
94. BROTHERS, S Daily Assessment of Executive Functioning and Expressive Suppression Predict Daily Functioning among Community-Dwelling Older Adults
95. DAVIS, JR Validation of Daily At-Home Assessment of Executive Functioning in Older Adults
96. REED, CM Examining Predictors of Stroop Performance in an Older Adult Sample
97. SANBORN, V Predicting MCI Status Using Automated Speech Assessment in Community-dwelling Older Adults
98. CLARK, HA Neuropsychological Findings in Older Adults with Normal Versus Discrepantly Low Performances on Visual Memory Tests
99. CHILDERS, L Differential Relationships Between Working Memory and Episodic Memory in Virtual Reality Among Young Adult and Older Adult Age Cohorts

**11:00 AM - 12:00 PM**

**Symposium 01: The Wisdom Workgroup in Indigenous Neuropsychology Global Strategies (Wisdom WINGS) Initiative: An International Collaboration to Advance the Understanding of Neurocognitive Health in Indigenous Peoples**

**Co-Chairs:** Monica Rivera Mindt, Micah Savin

**Presenters:** Kylie Radford, Cara Crook, Maral Aghvinian, Micah Savin

1. RADFORD, K The Neurocognitive Assessment, Prevalence and Social Determinants of Mild Cognitive Impairment in Older Aboriginal and Torres Strait Islander Australians

2. CROOK, CL The Effects of Aging, HIV-infection, and American Indian/Alaska Native Ethnoracial status on Neurocognitive Health
3. AGHVINIAN, M The Roles of Age, HIV, and Bilingualism on Risk for Neurocognitive Impairment among American Indian/Alaska Native
4. SAVIN, MJ The Prevalence and Determinants of HIV-associated Neurocognitive Disorders Among American Indian/Alaska Native people with HIV.

**11:00 AM - 12:00 PM****Symposium 02: Beyond Brain-Behavior Correlations: Using Connectome-Based Approaches to Derive Markers of Cognition****Chair and Presenter:** Ruchika Prakash**Presenters:** Monica Rosenberg, Lucina Uddin, Amy Kuceyeski, Oyetunde Gbadeyan

1. PRAKASH, RS A Whole-Brain Functional Connectivity Model of Alzheimer's Disease Pathology
2. ROSENBERG, M Predicting attentional abilities with functional brain connectivity
3. UDDIN, LQ Modeling behavioral and connectomic heterogeneity in autism and ADHD
4. KUCEYESKI, A Increased Range of Dynamic Functional Connectome Trajectories Predict Better Attention in Individuals with Traumatic Brain Injury
5. GBADEYAN, O Predicting Mind-Wandering from Task and Resting-State Functional Connectivity in the Aging Brain

**12:00 PM - 12:55 PM****Plenary B: The Neuropsychological Syndrome of Primary Progressive Aphasia (PPA) as a Dementia Syndrome****Presenter:** Sandra Weintraub

1. WEINTRAUB, S The Neuropsychological Syndrome of Primary Progressive Aphasia (PPA) as a Dementia Syndrome

**1:00 PM - 1:55 PM****Invited Symposia 2: Decolonizing Neuropsychology****Co-Chairs and Presenters:** Xavier Cagigas and Paola Suarez**Presenters:** Lily Kamalyan, Jean Ikanga, Janet Yáñez, Mirella Díaz-Santos

1. KAMALYAN, L Influence of Educational Background, Childhood Socioeconomic Environment and Language Use on Cognition among Spanish-speaking adults in the U.S.
2. IKANGA, JN A Call for Shifting from the Western to African Neuropsychology
3. YÁÑEZ, JJ Lead Contamination & Environmental Injustice: Implications for Neuropsychology
4. DÍAZ-SANTOS, M Decolonizing Neuropsychology Research WITH (alongside) the Underserved

5. CAGIGAS, XE Training in cultural neuropsychology as a proof of concept through community, sacrifice, and disruptive innovation amidst an inevitable paradigm shift

**1:00 PM - 2:00 PM**

**Paper Session 04: Multiple Sclerosis**

1. GENOVA, H A Randomized Clinical Trial to Treat Facial Affect Recognition Deficits in Multiple Sclerosis
2. CHEN, M Cognitive Fatigue is Associated with Altered Functional Connectivity in Interoceptive and Reward Pathways in Multiple Sclerosis
3. ERANI, F Assessing Fatigue in Individuals with Multiple Sclerosis Using a Clinically Accessible Measure of Switching
4. CADDEN, M Examining Cognitive Reserve as a Moderator of Neuropsychiatric Sequelae of Multiple Sclerosis
5. EILAM-STOCK, T Reliability of Cognitive Screening Measures Administered Remotely Through a Virtual Platform to Individuals with Multiple Sclerosis
6. ROMÁN, CA Examining Depression in Multiple Sclerosis Using Multi-Shell Diffusion Imaging and Structural Connectometry

**1:00 PM - 2:00 PM**

**Paper Session 05: Sports-Related Concussion**

1. URETSKY, M Clinical-Pathological Correlates of FLAIR White Matter Hyperintensities in Deceased Former American Football Players
2. CHAMPIGNY, C Student Athletes with High Preseason Anxiety Report Greater Symptoms Acutely Following Concussion
3. SCHAFFERT, J Neuropsychological Functioning in Aging Retired NFL Players
4. WALLACE, A Sports Engagement Predicts Cognition in Nine and Ten Year Old Children in the ABCD Study
5. GAUDET, CE Do multivariate base rates of low scores aid in concussion detection? A comparative study
6. LAING, JM Alterations in Brain Network Organization Following Sports-Related Concussion

**1:00 PM - 2:00 PM**

**Poster Session 3: Drug/Toxin Related Disorders/Infectious Disorders/Mood, Emotion, Psychiatric/Intervention/Other**

1. HUGHES, RL Memory and Alcohol Craving Interact to Predict Relapse in Veterans After AUD Treatment
2. MADDEN, SP Cognitive performance during a laboratory model of cocaine bingeing in experienced cocaine users
3. BACA, R Preliminary Evidence for Cannabis and Nicotine Urinary Metabolites as Predictors of Verbal Memory Performance and Learning Among Young Adults

4. BAIR, JL Cannabis Use Across Early Neurodevelopmental Stages and Young Adult Cognitive Outcomes: Exploring Relationships, Alternative Explanations, and Influencing Factors.
5. ROCKHOLD, M The Association of ADHD Symptoms and Learning Ability in Children with Prenatal Alcohol Exposure
6. PACHECO-COLON, I Exercise, Decision-Making, and Cannabis-Related Outcomes Among Adolescents
7. GUAREÑA, LA Impact of Emotional Health on Cognition amongst Hispanic and Non-Hispanic White People Living With HIV
8. AUNG, H Evidence of Premature Cognitive Aging Among a Community Sample of Optimally Treated People Living with HIV
9. BOWERS, C Assessing Cognition in HIV+ and HIV- Children in Tanzania: A Nonverbal Approach
10. THOMPSON, JL Evidence for Neuropsychological Health Disparities in Black Americans with HIV Disease
11. BRETON, J Psychological Acculturation and Cognition among Older Latinos Living with and without HIV
12. SALONER, R Cognitive and Physiologic Reserve Uniquely Relate to Superior Neurocognitive Abilities in Adults Aging with HIV
13. SUN-SUSLOW, N Frailty and Cognition: Cross-Sectional Comparison of the Fried Phenotype, Rockwood Frailty Index, and Veterans Aging Cohort Study (VACS) Index on HIV-Associated Neurocognitive Disorders
14. MORGAN, EE Alexithymia is Associated with Worse Real-World Functioning Among People with Controlled HIV Disease
15. BRITTON, M Profiling Cognitive Deficit in HIV-Alcohol Use Disorder Comorbidity: A Review
16. CYSIQUE, LA Premature and Accelerated Brain Aging in Chronic and Virally Suppressed HIV Infection Involves Cardiovascular Disease Factors: A Longitudinal Shape and Volume MRI Analysis
17. PECK, E A Case Study of Neuropsychological Function in an Adult Female with Behçet's Disease
18. FESTA, JR Does Covid-19 Unmask Nascent Neurocognitive Disorders?
19. CLAWSON, BR Long Term Effects of Anti-NMDA Receptor Encephalitis on Cognitive and Emotional Functioning: A Case Study of a Hispanic Female
20. PYNE, J Will the Neurological and Vascular Consequences of COVID-19 Result in Increased Risk for Dementia?
21. SHIN, S Cognitive and Psychological Effects of COVID-19 in Hospitalized Patients
22. SPAT-LEMUS, J Neuropsychologists at the Forefront: An Innovative, Hybridized Model for Service Care Delivery Developed for COVID-19 Patients
23. PERSICH, M Emotional Intelligence Training and Improvements to Emotional Regulation

24. TYTLER, C Does Emotion Regulation Mediate The Association Between Frontal Alpha-Band Asymmetry and Internalizing Problems?
25. KILLGORE, WD Development and Validation of the Interpersonal Affect Regulation Test (IPART)
26. HEPPNER, H Emotion Suppression, Positive Affect, and Executive Function
27. ILICH, M Study of depression in women with gastroenterological diseases
28. CLOONAN, S Examining Changes to Perceived and Ability Emotional Intelligence Following Emotional Intelligence-Specific Training
29. MATERIA, M Resilience Moderates the Impact of Adverse Childhood Experiences on Mental Health, Coping Behaviors, and Cognitive Ability.
30. CORNWELL, MA Early Childhood Circumstances Predict Anger Bias in Older Adulthood
31. CAVIASCO, A Influence of Affect and Working Memory on Semantic Priming
32. FRANDBSEN, SB Individuals with Bipolar Disorder Demonstrate Same Effects of Gender on Emotion Perception as Healthy Controls
33. ANDRADE, NC Music Emotion Recognition in Adult Life Span: a Neurodevelopmental Perspective
34. KILLGORE, WD Enhancing Emotional Awareness with an Online Training ProgramM
35. KILLGORE, WD Training Interoceptive Awareness
36. KILLGORE, WD Can Emotional Resilience Be Trained?
37. KAUR, M Anxiety Disorders and Executive Functions: Findings from a Meta-Analysis
38. SCHIFF, S Who benefits from computerized cognitive training? Lower processing speed predicts greater cognitive improvement
39. BERG, S The Relationship Between Postural Sway and Trait Anxiety While Viewing Aversive Stimuli
40. JOHNSON, J The Association Between Anxiety and Intelligence is Moderated by Sex
41. CHRISTIANSON, K Sleep Disturbances Are Related To Depression, But Not Executive Function: Framingham Offspring Study
42. MENKES, MW Sleep Quality and Neuropsychological Functioning in Euthymic Bipolar I Disorder
43. BOGOIAN, HR Vascular Depression in Older African Americans: A Systematic Review and Preliminary Evidence of Cognitive Dysfunction
44. RHODES, E The Impact of Amyloid Burden and APOE on Rates of Cognitive Impairment in Late Life Depression
45. MOOSATH, H Decision making in Depression: Differential Performance on the Iowa Gambling Task and Balloon Analog Risk Task
46. VANUK, J Severity of PTSD Symptoms is Associated with Greater Levels of Depression and Deficits in Short-Term Memory
47. SALLING, Z Effect of Aerobic Exercise on Anterior Cingulate Thickness and Depressive Symptoms in Late Life: A Pilot Study

48. TYTLER, C Brain or Heart: A Test of Central and Peripheral Nervous System Indices in Predicting Children's Internalizing and Externalizing Problems
49. TYTLER, C Alpha-Band EEG Asymmetry to Reward and Disappointment Predict Depression Trajectories Across Childhood.
50. PEREIRA, C Relationship between Bipolar Disorder and neuropsychiatric symptoms in dementia
51. DULAY, M Executive Functioning, Verbal Memory and Depressed Mood After Cerebrovascular Accident
52. VALENCIA, LR Incorporation of Cardio Exercise is Associated to Increased Levels of Gratitude Among PTSD Patients
53. TRASK, C Schizotypal Personality Traits are Unrelated to Delay Discounting in a Nonclinical Sample
54. BECKER, M Bifactor Structure of Cognition in Schizophrenia
55. PARRISH, E Ecological Momentary Facial Emotion Recognition in Psychotic Disorders
56. KOLAHI, Y Theory of Mind and Neurocognition as Predictors of Social Functioning in Schizophrenia
57. RUIZ, I Why do People with Schizophrenia Fail Effort Tests: Poor Cognition or Low Motivation?
58. HOPKINS, NA Differences in Baseline Symptom Reporting in Athletes with Psychiatric Treatment History
59. FISHER, A Intra-Individual Variability in Objectively-Measured Sleep Quality is Associated with Worse Cognition in Middle-Aged and Older Adults with and without HIV
60. CARLEW, A Patient Satisfaction and Utilization of Teleneuropsychology Feedback Visits
61. PARKER, A Patient Satisfaction with Teleneuropsychological Assessment and Feedback Across Home and Clinic Settings
62. HONSEY, B Neuropsychological Assessment and the Impact on Rehabilitation Outcomes
63. CLARK, HA How Might Neuropsychologists Target Educational Programs for Medical Residents to Promote Future Referrals?
64. CHANG, KH Administration of Human CD34+ Cells Mitigates Cognitive Decline in a Mouse Model of Healthy Aging
65. GEORGE, H Cognitive Stabilization Intervention During the COVID-19 Pandemic
66. NEHRA, A Brain Behaviour Relationship Uncovered From Assessment & Rehabilitation Perspective : Sharing Experiences of Low Resource Setting
67. ALBIZU, A Individualized Machine-Learning Derived Transcranial Electrical Stimulation Optimization for Working Memory Improvement in Older Adults

68. DESPOTI, AA Immersive Virtual Reality in Neuropsychological Rehabilitation: A Systematic Review
69. WEBER, R Initial Outcomes of an Executive Functioning Coaching Intervention with Postsecondary Students
70. GRIFFIN, KL Cognitive Remediation Among Psychiatric Inpatients
71. LALL, S Cognitive and Psychiatric Sequelae of Mild to Moderate COVID-19 Infection: Treatment Implications for Integrated Cognitive Remediation (CR)/Cognitive Behavioral Treatment (CBT)
72. HAYDUKE, DS Outcomes of Neurocognitive Rehabilitation Targeting Working Memory Deficits Subsequent to Pediatric Sickle Cell Disease
73. CRUZ-NARCISO, B Effectiveness of a Neuropsychological Intervention Program in Cognitive Improvement and Independence in Everyday Activities and Self-Care in a Patient Surviving Aneurysmal Subarachnoid Hemorrhage
74. MCLAREN, ME Functional Neural Correlates of Apathy and Anhedonia in Older Adults: A Pilot Study
75. JENKINS, LM Cortical Thickness Associated with Past-Year Mood Episode in Major Depressive and Bipolar Disorders
76. MCCLINTOCK, SM A Possible New Assessment Method to Inform Acute Electroconvulsive Therapy Cognitive Adverse Effects in Older Adults with Major Depressive Disorder
77. BOTTARI, S Preliminary evidence of transcutaneous vagal nerve stimulation effects on sleep microstructure in veterans with PTSD
78. SAGAR, K Veterans Demonstrate Improved Performance on Measures of Executive Function Following Six Weeks of Treatment with A Cannabidiol Product
79. MENDOZA ESTRADA, NE Psychiatric Symptoms Impact Daily Functional Ability in Cognitively Impaired Individuals
80. KIDWAI, J A Review of Novel Technology used in Aphasia Rehabilitation
81. WONG, RE The Influence of Perceived Control, Depression, and Anxiety on Subjective Memory Complaints
82. VITALE, G C-Log and O-Log Discrepancies in a Rehabilitation Sample
83. NOYES, E Relationship of MoCA and FIM Cognitive Subscale to Increased Level of Care Needs Following Post-Acute Care Rehabilitation
84. ROCHETTE, A Psychometric Evaluation of the Hopkins Rehabilitation Engagement Rating Scale in Older Veterans Admitted for Post-Acute Rehabilitation
85. KOHLI, M Evidence of the Feasibility of Video-Based Neuropsychological Evaluations Among Persons With and Without HIV
86. MANDERINO, L Validating the Hopkins Rehabilitation Engagement Rating Scale in an Older Veteran Post-Acute Rehabilitation Sample
87. OLEYNICK, V Neuropsychological Deficits in Three Patients with COVID-19 Infection in Post-Acute Physical Rehabilitation: A Case Series

88. HARIK, L Neuropsychological Functioning Post-COVID-19 Recovery in Acute Inpatient Rehabilitation: A Case Series
89. WERTHEIMER, JC Identification of Functional Limitations and Discharge Destination in COVID-19 Patients
90. CHESTER, AZ Preserved Bilingual Language Functioning and Decline in Visuospatial Reasoning and Memory in Persistent Dissociative Amnesia: A Bilingual Case Study
91. KOAY, JM The Effect of Emotion Regulation on Executive Function
92. ESPINAL, E Electrical Stimulation in Lateral Orbitofrontal Cortex Evokes Retrieval of Complex Memories
93. ANTEBI-LERMAN, E Caudate and Hippocampal Contributions to Spatial Navigation
94. BOWREN, M Lesion-Network Mapping of General Cognitive Ability
95. RAPHAEL, A Evaluating the Role of Hemispheric Rivalry in Visual Attention Using Repetitive Transcranial Magnetic Stimulation

**1:00 PM - 2:00 PM****Symposium 03: Novel neuropsychological approaches for assessing cognitive decline in the early stages of the Alzheimer's disease continuum****Chair:** Louisa Thompson**Presenters:** Roos Jutten, Karra Harrington, David Libon, Deirdre O'Shea, Jet Vonk

1. JUTTEN, RJ A neuropsychological perspective on defining cognitive impairment in the clinical study of Alzheimer's disease: Taking a continuous approach.
2. HARRINGTON, KD Feasibility, Reliability, and Validity of Novel Mobile App-Based Cognitive Assessments for use with Older Adults at Risk of Alzheimer's Disease: Results from the Einstein Aging Study
3. LIBON, D Defining the Neurocognitive Constructs Underlying the Model of Executive Attention with Time-Based and Error Data in Patients with Mild Cognitive Impairment
4. O'SHEA, D Adding Cognition to the Alzheimer's Disease Biomarker Framework Improves Prediction of Cognitive and Functional Decline in Non-Demented Older Adults
5. VONK, JM Item-level metric of semantic fluency relates to brain volume in non-demented adults over and above traditional risk factors of Alzheimer's disease

**2:00 PM - 3:00 PM****Paper Session 06: Aging & Dementia: Neuroimaging**

1. KISELICA, A Empirically Defining the Preclinical Stages of the Alzheimer's Continuum in the Alzheimer's Disease Neuroimaging Initiative
2. KIDD, E Relationship Between MRI Volumes and Attentional Control in Asymptomatic Older Adults at Risk for Developing Alzheimer Disease

- 3. FLETCHER, E                      A Comparison of Brain Gray Matter Signatures for Everyday Memory Ratings and Verbal Episodic Memory Performance
- 4. SUNDERARAMAN, P              Self-Awareness related to Financial Decision Making is linked to Right Temporal Cortical Thickness in Cognitively Healthy Older Adults.
- 5. BANKS, E                         Synaptic Loss Measured In Vivo with [11C]UCB-J PET is Associated with Cognitive Impairment in Alzheimer's Disease
- 6. BERNIER, RA                      Sex-Specific Associations Between AD-Biomarkers and Cognition in Older Adults Extend to Vascular Pathology Markers

**2:00 PM - 3:00 PM**

**Symposium 04: Ethical Considerations in the Field of Neuropsychology: Addressing Increasing Needs for Competence in Multicultural Neuropsychology and Advances in Technology**

**Chair:** Michelle Madore

**Presenters:** Rachel Hughes, Travis Scott, Rebecca Avila-Rieger, Jasmine Dixon

- 1. HUGHES, RL                      Ethical and Practical Considerations in Computerized Assessment
- 2. SCOTT, TM                        The Ethical Practice of Teleneuropsychology During and Beyond the COVID-19 pandemic: A discussion of considerations applied to multiple models of practice
- 3. AVILA-RIEGER, R                Ethics of Cultural Competence in Neuropsychology: Preliminary Findings and Future Directions
- 4. DIXON, JS                         A Multicultural Approach to Neuropsychological Assessment with Racial and Ethnic Minority Older Adults

**2:00 PM - 3:00 PM**

**Symposium 05: Competing Models of Cognitive Decline and Dementia in Epilepsy**

**Chair and Presenter:** Carrie McDonald

**Presenters:** Hyunmi Choi, Albert Aldenkamp, Anny Reyes, Alice Lam

- 1. MCDONALD, CR                 Neuroimaging and Genetic Biomarkers of Cognitive Decline in Epilepsy
- 2. CHOI, H                         Cognitive Decline in Older Adults with Epilepsy: The Cardiovascular Health Study
- 3. ALDENKAMP, AP                Accelerated Cognitive Aging in Epilepsy
- 4. REYES, A                         Diagnostic Classification of Cognitive Disorders in Older Adults with Temporal Lobe Epilepsy
- 5. LAM, A                         Clinical Cases at the Boundary of Alzheimer's disease and Epilepsy

**2:00 PM - 3:30 PM**

**INS Awards Ceremony**

**Awards Committee Chair: Roy P. Kessels**

**Early Career Award Presentation: Biopsychosocial Pathways in Dementia Inequalities**

**Award Recipient:** Laura B. Zahodne

1. ZAHODNE, LB

Biopsychosocial Pathways in Dementia Inequalities

**Mid-Career Award Presentation: Minding the Gap in Evidence Based Perioperative Brain Behavioral Research for Older Adults Electing Surgical Procedures with Anesthesia**

**Award Recipient:** Catherine C. Price

1. PRICE, CC

Minding the Gap in Evidence Based Perioperative Brain Behavioral Research for Older Adults Electing Surgical Procedures with Anesthesia

THURSDAY, FEBRUARY 4, 2021

**8:00 AM - 9:30 AM**

**CE Workshop 09: Practice Effects in Clinical Trials for Alzheimer's Disease: What We Know, What We Don't Know, and What We Better Figure Out Really Quick**

**Presenter:** Kevin Duff

1. DUFF, K

Practice Effects in Clinical Trials for Alzheimer's Disease: What We Know, What We Don't Know, and What We Better Figure Out Really Quick

**8:00 AM - 9:30 AM**

**CE Workshop 10: Neuropsychological Assessment of American Indian and Alaska Native Populations: Cultural Implications for Research and Practice**

**Presenters:** Lynette Abrams-Silva, Steven P. Verney

1. ABRAMS-SILVA, L

Neuropsychological Assessment of American Indian and Alaska Native Populations: Cultural Implications for Research and Practice

**8:00 AM - 9:00 AM**

**Paper Session 07: HIV & Infectious Diseases**

1. DEVLIN, KN

Vascular and Metabolic Risk Factors Differ Among Neurocognitive Phenotypes In HIV+ Adults

2. HUSSAIN, MA

Combined Effects of Loneliness and Inflammation on Depression in People with HIV (PWH)

3. KAMALYAN, L

Higher Allostatic Load is Associated with Lower Cognition among a Cohort of Older Diverse Adults Living with HIV

4. PAOLILLO, E

Higher Cumulative Depression and Plasma D-Dimer Synergistically Predict Steeper Neurocognitive Declines Over Time among People with HIV

- 5. YOUNG, J Early Academic Achievement of HIV-Exposed Uninfected Children
- 6. BABICZ, M Wear a Mask and Don't Drink Bleach: The Role of Neurocognition and Health Literacy in COVID-19 Online Information Seeking Skills, Knowledge, Prevention Intentions, and Prevention Behaviors

**8:00 AM - 9:00 AM**

**Paper Session 08: Pediatric Cancer**

- 1. LEVITCH, C Long Term Neuropsychological Outcome of Young Children Treated with Intensive Chemotherapy Followed by Myeloablative Consolidation Chemotherapy and Autologous Hematopoietic Cell Rescue for Brain Tumors: Follow-Up for Head Start 2 Survivors
- 2. FAY-MCCLYMONT, TB Memory and Learning in Pediatric Brain Tumor Survivors Compared to Children with Acute Lymphoblastic Leukemia.
- 3. ALEKSONIS, H Periventricular White Matter Hyperintensity Relationships with Processing Speed in Long-Term Survivors of Childhood Posterior Fossa Tumor
- 4. HALLER, O White Matter Hyperintensities Relate to Executive Dysfunction in Long-Term Adult Survivors of Pediatric Posterior Fossa Tumor
- 5. BANERJEE, P Neurocognitive Phenotypes in Long-Term Survivors of Childhood Cancer: A Report from the St. Jude Lifetime Cohort Study
- 6. APPLE, AC Longitudinal Trajectories of Memory Performance in Cancer Patients: the Role of Chemotherapy on Practice Effects

**8:30 AM - 9:30 AM**

**Poster Session 4: Assessment/Diversity and Inclusion**

- 1. DOTTERER, H Using a Biocognitive Approach to Parse Psychopathic Personality
- 2. BORESS, K The Cognitive Bias Scale: Replication and Cross-Validation in a Mixed Clinical Sample
- 3. LIVINGSTONE, JR Minnesota Multiphasic Personality Inventory-2-Restructured Form (MMPI-2-RF) Elevated Validity Scales Prediction of Over-Reported Neurological/Cognitive Complaints and Effort Test Failure in a General Clinical Sample
- 4. LEIB, S Concordance Between Minnesota Multiphasic Personality Inventory-2-Restructured Form (MMPI-2-RF) and Clinical Assessment of Attention Deficit-Adult (CAT-A) Over-Reporting Validity Scales for Detecting Invalid ADHD Symptom Reporting
- 5. MUSLIN, S Crystallized and Fluid Intelligence Components of Benton's Visual Retention Test
- 6. GOETTE, WF Identification of Word Characteristics and Individual Factors that Predict Word Learning on the CERAD List Learning Test
- 7. HUSTON, CA The Tri-Choice Naming and Response Bias Measure (N-Tri) - A Novel Measure of Response Bias
- 8. HUSTON, CA Sensitivity and Specificity of the Reliable Digit Span: Online vs. In-Person

9. HUSTON, CA The Detection of Coached Malingering: Preliminary Validation of the Tri-Choice Naming and Response Bias Measure (N-Tri)
10. COHEN, C Classification Accuracy and Stability of Abbreviated Versions of the Test of Memory Malingering Across Visuospatial Memory Impairment Severity
11. DAWSON, D Assessing Cognitive Bias with the Personality Assessment Inventory (PAI): Development of New Measures in a Mixed Clinical Sample
12. GASS, CS Does Anxiety Impact Memory Test Performance?: Relation of Anxiety Measures to Cognitive Complaints and Performance.
13. LAMBEZ, B Logical Memory Subtest of the Wechsler Memory Scale: Gist and verbatim information and their role in auditory and visual memory
14. KASEDA, ET Measurement Invariance of the UK Biobank Cognitive Battery in Neurologic, Pre-Clinical, and Non-Clinical Samples
15. BELL, SA Rates of Impairment on Verbal Memory Tests and Association with Executive Functioning
16. SINGH, S Evaluating Usage and Reliability of Tests in the TestMyBrain Digital Neuropsychology Toolkit
17. LAHIRI, A Towards Evaluation of Cognitive Behaviour and Personality Traits Through Computer Based Gaming
18. WOOD, L The Validity, Feasibility, and Acceptability of At-Home Video Conference-Based Neuropsychological Assessment
19. FOX-FULLER, JT Preliminary Evidence of Reliability and Validity of the Computerized Memory for Semantically Related Objects (MESERO) Test – a Pilot Study in Healthy Young Adults
20. KUZMUK, L Three-month Practice Effect of the NIH Toolbox Cognition Battery in Young Healthy Adults
21. CORRERO, AN Mini-Mental State Examination (MMSE) Items Demonstrate Incremental Validity Among Veteran Outpatients
22. HILSABECK, RC Comparison of the Boston Naming Test (BNT-60) and Multilingual Naming Test (MINT-32) in an Older Adult Memory Clinic Population
23. ANDREWS, HE Psychometric Properties of the Mindful Attention Awareness Scale (MAAS) in Older Adults: Are We Capturing Attention?
24. NOWINSKI, C Mobile Toolbox: Remote Assessment for Measuring Cognitive Change Across the Lifespan
25. WIGGINS, M Normative Data for Digital Maze Test (dMaze) Performance in a Sample of Cognitively-Well Older Adults
26. LOGAN, PM When there's a WMS there's a way: Investigating the differential utility of the WMS-IV Logical Memory I Adult versus Older Adult versions in a mixed clinical sample of 65-69 year-old veterans

27. CAMPBELL, LM The Relationship Between Contextual Factors, Performance, and Validity of Smartphone-Based Mobile Cognitive Tests of Executive Function and Learning
28. SERRANO, Y Comparing an RBANS Logistic Regression to the RBANS Effort Index (EI) in two independent Veteran samples.
29. RIZER, S Consistency of Remote and In-Person Cognitive Assessment in Older Adults with Essential Tremor
30. LAVIGNE, S Preliminary Support for Increased Cutoff Scores on the Test of Memory Malingering when Accounting for Educational Attainment Level
31. BILDER, RM Item Response Theory Analyses of Matrix Reasoning: Towards a New Short Form or Adaptive Test?
32. CHIN, PE Gender Differences on Neuropsychological Measures in a Highly Educated Physician Population
33. KOLTAI, DC Normative Neuropsychological Standards for Physicians Practicing Medicine
34. FERNANDEZ, AL Reading Fluency as a Measure of the Educational Level
35. SPARADEO, F Cognivue: An effective tool in the detection of subtle cognitive impairment
36. TIBONI, H Feasibility of a Remote Cognitive and Dietary Assessment During the COVID-19 Outbreak
37. PATRICK, SD Measurement Invariance of Mental, Physical, and Social Health across Injury Type using the PROMIS Self-Reported Health Measures
38. RASKIN, S Measuring the Effects of Acculturation on Prospective Memory in Spanish-Speaking Latinos/as/xs
39. SCHAFFER, J Examining the Therapeutic Alliance in a Neuropsychological Assessment Setting
40. LENGU, K Examining the Validity of the Executive Error Index for the RBANS in Older Adults with MRI Volumetry
41. EVANGELISTA, ND Evidence of Potential Race/Ethnicity Bias in the Montreal Cognitive Assessment (MoCA)
42. VAN PATTEN, R Test-Retest Reliability of Mobile Cognitive and Balance Testing Administered Virtually in Healthy Adults
43. HANSEN, J Is the Verbal Concept Attainment Test (VCAT) an Effective Test to Measure Executive Functioning?
44. NGUYEN, C Systematic Review of Neuropsychological Tests and Normative Neuropsychological Data for the Vietnamese-Speaking Population
45. HAWLEY, NA Development of an embedded measure of Grit for the Personality Assessment Inventory
46. KERSTING, HM Assessing the Predictive Value of Visual-Motor Abilities on Intellectual Functioning

47. VON BUTTLAR, AM Inequivalence of the Second and Third Editions of the Adaptive Behavior Assessment System in Mixed Clinical Samples
48. LESICA, S Depression as a Mediator of the Effects of Acculturation on Cognitive Functioning in a Sample of Elderly Hispanics: Sacramento Area Latino Study of Aging (SALSA)
49. KAPOULEA, EA Loneliness and CVD Risk Factors in Adults from the United States and Japan
50. AMOFA, PA Health Concerns and Determinants of Aging Research Participation Among North Florida African Americans
51. REHMAN, S Barriers to Pursuing Neuropsychology as Immigrants
52. CERVANTES, R The Effect of Acculturation on the Cordoba Naming Test in Mexicans
53. PENNA, S The Emory Brain Share Project: A Pilot Collaboration with the University of Rwanda to Develop a Training Program in Neuropsychology
54. PURNELL, J Moving Away from a Binary Perspective: Evaluating the Use of Normative Data in the Neuropsychological Assessment of Transgender and Gender Non-Confirming Individuals
55. CHAN, KK Training the Next Generation of Brain-Behavior Scientists from Diverse Backgrounds through the Summer of Translational Aging Research for Undergraduates (STAR U) Program
56. FURTADO, MR The Crisis in Neuropsychology: Steps Towards Maintaining Relevance
57. BOEVE, A Does Sleep Quality Modify the Relationship Between Socioeconomic Status and Verbal Memory in Older Adults?
58. SCHUBERT, BL The Role of Minority Status on the Relationship between Childhood Experiences of Physical Abuse and Working Memory
59. ORTEGA, N Factors of Acculturation and its Relationship to Working Memory in Ethnically Diverse Individuals
60. MARTINEZ, MN Body Mass Index (BMI) and Cognition in Urban- and Rural-Dwelling Mexican Middle-Age and Older Adults
61. PIZER, JH Cognitive Intra-Individual Variability Varies by Race/Ethnicity
62. CERNY, B Predictive Value of Victoria Symptom Validity Test Response Latency over Response Accuracy in Determining Performance Validity Status
63. SULLIVAN-BACA, E Validity of Collateral Informant Report in the Context of Patient Performance Validity Test and Symptom Validity Test Failure
64. POTTER, B Investigating the Utility of Embedded Validity Indicators among Children Treated for Brain Tumors: Impact of Sleepiness and Cognitive Impairment associated with Craniopharyngioma
65. ROBINSON, A Performance on the Victoria Symptom Validity Test and b Test in a Sample of Adults Referred for Psychoeducational Testing
66. CLARK, A Utilizing Embedded Indicators from the Wisconsin Card Sorting Task to Detect Suboptimal Effort in College Students

67. MAYNARD, TR Characterization of a Sentenced Prison Population Referred for Neuropsychological Evaluation
68. SIMONS, M Embedded Performance Validity Test Functioning in the Delis-Kaplan Executive Functioning System (D-KEFS) Trail-Making and Color-Word Interference Subtests
69. TIERNEY, SM Varying “Failure Criteria” on Commonly Used Performance Validity Tests Influences Interpretation of Cognitive Outcomes
70. LACE, JW Disability-Seeking and VSVT are Better Predictors of Neuropsychological Test Performance than Lesion Burden and Atrophy in Multiple Sclerosis Patients
71. BAIRD, A Trails B Completion Time as an Indicator of Performance Validity in Retired Athletes
72. THOMPSON, RC Utility of a composite score to assess performance validity in a sample of healthy youth athletes.
73. THOMPSON, RC Impact of Full-Scale IQ on performance validity testing in a sample of healthy youth athletes
74. SHEIKH, K The Golden Stroop Color and Word Test: Cross-Validation of Embedded Validity Measures
75. SHEIKH, K Classification Accuracy of The Boston Naming Test as a Language-Based Embedded Measure of Performance Validity
76. RIEDLER, ND Detection of Feigning and the Impact of Cultural and Administration Methods on the Poreh Nonverbal Memory Test
77. GICAS, KM Cognitive and Functional Trajectories in Homeless Adults: 6-Year Outcomes From the At Home/Chez Soi Study
78. DE LA TORRE, GG Neurocognitive Impairment in Severe Mental Illness. Assessment of Spanish-Speaking Sample Using the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)
79. SABAN, W PONT: A Platform for Online Neuropsychological Testing
80. TYTLER, C Research Domain Criteria: Are the Parts more Informative than the Whole?
81. SANTOS, OA Clinical Neuropsychology Trainee Forum: A Proposal for Impactful Student/Trainee Advocacy
82. DESRUISSEAUX, LA Intra-Individual Variability in Performance as a Marker for Vulnerability to Temporary Executive Depletion due to Burdensome Emotion Regulation
83. DESRUISSEAUX, LA Intra-Individual Variability in Performance Predicts Temporary Executive Depletion due to Experimentally Induced Emotion Regulation
84. LEE, GJ Noncredible Responses Impact Associations Between Executive Functioning and Functional Impairment
85. MAJEED, NM Musical Experience and Executive Functioning: Evidence from Frequentist and Bayesian Structural Equation Modelling
86. WONG, RE Preliminary Results on the Potential Relationship Between Role-Playing Video Games and Executive Functioning

87. MITZKOVITZ, C The Relationship Between Facets of Impulsivity and Problematic Phone Use
88. DE LA CRUZ, RA Sex Differences in Verbal and Nonverbal Set-shifting
89. BEVERSDORF, DQ Effects of paced breathing on measures of convergent and divergent thinking
90. ZOLLIECOFFER, CJ Pinpointing the D-KEFS Stroop Color Word-Inhibition Construct Validity
91. PRESLEY, C Psycholinguistic Predictors of Item Difficulty on the Boston Naming Test
92. GASS, CS Memory Retrieval Factors in Performance on the Wechsler Memory Scale-IV
93. TURMAN, ML Peritraumatic Cognitive Load, Attention, Working Memory, and Memory within the Distressing Film Paradigm: An Experimental Study.
94. TWAMLEY, EW Memory, Fluid Reasoning, and Functional Capacity in Adults Experiencing Homelessness
95. MARVIN, ME Neural Activity and Network Analysis for Understanding Reasoning Using the Matrix Reasoning Task
96. ISAAC, L Frontoparietal and Salience Network Activation Varies with Difficulty on Tower of London Trials
97. RUIZ, A Phonemic and Semantic Fluency in Bilinguals Versus Monolinguals
98. CHATTERJEE, S Cultural Influences on Visual Object Perception: Investigating the Influences of Eye Movements, Self-Construal, Object Familiarity, and Cultural Relevance on Silhouette Test Performance in Indian and British Participants.

**9:00 AM - 10:00 AM**

- Paper Session 09: Neuroimaging Methods**
1. KRAFT, JN Functional Neural Correlates of the Useful Field of View (UFOV) Task in Older Adults
2. STEINBERG, S Within-Individual Neural Variability in the N-Back Task: Relation to Reaction Time and Accuracy
3. HARDCASTLE, C Frontoparietal Control and Cingulo Opercular Resting State Network Connectivity Predicts Useful Field of View Performance
4. CROWELL, SH Links Among White Matter Volume in the Mentalizing Network and Theory of Mind Throughout Development
5. YEW, B Contributions of Dynamic Cerebrovascular Function to Cognitive Decline: Validation of a Novel Neuroimaging Approach
6. CWIEK, AP Too Good to be True: Machine Learning and the Problem of Overfitting in Network Neuroscience

**9:00 AM - 10:00 AM**

- Paper Session 10: Dementia: Risk & Prediction**
1. YUAN, J Midlife and Late-Life Framingham Stroke Risk Profile and Incident Dementia and Subtypes

- 2. ALLY, M Utility of Plasma P-tau181 for the Detection of Alzheimer's Disease Dementia
- 3. ANDERSEN, SL Errors Related to Executive Impairment Made on Memory and Language Tests Predict Incident Dementia
- 4. PASTERNAK, E Mild TBI and Clinical Dementia Risk in the OneFlorida Research Consortium Cohort
- 5. AMARANTE, E Are residents of Naturally Occurring Retirement Communities (NORCs) at decreased risk for development of dementia?
- 6. KAWLES, AS Clinicoanatomic Distribution of the 3R Tauopathy of Pick's Disease in behavioral variant Frontotemporal Dementia (bvFTD)

**9:55 AM - 10:55 AM**

**Program Chair Welcome & Plenary C: Early Detection of Autism Spectrum Disorder**

**Presenter:** Diana Robins

- 1. ROBINS, D Early Detection of Autism Spectrum Disorder

**11:00 AM - 11:55 AM**

**Panel Discussion hosted by the INS Student Liaison Committee  
01: Neuroimaging and Biomarkers: Our Scope of Practice as Neuropsychologists**

**Presenters:** Gaël Chételat, Elisha Josev

- 1. CHÉTELAT, G Use of neuroimaging in neurodegenerative diseases: Clinical and Research Perspectives
- 2. JOSEV, E The Use of Neuroimaging in Paediatric Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS)

**11:00 AM - 12:00 PM**

**Paper Session 11: Epilepsy**

- 1. ARROTTA, K Identifying Cognitive Phenotypes in Frontal Lobe Epilepsy: Moving Towards Precision Neuropsychology
- 2. MODIANO, YA Predictive Utility of MMPI-2-RF in Differentiating Psychogenic Non-Epileptic Events and Epilepsy in a Largely Male Veteran Sample
- 3. BUSCH, RM Nomograms to Predict Memory Outcomes After Temporal Lobe Resection in Adults with Epilepsy
- 4. MCMILLAN, T Processing Speed and Cognitive Health in Temporal Lobe Epilepsy

**11:00 AM - 12:00 PM**

**Poster Session 5: Parkinson's Disease and Other Dementias**

- 1. MCLAREN, ME Teleneuropsychology in Parkinson's Disease: A Case Study
- 2. KENNEY, L Not All Memory Domains are Created Equal: How the Operationalization of Memory Domains Influences Classification of Parkinson's Disease-Mild Cognitive Impairment
- 3. MCMANN, T Antidepressants Exacerbate Cognitive Dysfunction in Parkinson's Disease
- 4. LOPEZ, FV Stacking Up Against Tradition: Computerized Tests of Executive Function on Global Cognitive Status in Parkinson's disease

5. ALTARAS, CS Examining the NIH EXAMINER Unstructured Task in Parkinson's Disease
6. GREIF, T Anterior Subthalamic Nucleus Lead Location Predicts Greater Phonemic Fluency Decline following Deep Brain Stimulation for Parkinson's Disease
7. KRUMP, D Clarifying the Impact of Anxiety on Processing Speed in PD: The Role of Modality and Accuracy
8. LEA, R Convergent and Ecological Validity of the Uniform Data Set-3.0 Neuropsychological Battery in a Parkinson's Disease Sample
9. WHITELEY, N Is Fatigue Dissociable from Apathy in Parkinson's Disease?
10. HOWARD, EF Frontal Lobe-Mediated Executive Dysfunction Relates to Complex Numbers Impairment in Progressive Supranuclear Palsy
11. SCOTT, BM Cognitive effort-based decision-making in Parkinson patients with motivational disorders.
12. VANDEBUNTE, A Punctuality as a Predictor of Poor Attention and Processing Speed in Parkinson's Disease
13. VANDEBUNTE, A Do Sleep Problems Worsen the Cognitive Symptoms of Parkinson's Disease?
14. VANNINI, MN Sensitivity to Punishment and Reward in Non-Demented Individuals with Parkinson's Disease
15. KAPLAN, RI Discordance Between Reports of Symptoms in Persons with Parkinson's Disease and Informants in an Online Survey Sample
16. KINGER, SB We Hope You're Listening: A Qualitative Study Identifying Types of Advice Given by Individuals with Parkinson's Disease
17. POOLE, LG Exercise Engagement in Relation to Motor Symptoms and Quality of Life in Parkinson's Disease
18. KINGER, SB The Relation Between Exercise and Non-Motor Symptoms in Parkinson's Disease
19. WALL, J Caregiver Perspectives on the Experience of Parkinson's Disease: A Qualitative Analysis
20. MOLLENKOPF, KK Physical Activity and Motor Performance Among Older Adults with Neurocognitive Disorder
21. OKOLICHANY, R Global Cognition and IADL Correlates of Apathy in Probable Alzheimer Dementia
22. RIGBY, T Does Objectively Measured Physical Activity Level Predict Cognitive Function in Community Dwelling Older Adults With and Without Mild Alzheimer's Disease
23. ELLURU, A Seeing Color: Examining Cognitive Profiles in Autopsy-Confirmed Alzheimer's Disease (AD) Across Ethno-Racially Diverse Groups
24. AARON, H Frequency of IADL Impairment in Probable Alzheimer's Dementia Patients Unable to Complete Trails B
25. HOLMQVIST, S Intraindividual Cognitive Variability is a Marker of Early Neurodegeneration in Older Adults

26. BECKER, M Early and Late List Learning in Parkinson's and Alzheimer's Diseases
27. ACEVEDO-MOLINA, MC Exploring Autobiographical Memory in Bilingual Hispanics
28. ALEXANDER, C APOE, But Not Traumatic Brain Injury, Predicts Risk for Alzheimer's Disease
29. PELCHER, I Revised Framingham Stroke Risk Profile: Association with Cognitive Status and MRI-Derived Volumetric Measures
30. FERGUSON, C Understanding the Relationships Between Neurocognitive Variables Across the Early Alzheimer's Disease Spectrum: An Application of Network Psychometrics
31. SCHOLL, J Relationship Between APOE4 Status, Combat Exposure, and Dementia
32. CHAPMAN, KR Development of an Assessment Measure for Sexual Disinhibition in Dementia
33. EDWARDS, L Relative Contributions of White Matter Hyperintensities and PET Biomarkers of Amyloid and Tau Pathologies to Cognitive Deficits in Symptomatic Patients with Alzheimer's Disease
34. PATRICK, KS Pain in persons with dementia: The contribution of neuropsychiatric symptoms and pain self-efficacy to caregiver burden
35. PREMNATH, P Trajectory of Neuropsychiatric Symptoms in Relation to Tau Burden in Older Adults with Mild Cognitive Impairment and Alzheimer's disease Dementia
36. SALONGA, S Severity of Combat Exposure of Veterans with PTSD and Dementia
37. NGUYEN, A Examination of Potential Cross-Cultural Differences in Individuals who are at a Higher-Risk for Dementia
38. MCCLURE, RJ Blood Glucose Levels Predict Verbal Memory in Individuals with Alzheimer's Disease and Type II Diabetes.
39. KADEY, K Five-Year Change in Body Mass Index Predicts Conversion to Mild Cognitive Impairment or Dementia only in APOE  $\epsilon$ 4 Allele Carriers
40. MOODY, JN Body Mass Index and Genetic Risk for Alzheimer's Disease Predict Conversion to Alzheimer's Disease
41. JOHNSON, E Racial differences in cognitive decline: A longitudinal examination of predictors of neuropsychological performance and development of Alzheimer's disease
42. PRINCE, T MRI and Neuropsychological Comparisons of Native and Non-Native English Speakers with Alzheimer's Disease
43. LIBUTTI, FL Depression as a Moderator of Relationship between APOE  $\epsilon$ 4 Allele Presence and Alzheimer's Disease Severity
44. WOOD, ZB Effect of Depressive Symptoms and Alzheimer's Disease Severity on Right Hippocampal Volume
45. NG, W Functional Ability of Individuals with Alzheimer's disease, Apolipoprotein E  $\epsilon$ 4, and Type 2 Diabetes

46. STOCKS, J                      Concordance between Cortical Neurodegeneration and FDG-PET Hypometabolism across Brain Networks Differentially Predicts Memory Decline in “A/T/N” subgroups of Alzheimer’s Disease
47. PLUIM, C                      Digital Clock Drawing and Markers of Brain Pathology in Preclinical Autosomal Dominant Alzheimer’s Disease
48. MCWATERS, AR              Anosognosia Prevalence in a Community Sample of Older Adults
49. TURNEY, IC                    Is Brain Health in Middle-aged Adults Associated with Their Parents’ Cognitive Status?
50. CARCAMO, J                 Neuropsychological Predictors of Severe Dependency in a Multiethnic Community Cohort of Individuals with Alzheimer’s Disease
51. HEYDARI, N                 The Relation between Subjective and Objective Naming in Healthy Aging, Mild Cognitive Impairment, and Alzheimer’s Disease
52. SADAGHIYANI, S            Interest and Willingness to Engage in Alzheimer’s Disease Risk Disclosure in a Racially Diverse Sample of Older Adults and their Caregivers
53. ADUEN, PA                 Association of Lifetime Stress Exposure with Cognition and Brain Pathology in Autosomal Dominant Alzheimer’s Disease: Preliminary Findings from the COLBOS Project
54. FATIMA, H                 Functional Ability Questionnaire Ratings Predict Time to Nursing Home Placement in Patients with Alzheimer’s Disease
55. JOYCE, JL                    Mood Symptoms Do Not Change the Sensitivity of Subjective Cognitive Decline to Intrusions
56. ZHENG, Z                    Associations Between Education and Cognitive Profiles at Time of Alzheimer’s Disease Diagnosis
57. ARCE RENTERÍA, M        Active Bilingualism, Parental Alzheimer’s Disease, and Cognitive Performance among Middle-aged Latinx.
58. NELSON, LD                Longitudinal study of changes in amyloid and tau biomarkers in Alzheimer’s disease and Down syndrome.
59. DENNY, A                    Neuropsychological Risk Factors for Progression of Mild Cognitive Impairment to Alzheimer’s Disease
60. TSIKNIA, A                 Sex Differences in the Relationship Between Cardiovascular Risk, Cerebral Blood Flow and Cognition
61. BANKS, SJ                 The Impact of Sex and Amyloid Status on Cognitive Performance in Aging
62. SHIFFLETT, B              Sex Differences in Cognitive Reserve in Early Alzheimer’s Disease: The Impact of Apolipoprotein E Genotype
63. PEREIRA, C                Evaluating Racial Disparities in Healthcare System Utilization Among Older Adults with Dementia
64. CHAPMAN, S              Gender Differences in Subjective Cognitive Decline and Associated Factors
65. JOHN, SE                 Contribution of Executive Functioning to Verbal Memory Abilities

66. GAYNOR, LS Brain Biomarkers of Early Disease Progression Predict Performance on a Translational Cognitive Marker of Alzheimer's Disease
67. SALDANA, DG Socially Responsible Neuropsychology in Action: Differential Diagnosis of Alzheimer's Disease in a Highly Educated Multilingual Latino Older Adult
68. GAYNOR, LS Brain Biomarkers of Early Alzheimer's Disease Progression Underlie the Relationship Between Diagnosis and Visual Object Discrimination Task Performance
69. TRAN, N Social Functioning in Dementia, Loneliness, and Life Satisfaction Among Older Adults with Neurocognitive Disorder
70. ROGERS, S The Role of Disinhibition on Cognition in FTD
71. KESZYCKI, R Neuropsychiatric phenotypes in PPA and bvFTD due to Pick's disease
72. SALTIEL, N Neuropathological Contributors to Cognitive and Neuropsychiatric Symptoms in Brain Donors Exposed to Repetitive Head Impacts
73. MARTIN, JT Dementia Caregiver Burden and Communications in a Memory Clinic Setting
74. BARKER, M Memory and Other Aspects of Cognitive Function Differ Between Genetic Mutations in Prodromal Behavioral Variant Frontotemporal Dementia
75. BUTLER PAGNOTTI, RM Is Reliable Digit Span (RDS) a Valid Effort Measure in Patients with MCI and Dementia due to Primary Progressive Aphasia?
76. HAZELTON, JL Impaired cardiac interoceptive accuracy in behavioural-variant frontotemporal dementia and Alzheimer's disease: An international multi-centre study
77. KRUMHOLZ, MF COVID Catalyst: A Case Presentation on the Impact of COVID-19 in Posterior Cortical Atrophy
78. COHEN, MS A Case Study of the Clinical Utility of Parietal Lobe Assessment for Differential Diagnosis of Dementia with Lewy Bodies
79. ABDOLMOHAMMADI, B Chronic Traumatic Encephalopathy in a Cohort of Military Veterans and Players of American Football in the VA-BU-CLF Brain Bank
80. ORTIZ, G Frontal Default Mode Network Functional Connectivity and Knowledge of Social Norms in Pre-Clinical bvFTD
81. NESTER, CO Utilizing Daily Diary Report to Assess Subjective Cognitive Concerns in Older Adults with Motoric Cognitive Risk Syndrome
82. KARPOUZIAN-ROGERS, T Task-evoked pupillary response and word frequency in Primary Progressive Aphasia
83. GOODMAN, ZT Differences in Limbic Functional Connectivity Among Offspring of Patients with Alzheimer's Disease
84. POMMY, J A Comparison of Visual Assessment and Quantitative Neuroimaging Techniques in Logopenic PPA and Amnesic MCI

85. EHMANN, M Using Finite Element Modeling to Assess the Variability in HD-tDCS Delivered Current Across the Dementia Spectrum
86. MORELLO GARCÍA, F Assessment of Reading and Writing Impairments in Spanish-Speaking Patients with Semantic Variant Primary Progressive Aphasia
87. MASHINCHI, GM Cognitive Reserve and Sex Differences in an Alzheimer's Disease Population
88. CHUANG, Y Own-Age Effect on Facial Emotion Recognition in Normal Elderly People and Individuals with the Preclinical and Demented Alzheimer's Disease
89. JACOBS, DM Use of Interactive Video Technology Among Participants in Alzheimer's Disease Research: Implications for Remote Assessment
90. HICKS, EC Tech Support: Utilizing a Computerized Measure to Screen for Alzheimer's Disease
91. LENGU, K Learning Ratio is Better than Raw Learning Slope for Classifying Cognitive Impairment in Older Adults Across the AD Spectrum
92. PUGH, E Beliefs, Understanding, and Barriers Related to Dementia Research Participation among Older African Americans
93. PUDUMJEE, SB Associations of The Rey-O Complex Figure-Copy with Other Measures of Executive Function in Progressive Apraxia of Speech and Progressive Agrammatic Aphasia
94. DEMETROPOLIS, SM Are language and cognition strongly linked in people with aphasia?
95. GARLAND, M Who Are You? The Study of Personality in Patients with Anterograde Amnesia

**11:00 AM - 12:00 PM****Symposium 06: Social Cognition across the Lifespan****Chair:** Skye McDonald**Presenters:** Vicki Anderson, Miriam Beauchamp, Christine Padgett, Olivier Piguet, Sarah E MacPherson

1. ANDERSON, V Evaluating social competency using PEERS with paediatric clinical populations
2. BEAUCHAMP, M Socio-moral reasoning in youth with acquired and neurodevelopmental conditions
3. PADGETT, C Social Cognition and Psychosocial Outcomes after Acquired Brain Injury – Does Gender Make a Difference?
4. PIGUET, O Differential impact of emotion on decision-making in behavioural-variant frontotemporal dementia and Alzheimer's disease
5. MACPHERSON, SE Assessing Social Cognition in People with Dementia: The Edinburgh Social Cognition Test (ESCoT)

**11:00 AM - 12:00 PM**

**Symposium 07: Diversity Factors in Clinical Neuropsychology: Pre- and Post-Coronavirus 2019 (COVID-19) Challenges**

**Chair:** Lynette Abrams-Silva

**Presenters:** Rebecca Avila-Rieger, Aikisha Harley, Cynthia Funes, Michelle Miranda

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|--------------------|---|
| 1. AVILA-RIEGER, R | Inclusion of Cultural Considerations and Diversity Factors in Neuropsychological Reports  |
| 2. HARLEY, A       | Impact of In-Office versus Tele-Neuropsychology on Basic Auditory Attention in an English- and Spanish-Speaking Sample: A Pilot Study |
| 3. FUNES, C        | Characterizing Effort Involved in Non-English Interpreter-Mediated Neuropsychological Evaluations                                     |
| 4. MIRANDA, M      | Higher Rates of Mood Disturbance During COVID-19 Among a Sample of Latinos  |

**12:00 PM - 12:55 PM**

**Plenary D: Adaptive Constructive Processes in Memory, Imagination, and Creativity**

**Presenter:** Daniel L. Schacter

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| 1. SCHACTER, DL | Adaptive Constructive Processes in Memory, Imagination, and Creativity |
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**1:00 PM - 1:55 PM**

**Invited Symposia 3: Advancements in Tele-Neuropsychology Practice and Training During COVID-19**

**Chair and Presenter:** Julija Stelmokas

**Presenters:** Munro Cullum, Lana Harder, David Marra, Dawn Bowers, Amber Rochette, Franchesca Arias, Cristina A. F. Román, Diomaris Safi, Ana Díaz Santos

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|----------------|---|
| 1. CULLUM, M   | History and Evidence for Tele-neuropsychology Across the Lifespan   |
| 2. MARRA, D    | Rapid Deployment of Teleneuropsychology (teleNP) into Clinical Practice: A Research-Based Approach  |
| 3. ROCHETTE, A | Clinical neuropsychology practice survey during COVID-19 within the United States: Service delivery and decision-making                         |
| 4. ARIAS, F    | COVID-19-related Shifts in Clinical Practice Among Neuropsychologists Providing Services to Monolingual and Bilingual Spanish-speaking Patients |
| 5. SAFI, DE    | The Impact of COVID-19 on Neuropsychology Trainees in Cross-Cultural Settings: Challenges and Opportunities                                     |

**1:00 PM - 2:00 PM**

**Paper Session 12: Aging & Assessment**

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|------------------|---|
| 1. MARTINEZ, KA  | The Dot Counting Test Is Not Associated With Memory in Older Adults With Mild Cognitive Impairment or Mild Dementia |
| 2. FORMANSKI, EM | Digit Misplacement within Clock Drawing May Be a Novel Marker of Mental Planning                                    |

3. KURNIADI, NE      Branching Condition of the Color-Word Interference Test Enhances Prediction of Meta-Tasking in Community-Dwelling Older Adults
4. EISENSTEIN, A      Task-Switching Abilities in Bilinguals: The Importance of Language Dominance and Acculturation
5. BARNES MARRERO, I      Exploring the Effect of Bilingualism on Rapid Naming
6. LAO, P      Cognitive performance in middle-aged adult children is related to parental brain health across race/ethnicity groups

**1:00 PM - 2:00 PM****Poster Session 6: Concussion/TBI**

1. PASSLER, J      Depression in Older Adults 12 Months Following Traumatic Brain Injury
2. HERSHAW, JN      The Influence of Depressive and Post-Traumatic Symptoms on Neuropsychological Performance in TBI
3. PÉREZ-LÓPEZ, L      Adaptation of a Cognitive Stimulation Program for a Blind Patient with Acquired Brain Injury: A Case Report
4. SPLIT, M      Virtual Reality Driving Simulation: An Innovative Tool for Assessing the Cognitive Demands of Driving After Brain Injury
5. ZACHAR-TIRADO, C      Clinical utility of the GAD--7 in identifying anxiety disorders after traumatic brain injury
6. FAHEY, A      Assessment of Awareness of Functional Ability Across TBI Severity
7. GRANT, A      Cognitive Reserve, Neuropsychological Abilities, Emotional Status, and Functional Outcomes in Military Veterans and Civilians Following Traumatic Brain Injury
8. MCCUDDY, WT      Non-Frontal Brain Tumors and Fronto-Executive Dysfunction: A Voxel-Based Lesion Symptom Mapping Pilot Study
9. THOMAS, J      Understanding Age, Gender, and TBI Severity Influence on Verbal and Visual Memory Performance
10. ROPER, CL      Individuals with ABI Teach Graduate Students About Their Lived Experience
11. HO, M      Influences of White Matter Lesions and Cognitive Reserve on the Relationships Between Carotid Artery Stenosis and Cognitive Functions
12. SORG, SF      Greater Self-Reported Memory Difficulties are Associated with Lower Frontal and Temporal Lobe Cortical Thickness in Veterans with Histories of Mild Traumatic Brain Injury
13. LITVIN, PY      Word Frequency on Fluency Tasks as Predictors of Outcome in Moderate-to-Severe Traumatic Brain Injury
14. RUGH-FRASER, R      Examining Various Methods of Executive Ability from Trail Making Test Part B in Traumatic Brain Injury Survivors
15. LANDAU, P      Misconceptions About Traumatic Brain Injury: A Survey of Endorsements by North Carolina School Psychologists

16. KIM, G Resting State Connectivity in the Theory of Mind Network in Children with Traumatic Brain Injury
17. SCHRAEGLE, WA Utility of WISC-V Reliable Digit Span (RDS) in Detecting Noncredible Performance in Pediatric mTBI
18. STOLZ, E Evidence Based Assessment to Support Return to School Following Concussion
19. DENELSBECK, E Student beliefs about what factors influence their GPA
20. FLYNN, AJ PTSD Symptoms, not TBI, predict Suicidal Ideation and Suicide Attempts in a Veteran Population
21. MCCONATHEY, EM Short-Term Heading Exposure Impacts Processing Speed in College Soccer Players
22. SCIULLI, S Cognitive Performance Under Distraction Following Mild Traumatic Brain Injury
23. MEREDITH-DULIBA, TJ Depressive Symptoms and Head Injury Exposure in Cognitively Normal Retired NFL Players
24. TERPSTRA, A Psychological Mediators of Avoidance and Endurance Behavior After Concussion
25. FARBER, K The Relationship Between Heading and Depression and Anxiety Symptoms in College Soccer Players
26. MERRITT, VC An Epidemiological Analysis of Self-Reported Cognitive and Psychiatric Functioning in Veterans with and without a History of Traumatic Brain Injury—A Million Veteran Program Study
27. LIEBEL, SW Sensation-Seeking is Associated with Sport-Related Concussion Risk and Incidence and Sport Contact Level in Collegiate Athletes
28. WALLER, CS Loss of Consciousness as a Moderator in the Relationship Between Sleep-Wake Dysfunction and Postconcussion Syndrome
29. RIEGLER, K Prospective Implications of Insufficient Sleep for College Athletes
30. GUTY, ET Improving Clinical Interpretation of Performance on a Neuropsychological Concussion Battery by Utilizing Premorbid IQ
31. ARNETT, PA Validity of Post-Concussion Only Algorithms in Collegiate Athletes Following Sports-Related Concussion
32. SULLAN, M Sleep Quality in Veterans with Comorbid PTSD and TBI: Impact on Recovery during PTSD Treatment
33. EPPIG, J Latent Neuropsychological Classes in Veterans with a History of Repetitive mTBI: Associations with Risk and Resilience
34. MIS, RE Relations Among Executive Functioning, Lifetime Concussion History, and Performance on a Virtual Reality Assessment of Everyday Functioning in Young Adult Athletes
35. WHITTINGTON, LT Number of mTBI Events and Reported Aggression and Symptoms in a Veteran Sample
36. HUBER, D Variability in the Approach to Diagnosis, Prognosis, and Recommendations for Concussion Among Clinical Providers
37. VAN PATTEN, R Predictors and Correlates of Depression in Retired Professional Rugby League Players

38. HERSHAW, JN Influence of Repetitive Blast Exposure on White Matter Integrity following Uncomplicated Mild Traumatic Brain Injury
39. BRYANT, AM Perception of Peripheral Injuries in Patients with Mild Traumatic Brain Injury and Its Relationship to Outcomes
40. HOFFMAN, LJ Concussion Status, but Not Fronto-Striatal White Matter, Predicts Reward-Based Impulsivity
41. SAKAMOTO, MS Greater Neuropsychological Intra-Individual Variability Predicts Unemployment Status in Veterans with a History of Remote Mild TBI
42. MERRITT, VC Elevated Neuropsychological Intra-Individual Variability Predicts Poorer Health-Related Quality of Life in Military Veterans with a Remote History of Mild Traumatic Brain Injury
43. CARONE, BJ Effects of Major Depressive Disorder and Multiple Mild Traumatic Brain Injuries on Cognitive Functioning and Neurobehavioral Symptoms in Combat-Exposed Veterans
44. VAN PATTEN, R Predictors and Correlates of Perceived Cognitive Impairment in Retired Professional Rugby League Players
45. REID, MW A Pilot Study of Mild Traumatic Brain Injury and DNA Methylation.
46. DAVEY, DK Independent Contributions of Sleep Disturbances, Fatigue, and Pain to Cognitive Functioning in Iraq/Afghanistan Veterans with Comorbid PTSD and History of TBI
47. WERHANE, ML Clinical Characteristics Associated with Reduced Physical Activity in Veterans with a History of Mild Traumatic Brain Injury.
48. MARSTON, E Performance Validity Testing and Outcomes on Neuropsychological Measures in Military Mild Traumatic Brain Injury: A Meta-Analysis
49. TWAMLEY, EW Age and Psychiatric Symptoms do not Moderate Relationship Between Neuropsychological Performance and Functional Capacity Following Mild Traumatic Brain Injury in Veterans
50. POLEJAEVA, E Association Between Symptoms of Depression and Anxiety with Performance on Measures of Executive Functioning in a Clinical Sample of Veterans with a History of Traumatic Brain Injury
51. DAILEY, NS A Shared Biomarker of Cognitive Ability and Sleep Disruptions in Mild Traumatic Brain Injury
52. HOLIDAY, KA Cognitive Fatigue is Associated with Increased Neural Activation During Response Inhibition in Veterans with mild TBI
53. OZTURK, E Elevated Somatic-Sensory Postconcussive Symptoms Predict Reduced Orbitofrontal and Temporal Cortical Volumes in Blast-Related Mild TBI
54. CABLE, ST Who will they talk to? Adolescent perspectives and comfort levels communicating about concussion symptoms and needs following injury

55. PLOURDE, V Expectations of Symptom Duration are Associated with Emotional Stress in Children and Adolescents with Protracted Concussion Recovery
56. CAIRNCROSS, M Fear Avoidance Behavior in Youth with Poor Recovery from Concussion: Measurement Properties and Correlates of a New Scale
57. STAPLES, G The Importance of Multi-Modal Assessment: Evaluating the Relationship Between Symptom Ratings and Neuropsychological Test Performance in Pediatric mTBI
58. GOODWIN, GJ Post-Concussion Symptom Scores Among Athletes with Neurodevelopmental History
59. PULSIPHER, DT Latent Profile Analysis of Neuropsychological Performance in Youth and Young Adults with Multiple Concussions
60. MAIETTA, LN Effects of helmet use on concussion rates across sport categories
61. SNYDER, A Breathing After Concussion: The influence of cardiorespiratory functioning on cognitive performance
62. GUO, S Intellectual Functioning is Not Impaired Following Pediatric Mild Traumatic Brain Injury
63. SLEMP, J Exploring Gender Differences in Symptom Severity Following Concussion
64. MCARDLE, M Neurocognitive Trends in Concussion Patients Based on Gender and Loss of Consciousness
65. GOMES, D Reporting Patterns of Subjective and Objective Neuropsychological Symptoms in Adolescents with Sports-Related Concussions
66. TARKENTON, T Post-Injury Symptomatology Following Concussion Versus Orthopedic Injury
67. TARNAI, KA Return to School 1 Year After Traumatic Brain Injury: A Study Using the Traumatic Brain Injury Model Systems National Database
68. RADIGAN, LJ Influence of Insurance Type on Disability and Emotional Outcomes Following TBI
69. VERVOORDT, SM Examining Depression as a Marker for Decline in Older Adults with a History of Moderate to Severe Traumatic Brain Injury: Genetic Risk, Cognitive Deficits, and Hippocampal Volumetric Changes
70. VERVOORDT, SM All Breadth and Little Depth: A Critical Review of Depression in Moderate to Severe Traumatic Brain Injury
71. LAMBEZ, B The effectiveness of External vs. Internal Memory Remediation Strategies as a function of injury severity in individuals with traumatic brain injury: Systematic Review and Meta-analysis
72. PATRONICK, J Review of Genetic Factors Associated with Recovery after Traumatic Brain Injury: A 4-year Update

73. QUANG, H Influence of Family Functioning, Overprotectiveness and Self-Efficacy in Apathy after Traumatic Brain Injury
74. FATOORECHI, S Assessing Memory Workload in Latinx Participants With Traumatic Brain Injury
75. LOPEZ, AO Effect of Anxiety on Verbal Fluency in a Traumatic Brain Injury Sample
76. GRAUB, N The Relationship Between Bilingualism and Traumatic Brain Injury on Verbal Fluency Across Performance Intervals
77. ZAKARIAN, F The Effect of Moderate Alcohol Consumption on Verbal Fluency Performance in Traumatic Brain Injury Survivors
78. TORRES, E Perceived Workload on the Dot Counting Test and Rey 15-Item Recall and Recognition Test in Bilingual and Monolingual Traumatic Brain Injury Survivors and Healthy Comparison Adults
79. OLMOS, W Anxiety and Depression Symptomatology on Memory Performance in Traumatic Brain Injury Survivors
80. WEBER, E Time Monitoring Independently Predicts Time-Based Prospective Memory in Individuals with TBI
81. SNYDER, RL Metacognitive Evaluation of Inhibitory Processes After Traumatic Brain Injury
82. FEIGER, J Baseline Predictors of Adjustment Functioning After Post-Acute Rehabilitation for Traumatic Brain Injury
83. KLECHA, H Improving Intraindividual Variability in TBI Using Mindfulness: Preliminary Findings from a Pilot Study
84. CHIOU, KS Improvements in Reaction Times of Metacognitive Confidence Judgment with Repeated Exposure After Moderate to Severe TBI
85. KLECHA, H Cognitive fatigue in TBI: Do State and Trait Measures of Fatigue Assess the same Underlying Construct?
86. SANDERS, G Growth Curve Trajectories of Processing Speed After Moderate or Severe Traumatic Brain Injury
87. GROSSNER, EC Age and Time Post Injury Moderate the Relationship Between Metacognition and Executive Functioning After Traumatic Brain Injury
88. SMITH, KE Assessing Fluency Workload in Latinx Traumatic Brain Injury Survivors
89. ZACHAR-TIRADO, R Clinical Utility of the Patient Health Questionnaire–Adolescent in Adolescents with Traumatic Brain Injury
90. LENGENFELDER, J Theory of Mind in Pediatric Traumatic Brain Injury: The Jack and Jill Task
91. GREER, KM Examination of Executive Functioning in Frontostriatal Circuitry in Pediatric TBI: A SOBIK Study
92. VANLANDINGHAM, H Pairing Neurostimulation and Cognitive Intervention: A Theoretical Framework for Treatment of Co-Occurring TBI and PTSD
93. DONDEERS, J Short Versions of the TOMM in Pediatric TBI

94. NAVARRO, GY Can TBI & PTSD symptom clusters predict alcohol severity in a veteran population?
95. MARTIN, B CVLT-3 Response Bias as an indicator of engagement in a litigating mTBI population
96. URETSKY, M Quantitating Aggressive Symptomology in Chronic Traumatic Encephalopathy: A Factor Analysis of the Brown-Goodwin Assessment for Lifetime History of Aggression
97. BICHLMEIER, A The Effect of Anxiety and Depression Symptoms on Switching and Clustering Performance in Traumatic Brain Injury
98. WOOD, L Validity of the Verbal Concept Attainment Test in Traumatic Brain Injury
99. UGURU, O Examining Verbal Memory Deficits in Latinx Traumatic Brain Injury Survivors Compared to Healthy Adults
100. MANGASSARIAN, S Bilingualism Benefits Neuropsychological Function in Traumatic Brain Injury

**1:00 PM - 2:00 PM****Symposium 08: Cognitive Stimulation Therapy (CST) for dementia: Adaptation, validation and implementation challenges in developing regions****Chair and Presenter:** Elodie Bertrand**Presenters:** Aimee Spector, Fernanda Fucci, Renata Naylor

1. SPECTOR, A Cognitive Stimulation Therapy for dementia: International implementation in Brazil, India & Tanzania (CST-International)
2. FUCCI, F Challenges for adapting and implementing Cognitive Stimulation Therapy in Brazil
3. NAYLOR, R Cognitive stimulation therapy for people with dementia in Brazil (CST-Brasil): Results from a single blind randomized controlled trial
4. BERTRAND, E Cognitive stimulation therapy for people with dementia in Brazil (CST-Brasil): Neuroimaging findings

**1:00 PM - 2:00 PM****Symposium 09: Neuropsychological Evaluation of Epilepsy Presurgical Candidates: From the Clinic to the Operating Room****Moderator:** Cady Block**Chair:** Kelsy C. Hewitt**Co-Chair and Presenter:** Amanda Gooding**Presenters:** Daniel Loring, David Sabsevitz, Daniel Drane

1. GOODING, A Role of the Neuropsychologist and Neuropsychological Evaluation in the Epilepsy Presurgical Process
2. LORING, D Use of the Wada Test in Epilepsy Presurgical Candidates
3. SABSEVITZ, D Functional Mapping in Epilepsy Presurgical Candidates
4. DRANE, D Minimally Invasive Procedures for Epilepsy Surgery

**2:00 PM - 3:00 PM****Paper Session 13: Training/Drug and Other Related Disorders/Tumor**

1. TOWNS, SJ Personal and Emotional Consequences of the COVID-19 Pandemic on Neuropsychology Trainees: Survey from the Student Affairs Committee of the AACN
2. HIRST, R A survey of pre-doctoral internships with specialized training in clinical neuropsychology: Updated selection criteria
3. DE WATER, E Social Behaviors and Gray Matter Volumes of Brain Areas Supporting Social Cognition in Children and Adolescents with Prenatal Alcohol Exposure
4. ZUNDEL, CG Impact of Gulf War-Specific Neurotoxicant Exposures on Neuropsychological Functioning More Than 25 Years Post-War
5. WATSON, W Cannabis Use and 7-year Longitudinal Cognitive Trajectories Among Older Adults
6. FOX, ME Default Mode Network Recruitment During Attention and Working Memory Tasks in Survivors of Childhood Brain Tumors

**2:00 PM - 3:00 PM****Paper Session 14: Aging: Multicultural Factors**

1. BOOTS, EA Acute Versus Chronic Inflammatory Markers and Cognition in Older Black Adults: Results from the Minority Aging Research Study
2. WARREN, D The Influence of Occupational Complexity on Late-Life Cognition in Older Black Adults: Results from the Minority Aging Research Study
3. ESTRELLA, ML Allostatic Load and Cognitive Function among Middle-Aged and Older Hispanics/Latinos: Findings from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL)
4. AVILA-RIEGER, J Sex/Gender Differences in Age-Related Memory Decline within Race by Education Groups
5. MORRIS, EP Racial/Ethnic Differences in the Relationship between Financial Worry and White Matter Hyperintensities in Diverse Older Adults
6. FARIAS, S Using the Everyday Cognition Scales (ECog) to Predict Conversion to Cognitive Impairment in Different Ethnoracial Groups

**2:00 PM - 3:00 PM****Symposium 10: Beyond Social and Emotional Phenotypes: Perspectives for Neuropsychological Intervention Models****Chair and Presenter:** Nara Andrade**Presenters:** Miriam Beauchamp, Vicki Anderson, Claudia Mello

1. BEAUCHAMP, M Gamifying social skills: Can playing a video game improve social reasoning in adolescents?
2. ANDERSON, V Recovery of social skills following traumatic brain injury in children: a search for predictors to guide interventions
3. MELLO, CB Central Coherence Theory in Autism Spectrum Disorder

4. ANDRADE, NC

The Melody of Joy: Music Emotion Recognition and Perspectives for Interventions in Williams Syndrome

**2:00 PM - 3:00 PM**

**Symposium 11: Current and Future Directions of Cognitive Assessment: The (Overdue) Turn Toward Consideration of Culture and Linguistic Background in Cognitive Measurement**

**Chair:** Theone Paterson

**Presenters:** Melanie Cohn, Khush-Bakht Zaidi, Angela Gutches, John A.E. Anderson

1. COHN, M

Multiculturalism and Cognitive Testing in Parkinson's Disease

2. ZAIDI, K-B

An Examination of Cultural Bias in The Boston Naming Test

3. GUTCHESS, A

Cross-Cultural Differences in Memory and Perception

4. ANDERSON, JAE

Bilingualism Leads to Cognitive Reserve in Older Adults

FRIDAY, FEBRUARY 5, 2021

**8:00 AM - 9:30 AM**

**CE Workshop 11: Social Cognitive and Affective Neuroscience: From the Clinic and into the Wild**

**Presenter:** Agustín Ibáñez

1. IBÁÑEZ, AM

Social Cognitive and Affective Neuroscience: From the Clinic and into the Wild

**8:00 AM - 9:30 AM**

**CE Workshop 12: The Brain in Space: Implications for Human Explorations of Mars and Human Conditions on Earth**

**Presenters:** Vonetta Dotson, Ajitkumar Mulavara

1. DOTSON, V

The Brain in Space: Implications for Human Explorations of Mars and Human Conditions on Earth

**8:00 AM - 9:00 AM**

**Paper Session 15: Aging, Neuroimaging and Hormones**

1. BANGEN, KJ

Reduced Entorhinal Perfusion Predicts Future Cognitive Decline, Neurodegeneration, and White Matter Hyperintensity Progression in Nondemented Older Adults

2. MCEVOY, LK

Lower Hearing Acuity Among Older Adults Predicts Reduced Thickness and Intracellular Diffusion in Cortical Areas Related to Auditory Perception and Language Processing 10 Years Later

3. BOLTON, C

Smaller grey matter volumes and increased white matter hyperintensities predict more rapid functional decline in older adults

4. THOMAS, KR

Intrusion Errors Moderate the Relationship Between Blood Glucose and Regional Cerebral Blood Flow in Cognitively Unimpaired Older Adults

5. BELL, TR The Association between Locus Coeruleus and Subjective Cognitive Decline in Late Midlife
6. SUNDERMANN, EE Elucidating the Relationship between Testosterone and Cognitive Function: Moderating Roles of APOE4 and Sex

**8:00 AM - 9:00 AM****Paper Session 16: Mood and Other Psychiatric Disorders**

1. TAIWO, Z Motivational Depressive Symptoms may be Uniquely Linked to White Matter Hyperintensities in Late-Onset Depression
2. THOMAS, GA The Influence of Self-Report Mood Difficulties on Baseline Symptomatology in College Athletes
3. MAHMOOD, Z An Integrated Cognitive-Behavioral Social Skills Training and Compensatory Cognitive Training Intervention for Negative Symptoms of Psychosis
4. LYKINS, HC Modifiable Predictors of Objective and Subjective Functioning in Individuals with Schizophrenia-Spectrum Disorders and High Levels of Negative Symptoms
5. BABAD, S Prior Trauma History and Adherence to Public Health Recommendations: The Role of Impulsive Decision Making
6. ISSARI, Y Early Life Adverse Experiences, Immigration Status, and Cognition Among Middle-Aged Latinx Adults

**8:30 AM - 9:30 AM****Poster Session 7: ADHD, Autism Spectrum and Other Pediatric Conditions**

1. COULTIS, N Predicting Executive Functioning, Social Impairment, and Internalizing Symptoms in Youth with ADHD and Sluggish Cognitive Tempo
2. HAI, T Cerebellar Volume in Paediatric Attention-Deficit/Hyperactivity Disorder
3. SCIMECA, LM The Clinical Utility of the Trail Making Ratio Scores in Adults with Attention-Deficit/Hyperactivity Disorder
4. MARCELLE, E Examining External Distractibility in Adult ADHD
5. VITALE, GJ A Call for More Research on ADHD Presentations in Native American Populations
6. KEEZER, R Masking Effect of High IQ on the Rey Auditory Verbal Learning Test in an Adult ADHD Clinical Population
7. TURKELSON, L Measuring Mind-Wandering in Mindfulness Research: A Systematic Review
8. CALLAHAN, BL Clinical and Cognitive Differences Between Cases of Late-Life ADHD Who Report Recent vs. Childhood Symptom Onset.
9. LEIB, S Utility of Performance-Based Measures to Identify ADHD in a Clinical Pediatric Neuropsychology Sample
10. MARSTON, E Assessing the Convergent Validity of Performance-Based Measures and Rating Scales of Executive Functioning within a Pediatric ADHD Population

11. HAAK, C Utility of collateral-report measures to identify ADHD in a clinical pediatric neuropsychology sample.
12. BEDNARZ, H Symptoms of Inattention and Driving Difficulties in Young Drivers with ADHD
13. LIAO, Y Failure Inhibition in Posterior Cortex of ADHD Children in Visual Distract Task
14. NG, E Investigating the Relationship between Processing Speed and FSIQ in ADHD and Non-ADHD Groups.
15. FORCHELLI, G Functional Implications of Weak Processing Speed in Clinically-Referred Youth
16. HAMMOND, J Computerized Wisconsin Card Sorting Task (WCST) Performance Among Children with ADHD
17. MANDELBAUM, SA Behavioral Observations in Pediatric Teleneuropsychology Evaluation: The New Normal of Two or More Settings
18. PHILLIPS, M Standardized Pragmatic Language Abilities in Children Diagnosed with Autism Spectrum Disorder: Comparing Sex Differences in Performance Using the Comprehensive Assessment of Spoken Language, 2nd Edition
19. BONDA, E Neurocognitive Enhancement of categorization abilities in Autism Spectrum Disorder
20. THOMAS, RP Symptoms of ASD and Global Developmental Delay in Children with Low Mental Age
21. MYSZKO, Z Parental Perspectives of the Effects of the COVID-19 Pandemic on Young Adults with Autism: A Pilot Study
22. BECKERSON, ME Corpus Callosum Morphology and Homotopic Functional Connectivity in Autism Spectrum Disorder
23. NG, R Associations Between Parent Factors and Externalizing and Internalizing Symptomatology Among Children with ADHD, ASD, Comorbid Diagnosis, and Communication Disorder
24. CHANG-TRAN, J Cross-Cultural Examination of Vaccine Hesitancy and Attributions for Autism Spectrum Disorder (ASD) in Parents of Children with ASD
25. ROSENSWEIG, C A Case Study of Peer-To-Peer Learning in Two Adults with Developmental Disorders
26. GENOVA, HM The Impact of the COVID-19 Pandemic on School Aged Children with Autism: Parental Report
27. WEXLER, D More Alike than Different: Comparing Children with Low Average Intellectual Abilities to Their Lower Functioning Peers
28. GENOVA, HM What are Your Strengths? How Youth with Autism Differ in the Expression of Personal Strengths during the Job Interview
29. NICHOLS, L Provider and Child Characteristics Impacting ASD Surveillance
30. TRAPANI, JA Autism Symptomatology and Neuropsychological Mechanisms Underlying Deception Detection

31. BRUKILACCHIO, BH A Matched Pairs Analysis of Sex-Based Social Communication Differences in Young Children with Autism
32. FAERMAN, A Language Ability Predicts Both Verbal and Nonverbal Intelligence in Children with Autism Spectrum Disorder
33. NG, R Distress Tolerance and Behavioral Functioning in Youth with ADHD, ASD, ADHD+ASD and Intellectual Disability: Mediating Role of Family Stress
34. SMITH, J Caregiver Strain & Profiles of Executive Functioning (EF) in ASD and ADHD
35. SRIDHAR, A Changes in Neural Network Connectivity Across Brain States in ASD
36. HANDSMAN, RC Improvement in Executive Functioning & Reduced Caregiver Strain in Autistic Children
37. CAMODECA, A Intact Emotion Fluency Abilities in Children with Autism Spectrum Disorders
38. HUANG, W Mind-PEACE Neuropsychological Intervention for Autism Spectrum Disorder: A Case Report
39. RIGGALL, E Verbal Learning and Memory Factor Structure and Text Reading in Children with Developmental Dyslexia
40. THOMAS, TI Semaphorin 6D and Reading: An Imaging Genetics Study
41. FARRELL, A Mind Wandering and Reading in Middle School
42. WAKEMAN, H Modeling the Speeded Determinants of Adolescents' Academic and Attentional Functioning
43. GIOIA, A The Assessment of Writing, Self-Monitoring, and Reading (AWSM Reader) and its Relationship with Executive Function
44. WARD, A The Impact of Slow Processing on Reading Skills Among Child Psychiatric Outpatients
45. BAJAJ, S Association between Network-wise Morphometry and Irritability in Adolescents
46. WHITFIELD, C Maternal Alcohol and Nicotine Consumption as Environmental Moderators in the Relationship Between Gestational Age and Social-Emotional/Communication/Cognitive Development in Infancy
47. BONDI, BC Cumulative Risk, Protection, and Early Intervention: Neurodevelopment in Sibling Groups Exposed Prenatally to Substances
48. DANDAR, C Executive Functioning in Preterm-Born Preschoolers: Associations with Cognitive and Motor Skills
49. POTH, LD Language and Communication Abilities in Adolescents with Fetal Alcohol Spectrum Disorders
50. LEE, C The Relationships Between Anemia of Prematurity, Intellectual, and Language Functioning in Preterm-Born Preschoolers
51. TANGEN, R Understanding the Impact of Sleep on Anxiety and Behavioral Functioning in Children with Fetal Alcohol Spectrum Disorder

52. BUSCH, TA Executive Functioning Predicts Academic Readiness in Very Preterm Children
53. OZTURK, E Cerebrovascular Function during Adolescent Development
54. FOSS, S Associations Among Maternal Lifetime Trauma, Psychiatric Symptoms in Pregnancy, and Infant Stress Reactivity and Regulation
55. CLIFFORD, M Neuropsychological Profile of an Adolescent Diagnosed with Dissociative Identity Disorder (DID)
56. LOBERMEIER, M Association Between Obstetric Mode of Delivery and Social, Communication, and Cognitive Development in Infancy
57. STINSON, EA Self-Reported Antioxidant Diet Levels are not Associated With Cognitive Performance in Healthy Adolescents and Young Adults
58. DESIRE, N Examining the Feasibility and Client Satisfaction of a Tiered Approach to Delivering Videoconference-Based Screening Assessments to Youth and Families During COVID: Preliminary Findings
59. CLARK, SV Relationships Between Cerebello-Cortical Functional Connectivity and Executive Functioning Across Childhood and Adolescence
60. THOMAS, P Responses to Stress Correlate with Cortical Thickness Across Adolescence in Healthy Neurodevelopment
61. MATTES, AM Postnatal Growth Change Scores and Executive Functioning in Preterm Preschoolers
62. GULER, J A Systematic Review of the Influence of Childhood Trauma Exposure on Executive Functioning
63. GIMBEL, B Neuropsychological correlates of psychopathology in a homeless youth sample: Understanding aggressive behaviors in the context of extreme adversity
64. MAUER, E Book-Sharing Complexity and Executive Function Among Low-Income, Preschool-Aged Dual Language Learners
65. NIELSEN, J Impacts of Socioeconomic Status on Executive Functioning and Cortical Structure in Early Adolescence
66. HOLDING, E Executive Functioning and Working Memory: Exploring the Associations among Parent Report and Individual Performance Measures
67. ROBINSON, MI Cognitive Brain Network Connectivity Changes in Childhood
68. NI, T The Effectiveness of Executive Function Training Program of Prader-Willi Syndrome
69. SHEN, C Children Born Very Low Birth Weight with Normal Early Development Slowly Catch Up on Cognitive Executive Functions at School-Age
70. PI, Y Therapeutic Effectiveness of Neurofeedback-Based Neuropsychotherapy on Impulsivity for Adolescents with IA and ADHD

71. MILLER, L Utility of Behavior Rating Inventory of Executive Function Metacognition Index for Identifying Risky Young Drivers: An Analysis of Subjective and Objective Behavioral Measures
72. FORCHELLI, G Convergence of Behavior Ratings of Executive Functions with Psychometric Tests and Psychopathology in Clinically-Referred Youth
73. MACDONALD, K Characterization of English and Spanish Language Proficiency and Balance among Middle School English Learners
74. KANAYA, M Association Between Food Memory and Hippocampal Dependent Memory in Children with Healthy Weight
75. MINOR, GN Behavioral and Eye-Movement Correlates of Item-Specific and Relational Memory in ASD
76. GIL DIAZ, LM Neuropsychological Testing in a Pediatric Sickle Cell Disease Sample: A Comparison Between the Wechsler Abbreviated Scale of Intelligence and the NIH Toolbox Cognition Battery
77. AHMED, F Waist-to-Hip Ratio in Young Adults: Performance on the Trail Making Test
78. BEATTIE, J Examiner Relationships and Concrete Guidance Predict Parent Satisfaction with Pediatric Neuropsychological Evaluations
79. GIES, LM Parent- and Adolescent-Reported Executive Functioning in the Context of Randomized Controlled Trials of Online Family Problem-Solving Therapy
80. BAUCKE, C Birthweight and Parental Education: Predictors of Communication Development in Infancy
81. MCCALL, D Hospital Referral Patterns in Pediatric Neuropsychology: An Update after 25 Years
82. MANIAK, JJ Feasibility of Remote Testing Methodology for the Study of Fine Motor Development in Preschool and School-Aged Children
83. TAYLOR, S At What Point is One Trial on the Test of Memory Malingering Enough? A Systematic Review of Pediatric Studies
84. GONZALEZ, I Exploring Bilingualism as a Protective Factor for Executive Functioning Performance in Children with Neurocognitive Disorders
85. FOY, A Social Behavior in Children with RASopathies and Idiopathic Autism
86. PARDEJ, SK Measurement of Attention in Young Children with NF1: Comparison of the K-CPT and K-CPT-2
87. MAHALE, M Neuropsychological Profile of Pediatric Hypotonia, Ataxia, and Delayed Development Syndrome (HADDS): A Case Study
88. KAIS, L Neuropsychological Screening in a Multidisciplinary Turner Syndrome Clinic: Feasibility and Preliminary Outcomes
89. KAMATH, N Conduct Problems are Associated with Parent-Reported Learning Difficulties in Children with Neurofibromatosis Type 1

90. WESTDAL, J Children with Mucopolysaccharidosis I and ASD: Observations from Case Studies
91. DEL CASTILLO, A Examining cognitive load in children with Neurofibromatosis Type 1 compared to typically developing children
92. BOADA, C eXtraordinary Babies: Early Developmental Profile of Infants and Toddlers with Prenatally Identified Sex Chromosome Trisomies
93. LEE, K Pre-Academic Predictors of Later School Age Academic Functioning in Children with Neurofibromatosis Type 1

**9:00 AM - 10:00 AM****Paper Session 17: Lifespan Trajectories & Predictors**

1. KAPOOR, A Systemic Markers of Angiogenesis and Neuropsychological Functioning in Older Adults
2. EGLIT, GM Cognitive trajectories in later adulthood: Impact of peak cognitive reserve and prior cognitive reserve decline
3. COLLIN, B Comparing Patterns of Benzodiazepine and Anticholinergic Drug Use on Cognitive Functioning in the Wisconsin Registry for Alzheimer's Prevention Study
4. GRILLI, M Autobiographical Memory Fluency Reductions in Cognitively Unimpaired Middle-Aged and Older Adults at Increased Risk for Alzheimer's Disease Dementia
5. BERTOLA, L Early-Life Socioeconomic Status Impact on Cognition is Higher for Older Than Middle-Aged Adults and Independent of Education Level and Late-Life Socioeconomic Status
6. FRANZ, CE Associations Between Cigarette Smoking in Early Midlife and Accelerated Brain Aging in Late Midlife

**9:00 AM - 10:00 AM****Paper Session 18: Concussion/Traumatic Brain Injury**

1. SHEPPARD, D Poorer Prospective Memory Performance is Associated with Reduced Time Monitoring Among OEF/OIF/OND Veterans with a History of Blast-Related Mild Traumatic Brain Injury
2. JURICK, S Trauma-focused Treatment Enhanced with Cognitive Rehabilitation Improves Memory Performance in Iraq and Afghanistan Veterans with Cognitive Impairment
3. RASKIN, S Cognitive and Emotional Functioning in Women who Experience Traumatic Brain Injury as a Result of Intimate Partner Violence
4. SILVERBERG, ND Matching Concussion Rehabilitation Approaches to Psychological Coping Styles: A Feasibility Randomized Controlled Trial
5. BRENNER, EK Demographic and Injury Characteristics Interact with Cognitive Reserve and APOE e4 Status to Affect Delayed Memory in Traumatic Brain Injury
6. DELL, KC Exercise May Reduce Depression in Women but not Men Aging with Moderate/Severe TBI

- 9:55 AM - 10:55 AM**      **Program Chair Welcome & Plenary E: Centering Social Justice and Public Health in Neuropsychology**  
**Presenter:** Jennifer J. Manly  
 1. MANLY, JJ      Centering Social Justice and Public Health in Neuropsychology
- 11:00 AM - 11:55 AM**      **Plenary F: The Impossibility of Monolingualism in the Mind of the Bilingual**  
**Presenter:** Monika S. Schmid  
 1. SCHMID, MS      The Impossibility of Monolingualism in the Mind of the Bilingual
- 12:00 PM - 12:55 PM**      **Plenary G: Age-related Trajectory of Brain Changes and Cognitive Decline in Autosomal Dominant Alzheimer's Disease**  
**Presenter:** Yakeel Quiroz  
 1. QUIROZ, Y      Age-related Trajectory of Brain Changes and Cognitive Decline in Autosomal Dominant Alzheimer's Disease
- 1:00 PM - 2:00 PM**      **Panel Discussion hosted by the INS Student Liaison Committee 02: Navigating Racial/Ethnic and Cultural Differences between the Neuropsychologist and the Client: Implications for Assessment**  
**Presenters:** Xavier E. Cagigas, Jennifer J. Manly, Lucette Adeline Cysique, Lauren Mai  
 1. CAGIGAS, XE      Navigating Racial/Ethnic and Cultural Differences between the Neuropsychologist and the Client: Implications for Assessment
- 1:00 PM - 2:00 PM**      **Paper Session 19: Assessment**
1. YÁÑEZ, JJ      Behavioral Symptoms of Dementia (BSD) Mediate Stress and Cognitive Symptoms Among Latinx Caregivers Caring for a Relative with Alzheimer's Disease and Related Dementias (ADRD's)
2. SCOTT, J      Development and Application of Novel, Data-Driven Performance Validity Metrics for Computerized Neurocognitive Batteries
3. GARCIA, JM      Differential Item Functioning of the Executive Interview (EXIT) and its Shorter Versions in a Rural, Multi-Ethnic Cohort
4. KARSTENS, AJ      Mayo Normative Studies: Regression-Based Normative Data for Category Fluency and Boston Naming Test for Ages 30–91 Years and the Varying Impact of Demographic Variables Across Measures
5. PUDUMJEE, SB      Mayo Normative Studies: Amyloid and Neurodegeneration Negative (A-N-) Auditory Verbal Learning Test Normative Data and Preliminary Validation
6. DULAY, M      Longitudinal Predictors of Memory and Executive Difficulties 17 Months After Stroke

**1:00 PM - 2:00 PM****Symposium 12: Good Trouble: Population Management Solutions For Diverse Pediatric Populations****Chair:** Christine Salinas**Presenters:** Beatriz MacDonald, Adriana M. Strutt, Veronica Bordes Edgar, Gretchen Berrios-Siervo, Heidi A. Bender, Adam Saad

1. MACDONALD, B

SALUD Strutt MacDonald Equitable Healthcare Model: A Comprehensive Approach to Addressing Healthcare Disparity in the Field of Neuropsychology

2. BORDES EDGAR, V

Developmental-Pediatric Screening Model

3. BERRIOS-SIERVO, G

Innovations in the Brief Neuropsychological Evaluation and Care of Children with Newly Diagnosed Epilepsy

4. BENDER, HA

Bridging the Gap: Providing Epilepsy Clinic Patients with Psychological Support and Center Outreach During the COVID-19 Pandemic

**1:00 PM - 2:25 PM****Invited Symposia 4: Symposium Honoring the Legacy of Nelson Butters****Chair:** Meryl Butters**Discussant:** James Becker**Presenters:** Mieke Verfaellie, Margaret O'Connor, Marlene Oscar Berman, Edith Sullivan, Mark Bondi, David Salmon  
Memory

1. VERFAELLIE, M

Alcohol Use Disorders

2. OSCAR BERMAN, M

Dementia

3. BONDI, MW

**2:30 PM - 3:00 PM****INS Business Meeting****2:30 PM - 3:30 PM****Paper Session 20: Neurodevelopmental Disorders/Pediatric**

1. CHEN, B

Executive functioning in a community sample of children and adolescents with autism spectrum disorder and/or attention-deficit/hyperactivity disorder

2. AMMONS, C

Structure of the Mid-Fusiform Sulcus in Autism Spectrum Disorder and its Relationship to Social Functioning

3. NAYAR, K

Concordance of the Dot Counting Test with the Test of Memory Malingering Trial 1 and Reliable Digit Span in a Mixed Clinical Pediatric Sample

4. DEMERS, L

Household Income and Executive Functioning Development in Early Childhood: A Prospective Three-Year Study

5. GAUDET, I

Social outcomes in preschoolers with congenital heart disease : an integrative perspective

6. BRADSTREET, LE

Neuropsychological Outcomes Associated with La Crosse Virus Encephalitis in a Pediatric Sample

**2:30 PM - 3:30 PM****Poster Symposium 1: Ethical Issues in Clinical Supervision****Chair and Presenter:** Lynn A. Schaefer**Presenters:** Dede Ukueberuwa, Nicolette Gabel, Brian P. Yochim  
Slippery Slopes and Blurred Boundaries

1. SCHAEFER, LA
2. UKUEBERUWA, D

Culture in Ethical Supervision: Perceptions, Pitfalls, and Empowerment

3. GABEL, N

Feedback Flops to Gatekeeping Gaffes: Ethically Informed and Effective Feedback to Trainees

4. YOCHIM, BP

Promoting Positive Supervision

**2:30 PM - 3:30 PM****Symposium 13: Comparing Approaches to Gauging Practice Effects in Aging and Alzheimer's Disease: Highlighting an Often Neglected Issue****Chair:** William S. Kremen**Presenters:** Daniel A. Nation, Kevin Duff, Mark Sanderson-Cimino, Alden Gross

1. NATION, DA

Older Adults Showing Neuropsychological Decline on Serial Testing Exhibit Greater Alzheimer's Disease Biomarker Abnormalities

2. DUFF, K

Practice Effects in Research on Alzheimer's Disease: Save the Baby and the Bathwater

3. SANDERSON-CIMINO, M

Accounting for Practice Effects in Follow-Up of MCI Cases Reduces Reversion Rates and Improves Detection of New Impairments

4. GROSS, AL

Do People with Alzheimer's Disease Improve with Repeated Testing? Comparison of Two Methods for Characterizing Practice Effects

**2:30 PM - 3:30 PM****Symposium 14: Characterizing Cognition Across Movement and Neuromuscular Disorders****Chair:** Sylvia Chapman**Presenters:** Corey T. McMillan, Megan Barker, Marjana Tafader

1. MCMILLAN, CT

Frequency, Hazard, and Genetic Risk Factors of Cognitive Impairment in Amyotrophic Lateral Sclerosis (ALS)

2. BARKER, M

Spontaneous Speech in Progressive Supranuclear Palsy: A Distinctive Pattern of Speech Output Over Time

3. TAFADER, M

Postmortem Neuropathological Substrates of Cognition in Essential Tremor

**2:30 PM - 3:30 PM****Symposium 15: Cultural Leadership in Neuropsychology: A Guide for Inter-Organizational Governance****Chair and Presenter:** Christine M. Salinas

**Presenters:** David M. Lechuga, Karen Postal, Courtney Ray, Anny Reyes, Octavio A. Santos, Nicholas S. Thaler, Marc Norman, Antonio E. Puente

1. SALINAS, CM
2. RAY, C
3. SANTOS, OA
4. THALER, NS

Cross-Cultural Leadership: A toolkit for creativity and innovation  
Leading Transformational Change: “What does gender and culture got to do with it?”  
Navigating Power Relationships Across the Leadership Lifespan  
Cultural Influence in Negotiation Strategies

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# Abstracts Presented at the Forty Ninth Annual Virtual Meeting International Neuropsychological Society February 2-5, 2021

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TUESDAY, FEBRUARY 2, 2021

**CE Workshop 01: Before the Cure: Cognitive Rehabilitation for Mild Cognitive Impairment**

**Presenters: Anthony Y. Stringer, Benjamin M. Hampstead, Margo Adams Larsen**

**8:00 AM - 11:00 AM**

**A. Y. STRINGER, B. M. HAMPSTEAD, M. ADAMS LARSEN. Before the Cure: Cognitive Rehabilitation for Mild Cognitive Impairment.**

Dementia is the major cause of disability in older individuals. The worldwide prevalence of dementia is predicted to reach 115.4 million people by the year 2050. Alzheimer's Disease (AD) is the etiology in 50-70% of dementia cases, and cerebrovascular disease accounts for another 20% of cases, with at least 22% of patients having a mixture of AD and cerebrovascular pathology. Over 400 clinical trials directed at AD are registered in the ClinicalTrials.gov database, with a third of them focused on alleviating cognitive symptoms through pharmacological intervention. Collectively, these studies have a stunning 99.6% failure rate. The overwhelming failure of these pharmacological clinical trials aimed at later stages of dementia has directed attention to the less severe, prodromal syndrome termed Mild Cognitive Impairment (MCI). Additionally, there is growing recognition that non-pharmacologic approaches may both improve cognition and delay conversion to a more severe clinical state. This workshop will focus on evidence supporting non-pharmacological, cognition-oriented treatments in patients with MCI. We will summarize critical methodological factors that may affect the nature and quality of evidence in this area. We will then review the available rehabilitation strategies for MCI and identify treatment resources for clinicians wishing to introduce these interventions into their practice. Data supporting/refuting the neuropsychological and neurophysiological effects (e.g., via functional neuroimaging) of MCI rehabilitation will be presented throughout. The session will close with a survey of the next generation of neuropsychological treatments, including concurrent neuromodulation, virtual reality interventions, and mobile phone applications, for this currently incurable neurological condition.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Analyze methodological factors that affect research on MCI cognitive rehabilitation 2) Critique the efficacy of various approaches to MCI cognitive rehabilitation 3) Describe next generation cognitive interventions for MCI patients.

Correspondence: *Anthony Stringer, Emory University, Atlanta, Georgia, 30088, United States.*  
Email: [astring@emory.edu](mailto:astring@emory.edu)

## **CE Workshop 02: Update on Vascular Contributions to Cognitive Impairment and Dementia**

**Presenter: Daniel A. Nation**

**8:00 AM - 11:00 AM**

### **D. A. NATION. Update on Vascular Contributions to Cognitive Impairment and Dementia.**

Vascular contributions to cognitive impairment and dementia are increasingly recognized in terms of the importance and scope of the problem facing older adults at risk for dementia. Rapid and recent developments in the field include new discoveries in the epidemiology, neuropathology, neuroimaging and neuropsychological aspects of vascular disease. These recent insights have triggered major shifts in the nosology of these disorders and their differential diagnosis with major implications for case conceptualization in clinical practice. This update will include recent developments in the clinical science of vascular cognitive disorders with implications for clinicians and scientists focused on assessment, diagnosis and therapeutic approaches to cognitive impairment and dementia in older adults.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Analyze epidemiology of vascular contributions to cognitive impairment and dementia 2) Discuss neuropathology and neuroimaging of cerebrovascular disease 3) Apply diagnostic principles and analyze neuropsychological profiles of vascular disease 4) Assess status of therapeutic approaches and predict future research directions.

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## **CE Workshop 03: At the Intersection of Poverty, Dialect, and Literacy: Assessment of Language and Reading of Low-Income African American Children**

**Presenter: Julie A. Washington**

**12:00 PM - 1:30 PM**

### **J. A. WASHINGTON. At the Intersection of Poverty, Dialect, and Literacy: Assessment of Language and Reading of Low-Income African American Children.**

The poor reading outcomes and academic achievement gaps among impoverished African American children has been well-documented and is widely referenced. Findings from large studies involving these students suggest that it likely is the intersection of these influential variables, poverty, dialectal variation and literacy attainment that contribute to the outcomes reported. What is not widely discussed is the impact on assessment outcomes when these variables collide. In particular, standardized tests of language and reading are presented in mainstream American English to children whose primary dialect may differ from this assessment standard. The cognitive load imposed by this mismatch between the language of the test and the child likely influence performance in ways that are not acknowledged. In these cases, what are we learning about children's knowledge of the assessed constructs and concepts? It is more

likely that their responses reflect their ability to perform on the instrument, than reflecting their true knowledge of the language or reading skills assessed, resulting in underestimation of their abilities. The outcomes of a longitudinal project focused on the growth of language and literacy skills in a large sample (N =896) of 1st through fifth grade, low income African American boys and girls are presented. Findings from this investigation have highlighted the difficulty in validly discriminating, dialect, language, and poverty in our assessments, and support the presence of an important relationship between dialect and language and dialect and reading, and a challenge for assessment. Outcomes are discussed relative to the variation that exists within this group of students and implications for assessment and identification of disabilities and, by implication, for educational placement.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) List cultural dialect forms used by African American preschool and elementary school-aged children 2) Describe the impact of these differences on standardized assessment of language and reading skills

3) Discuss the role of oral code-switching and dialectal variation on identification of reading and language impairments in impoverished African American learners.

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#### **CE Workshop 04: A Model for Extending Neuropsychological Assessment and Research into other Disciplines: Examples from the Perioperative Cognitive Anesthesia Network (PeCAN) for Neurodegenerative Disorders**

**Presenter: Catherine C. Price**

**12:00 PM - 1:30 PM**

#### **C. C. PRICE. A Model for Extending Neuropsychological Assessment and Research into other Disciplines: Examples from the Perioperative Cognitive Anesthesia Network (PeCAN) for Neurodegenerative Disorders.**

Although there is increasing recognition regarding the value of neuropsychological assessments in nontraditional settings (e.g., primary care physicians, presurgical anesthesia clinics), it remains challenging to establish and sustain connections for a successful combined evidence based clinical care model. This workshop will provide insights from non-neuropsychological clinical disciplines as to how they benefit from the inclusion of neuropsychology and neuropsychological assessment and research. Then, using the model of the Perioperative Cognitive Anesthesia Network (PeCAN) at the University of Florida, our team, with representation from Departments of Clinical and Health Psychology, Anesthesiology, and Geriatric Medicine, will discuss key components that helped to establish the PeCAN program and maintain success in a large tertiary care hospital. Topics will touch on the role of neuropsychology for hospital wide clinical care prediction models, Latino/Spanish and sociodemographic considerations, integrated team responses to in-person versus virtual assessment modalities, and the value of integrating funded research into programmatic growth for clinical-research-training evidence based impact. The remaining time will be spent in general discussion regarding the challenges and the promise for

this type of integrative clinical care and research model. Additionally, information will be shared on how to build a similar team and move towards collaborative networks internationally.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Explain the value of a needs assessment in nontraditional settings for clinical and research growth involving neuropsychology 2) List challenges and benefits of advancing neuropsychology in other disciplines 3) Describe strategies to promote evidence based medical care for older adults with neurodegenerative disorders in non-traditional settings.

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## **CE Workshop 05: Introduction to the Neuropsychology of COVID-19**

**Presenters: Lucette A. Cysique, Emilia Lojek**

**12:00 PM - 1:30 PM**

### **L. A. CYSIQUE, E. LOJEK. Introduction to the Neuropsychology of COVID-19.**

The workshop will be organized around three critical areas as related to COVID-19. First, the presenters will review up-to-the minute knowledge on COVID-19 as related to cognitive and brain functioning including definitions and concepts, epidemiology, neurological consequences of COVID-19, neuroinvasion and pathogenesis of SARS-COV-2 and associated comorbidities. Second, we will present the gained neuropsychological knowledge since the start of the pandemic. This will include previous neuropsychological research on conditions associated with COVID-19 illness (e.g., acute respiratory distress syndrome, stroke, encephalitis, ICU cognitive sequelae) and closely related viruses (SARS, MERS). Neuropsychological research specifically on COVID-19 will include case presentation and preliminary results of ongoing studies. Third, the presenters will provide an overview of the NeuroCOVID INS SIG recommendations for the evaluation of patients with COVID-19. These recommendations take onto account the phases of the disease, including the patient's infectious stage, the spectrum of possible neuropsychological disorders in COVID-19 and its severity levels (asymptomatic to very severe), the longitudinal dynamic of the illness and considerations regarding cross-cultural, demographics, mental health status, comorbidities, psychological and social factors.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe the current state of the knowledge on COVID-19 as related to cognitive and brain functioning 2) Critique the level of gained neuropsychological knowledge since the beginning of the pandemic 3) Discuss the recommendations for neuropsychological research and clinical practice for the assessment of COVID-19 patients.

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**WEDNESDAY, FEBRUARY 3, 2021**

**A Tribute to Alfredo Ardila**

**8:00 AM - 9:00 AM**

**Paper Session 01: Parkinson's Disease and Other Dementias****8:00 AM - 9:00 AM****R. VAN PATTEN, Z. MAHMOOD, D. PICKELL, S. C. ROESCH, J. E. MAYE, E. W. TWAMLEY, J. V. FILOTEO, D. M. SCHIEHSER. REM Sleep Behavior Disorder in Parkinson's Disease: Baseline Effects on Cognitive, Psychiatric, and Functional Outcomes at 16-47-Month Follow-up.**

**Objective.** In recent years, the scope of research in Parkinson's Disease (PD) has broadened to include nonmotor symptoms such as cognitive impairment, sleep disturbances, and psychological distress, which increase mortality and reduce quality of life. Rapid Eye Movement Sleep Behavior Disorder (RBD) is common in PD and is associated with cognitive impairments and diagnoses of mild cognitive impairment and dementia. However, the majority of the current evidence on the impact of RBD on cognition in PD is cross-sectional, which limits casual inference. In the current study, we evaluated the longitudinal impact of PD and probable RBD (pRBD) status on neuropsychological and functional outcomes, accounting for psychiatric symptomatology.

**Participants and Methods.** Sixty-six participants with PD (22 women, 44 men) completed the RBD Sleep Questionnaire (RBDSQ) and were classified as pRBD+ (n=25) or pRBD- (n=41) based on an established cutoff score of 6 on the RBDSQ. Participants completed comprehensive evaluations at baseline and variable lengths of follow-up (16-47 months). The assessment included a comprehensive neuropsychological test battery measuring attention/working memory, language, visuospatial functioning, learning, memory, and executive functions. We calculated cognitive composites for the six cognitive domains by averaging T-scores for tests within each domain. Finally, participants completed self-report measures of depression, anxiety, and apathy, as well as the UCSD Performance-Based Skills Assessment (UPSA) financial skills subtest and the Medication Management Ability Assessment as tests of performance-based functional capacity.

**Results.** The mean age of the overall sample at baseline was 67.9 (SD=8.1; range=45-86) and the mean years of education completed was 16.4 (SD=2.1, range=12-20). The two groups did not differ on any measured demographic characteristics. Mean baseline T-scores for the six cognitive domains were in the average range (range=46-55). Hierarchical linear models (HLMs) tested group differences in cognitive decline from baseline to follow-up, controlling for age, education, gender, depression, and apathy, and controlling for age only in models examining group differences in functional decline. We considered duration of time since PD diagnosis to be a proxy for disease characteristics; it did not correlate with any outcomes of interest, so it was not included as a covariate in the models. Compared to pRBD- patients, pRBD+ patients showed greater decline in attention/working memory ( $p=.009$ ;  $r=.31$ ) and UPSA financial skills ( $p=.001$ ;  $r=.38$ ), with a statistical trend toward a greater decline in global cognitive functioning ( $p=.09$ ;  $r=.21$ ). No other group differences approached significance.

**Conclusions.** Results suggest that RBD is differentially associated with attention/working memory decline in PD. RBD may also have a subtle negative impact on overall cognition, as evidenced by a greater decline in global cognition that approached significance. Moreover, these effects appear to extend to select instrumental activities of daily living (financial management),

which are subserved in part by abilities such as attention and working memory. Overall, our results underscore the importance of regular RBD screening in older adults with PD in order to triage symptomatic patients to full neuropsychological evaluations and, ultimately, appropriate cognitive and medical interventions.

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**Keywords:** Parkinson's disease, sleep disorders, aging disorders

**S. J. CROWLEY, G. BANAN, M. AMIN, J. J. TANNER, L. P. HIZEL, K. RODRIGUEZ, M. DING, T. A. MARECI, C. C. PRICE. Free Water Fraction Predicts Decline in Mental Flexibility for Individuals with Tremor Dominant Parkinson's Disease.**

**Objective:** The dorsal caudate nucleus (dCN) and basal nucleus of Meynert (BNM) have been implicated in cognitive function in PD. Integrity of these structures may be involved in cognitive decline. Free water fraction (FWF), an estimation of extracellular space, reflects multiple neurodegenerative processes including atrophy, vascular disease, and inflammation, and may serve as a marker of structural integrity. The current investigation aimed to classify individuals with PD based on FWF in the dCN and BNM and compare cognitive decline over a two-year span between these groups. We hypothesized that individuals with higher free water fraction in dCN and BNM would show greater declines in mental flexibility than PD peers with lower free water fraction.

**Participants and Methods:** Participants included 112 individuals with idiopathic tremor-dominant PD that were part of a larger NIH-funded study (NIH/NINDS R01-NS-082386). All participants underwent a baseline comprehensive neuropsychological assessment and diffusion imaging. FWF values were calculated using custom code written in MATLAB. BNM masks were defined from a study which utilized stereotaxic probabilistic mapping. The dCN masks were derived from previous research which used resting state MRI to separate dorsal and ventral caudate. BNM and dCN FWF values were entered into a hierarchical cluster analysis to determine optimum number of clusters, followed by a k-means cluster analysis to determine final cluster membership. Clusters were compared on demographic and disease-related factors. A sample of 67 participants with baseline and 2-year follow-up cognitive testing were included in the longitudinal analysis. Reliable change indices (RCI) for mental flexibility and verbal memory domains were calculated for all participants. The mental flexibility composite was an average of published normative-based z-scores of WAIS-III Letter-Number Sequencing, WAIS-III Symbol Digit Modalities Test, Stroop Color-Word Test, and Trail Making Test Part B. The verbal memory composite was an average of published normative-based z-scores of HVLTR Delayed Recall, HVLTR Recognition-Discrimination, and WMS-III Logical Memory II. The reference group for the RCIs included 26 non-PD peers recruited through the local community. An ANCOVA controlling for age and years of education compared RCI was compared between FWF clusters.

**Results:** The analysis resulted in three clusters: low FWF in both ROIs (Low FWF; n=36), moderate FWF in both ROIs (Medium FWF; n=57), and high FWF in both ROIs (High FWF; n=19). Clusters did not differ in sex proportion, years of education, disease comorbidity, disease duration, motor symptom severity, or dopamine medication dosage. Groups differed significantly by age (High FWF > Medium FWF > Low FWF). The High FWF cluster declined significantly

more than non-PD peers in mental flexibility ( $F[3,87]=3.16$ ,  $p=.03$ ,  $\eta_p^2=.10$ ). Groups did not differ in verbal memory RCI ( $F[3,87]=1.51$ ,  $p=.22$ ,  $\eta_p^2=.05$ ).

**Conclusions:** Our findings suggest that structural integrity of BNM and dCN predict decline in mental flexibility. Future research should examine other cortical areas affected in PD, particularly the mesial temporal lobe. Funding: R01 N5082386, NIH T32-NS082128

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**Keywords:** Parkinson's disease, neuroimaging: structural, executive functions

**A. M. RATAJSKA, F. V. LOPEZ, B. M. SCOTT, S. CHIU, B. PATEL, K. D. FOOTE, M. S. OKUN, C. C. PRICE, D. BOWERS. Differential Contributions of Depression, Apathy, and Anxiety to Neuropsychological Performance in Parkinson's Disease vs Essential Tremor.**

**Objective:** Mood and motivation symptoms are common non-motor features in movement disorders such as Parkinson's Disease (PD) and Essential Tremor (ET), and have been linked to worse cognition. The goals of the present study were twofold: (1) to compare severity of anxiety, apathy, and depressive symptoms in PD, ET, and healthy controls (HC); and (2) to examine differential contributions of mood symptoms to cognition in PD and ET. We hypothesized that apathy would be greater in PD and related to executive functioning, while anxiety would be higher in ET and related to memory.

**Participants and Methods:** Participants included a convenience sample of individuals with idiopathic PD ( $n=448$ ), ET ( $n=128$ ) and HC ( $n=136$ ) from the UF Fixel Institute for Neurological Diseases. As a group, participants were well-educated (1-3 years of college), in their late 60s, predominantly male in the disease groups, and scored  $\geq 120$  on the Dementia Rating Scale-2. A multi-domain neuropsychological assessment was administered, and the following composite scores were formed: recent memory, executive function, attention/working memory, and language. Self-report mood/motivation measures included the Beck Depression Inventory-II (BDI-II), State-Trait Anxiety Inventory (STAI), and Apathy Scale (AS). The groups were examined for differences in mood and cognition using one-way MANCOVAs with age and education as covariates. To evaluate the influence of mood/motivation on cognition in PD and ET groups, we conducted hierarchical regression analyses with separate models for each cognitive domain. Depression scores (BDI-II) were entered into Block 1, apathy scores (AS) in Block 2, and anxiety scores (STAI) in Block 3.

**Results:** Relative to the HC group, the PD and ET groups reported more mood/motivation symptoms [ $F(8,1410)=11.10$ ,  $p<.001$ , partial  $\eta^2=.059$ ] and had lower scores across cognitive domains [ $F(8,1410)=14.54$ ,  $p<.001$ , partial  $\eta^2=.076$ ]. Importantly, the PD and ET groups did not differ on mood/motivation or cognitive domains (all  $p$ 's $>.05$ ). Mood/motivation variables explained 3.9-13.7% of total variance in cognitive domains and varied by disease group. For PD patients, apathy was the only unique predictor of executive function ( $\beta=-.114$ ,  $p=.05$ ), and trait anxiety was the only unique predictor of attention/working memory ( $\beta=-.188$ ,  $p<.05$ ). There were no unique predictors of recent memory. For ET patients, depression was an initial significant negative predictor of executive function and attention/working memory, but lost significance in the final models when apathy/anxiety were added to the analysis.

**Conclusions:** Contrary to our hypotheses, a large cohort of ET and PD patients reported similar severity of mood/motivation symptoms. We suspect this phenotypic similarity arises from distinct, though overlapping, mechanisms. In this context, mood/motivation symptoms were

differentially associated with unique aspects of cognition in PD vs ET. As predicted, worse apathy was associated with worse executive function in PD, a well-known observation that largely reflects dopaminergic abnormalities affecting both domains. For ET patients, there were no unique predictors, though overall mood symptom severity contributed to cognition. Taken together, our study highlights the importance of screening for mood symptoms when assessing cognition in patients with movement disorders and raises questions about more sensitive measures of emotion for future research.

**Funding:** T32-NS082168, R01NS082386-01, R01AG055337-02

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**Keywords:** mood disorders, cognitive functioning, movement disorders

**C. J. WERTZ, N. SHAFF, Y. RIVERA, A. HARTMAN, A. R. MAYER, A. A. VAKHTIN, S. G. RYMAN. Dopaminergic Deficits and Cortical Thinning in Parkinson's Disease Patients Who Develop Psychosis.**

**Objective:** The development of visual hallucinations in Parkinson's Disease (PD) is a significant predictor of dementia and earlier nursing home placement. A reduction in striatal dopamine transporter (DAT) has been linked to posterior cortical atrophy and associated with the development of psychosis. Therefore, dopaminergic degeneration may be one mechanism of cortical atrophy associated with the development of hallucinations. Alternatively, limbic degeneration has also been associated with the development of hallucinations in PD. The current study examines the relationship between DAT imaging, subcortical and cortical volumes, and the development of hallucinations in PD early in the disease course. We hypothesize that PD patients who develop hallucinations exhibit posterior cortical thinning related to the extent of striatal dopamine loss in addition to reduced limbic volumes.

**Participants and Methods:** This study used data from a cohort of newly diagnosed patients with PD and healthy controls (HC) enrolled in the Parkinson's Progression Markers Initiative (PPMI). We extracted T1-weighted structural MRI and I123-ioflupane SPECT (DAT) data for 36 HC, 36 PD patients without hallucinations (PD-hall), and 36 PD patients with hallucinations (PD+hall) matched on age, sex, education, and PD severity via Hoehn and Yahr score. PD+hall were identified by a score of 1 or higher on question 1.2 of the MDS-UPDRS at any study visit.

Baseline MRI's underwent cortical reconstruction and volumetric segmentation with FreeSurfer-v7.1.0. Volumetric analysis between HC, PD-hall and PD+hall, were conducted with general linear models assessing cortical thickness and subcortical volumetric differences between groups.

**Results:** PD+hall exhibited reduced cortical thickness in the left inferior parietal ( $p = 0.03$ ) and right cuneus ( $p = 0.03$ ) relative to HC and PD-hall after correcting for multiple comparisons using family wise error rate. Additionally, PD+hall showed reduced left hippocampal subfield volumes [CA4 ( $F_{1,105} = 7.70, p = 0.006$ ); GC-ML-DG ( $F_{1,105} = 7.38, p = 0.007$ ). Lastly, DATscan values of striatal binding ratio for the left ( $r = 0.36, p = 0.03$ ) and right caudate ( $r = .32, p = 0.05$ ), were significantly correlated with left inferior parietal thickness in the PD+hall group only.

**Conclusions:** Our study found evidence of cortical thinning early in the disease course in PD patients who developed hallucinations in expected areas such as the inferior parietal and hippocampal subfields compared to matched patients and controls. The correlation between DAT

and inferior parietal in the PD+hall group reflects potential cortical atrophy via dopaminergic deterioration.

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**Keywords:** psychosis, neuroimaging: structural, Parkinson's disease

**S. G. RYMAN, C. J. WERTZ, N. SHAFF, Y. RIVERA, A. HARTMAN, A. A. VAKHTIN, A. R. MAYER, S. PIRIO RICHARDSON. Cardiovascular Risk, White Matter, and Cognition in Parkinson's Disease.**

**Objective:** Cognitive decline in Parkinson's disease (PD) is a significant predictor of functional impairment. Cardiovascular risk (CR) factors negatively impact cognitive functioning in PD. Detecting white matter changes that can serve as surrogates of the long-term effect of CR factors on PD are needed. Recently, diffusion weighted MRI has facilitated the detection of white matter changes prior to the development of white matter hyperintensities using the peak width of skeletonized mean diffusivity (PSMD) measure<sup>3</sup>, which has yet to be examined in PD. The current study aims to replicate and extend prior reports of CR, white matter changes, and cognition in PD in a longitudinal cohort.

**Participants and Methods:** This study used data from a cohort of PD and HC enrolled in the Parkinson's Progression Markers Initiative (PPMI). 130 PD and 64 HC were identified based on the availability of diffusion weighted imaging at baseline (which included longitudinal imaging data for a subset of PD patients: N =105 year 1, 94=year 2). Analyses of covariance and linear mixed models were used to examine relationships between CR, PSMD, and cognitive functioning [Montreal Cognitive Assessment (MoCA) and executive/processing speed measures Letter Number Sequencing (LNS) and Symbol Digit Modalities Test (SDMT)].

**Results:** We observed a significant main effect of CR across all cognitive measures and timepoints, whereby high CR PD and HC exhibited significantly lower cognitive scores relative to low CR PD and HC. The effect of group was only significant for the SDMT, with PD patients exhibiting a significant reduction in SDMT across timepoints (all  $p$ 's <0.001). High CR PD was the only group that exhibited a significant decline in MoCA scores across time. PSMD was not related to midbrain FreeWater measures or UPDRS-Part III (all  $p$  > 0.10). PSMD was significantly related to CR, LNS and SDMT measures across HC and PD. Longitudinal analyses indicated that High CR PD patients exhibited a significant reduction in PSMD over time.

**Conclusions:** Irrespective of patient group, individuals with CR exhibited a significant reduction in general ability (MoCA), processing speed, and executive functioning across all timepoints. Longitudinal data highlighted that only high CR PD patients exhibited a significant decline in MoCA scores, whereas low CR PD and all HC exhibited no significant decline. The PSMD measure is not related to PD status, diffusion changes in the midbrain, or motor scores. Rather, PSMD is related to CR across groups, suggesting that changes likely reflect those related to cerebrovascular related changes in PD. PSMD was related to MoCA, SDMT, and LNS. The longitudinal decline in PSMD and cognitive functioning in PD patients only suggest PD patients with high CR may be at greater risk of cognitive decline relative to high CR HC.

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**Keywords:** cardiovascular disease, neuroimaging: structural, Parkinson's disease

**F. KUMFOR, C. LIANG, J. L. HAZELTON, C. E. LEYTON, C. KAIZIK, E. DEVENNEY, E. CONNAUGHTON, R. LANGDON, E. MIOSHI, J. B. KWOK, C. DOBSON-STONE, G. M. HALLIDAY, O. PIGUET, J. R. HODGES, R. LANDIN-ROMERO. Delusions in dementia: A transdiagnostic examination of prevalence, nature and neurocognitive mechanisms.**

**Objective:** Delusions have been reported in some people with dementia, however, their prevalence across syndromes and underlying neurocognitive basis has been underexplored. Here we took a transdiagnostic approach to examine the prevalence, severity, content and neural correlates of delusions in dementia.

**Participants and Methods:** We recruited a large cohort of 487 people with dementia: 102 Alzheimer's disease, 136 behavioural-variant frontotemporal dementia, 53 semantic-variant primary progressive aphasia (PPA), 51 nonfluent-variant PPA, 50 logopenic-variant PPA, 29 motor neurone disease, 46 corticobasal syndrome, 20 progressive supranuclear palsy. All patients underwent brain MRI and cognitive assessment, and the Neuropsychiatric Inventory was conducted with an informant.

**Results:** In our cohort, 48/487 patients (10.8%) had delusions. The highest prevalence was observed in behavioural-variant frontotemporal dementia (18.4%) and Alzheimer's disease (11.8%). Individuals with frequent delusions performed worse on the Addenbrooke's Cognitive Examination ( $p = .035$ ), particularly on the orientation/attention ( $p = .022$ ) and memory ( $p = .013$ ) subtests than a demographically-matched group of patients without delusions. Delusional beliefs were associated with lower integrity of the left anterior temporal lobe and right middle frontal gyrus. Ninety-two percent of patients with a positive gene finding had delusions, whereas only 1 patient without delusions (8%) had a positive gene mutation.

**Conclusions:** Our results reveal that delusions are relatively common in dementia, particularly in behavioural-variant frontotemporal dementia. Delusions are associated with more severe cognitive impairment, frontotemporal brain atrophy and genetic abnormalities. Our results align with contemporary cognitive neuropsychiatric theories of delusion formation, and indicate that the right prefrontal cortex plays a central role in development of psychotic symptomatology in dementia. These symptoms may lead to delayed or inaccurate diagnosis, and therefore increased awareness of the neuropsychiatric features of dementia is important. Patients with delusions appear to have more widespread impairment and may be good candidates for targeted for symptom management.

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**Keywords:** neuropsychiatry, cognitive neuroscience

## **CE Workshop 06: Cognitive and Behavioral Phenotypes Associated with Neurogenetic Syndromes**

**Presenter: Nancy Raitano Lee**

**8:00 AM - 9:30 AM**

**N. R. LEE. Cognitive and Behavioral Phenotypes Associated with Neurogenetic Syndromes.**

The past 30 years have witnessed an increase in research on 'behavioral phenotypes' associated with different neurogenetic disorders. Rather than describe youth with intellectual and learning disabilities with regard to their degree of impairment, an etiology-driven approach has been increasingly used to characterize the cognitive and behavioral challenges associated with specific neurogenetic syndromes. This talk will provide an overview of the cognitive and behavioral phenotypes associated with neurogenetic syndromes (e.g., Williams, fragile X, and Smith-Magenis syndromes) that may be encountered in neuropsychological practice. Then an in depth review of Down syndrome and sex chromosome disorders (e.g., Klinefelter and Trisomy X syndromes) will be provided. In particular, research on their neuroanatomical and neuropsychological phenotypes will be reviewed, with an emphasis on language, social, and executive function and the use of measures to describe everyday behavior in these domains. A review of common psychiatric (e.g., autism and ADHD) and medical (e.g., sleep, heart abnormalities) comorbidities and their relations to cognition and behavior in these groups will also be provided in order to draw attention to the need to screen for these conditions when evaluating youth with these disorders.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe the major cognitive-behavioral features of Williams, fragile X, and Smith-Magenis syndromes 2) List the major features of the Down syndrome neuroanatomical phenotype and its relevance to the syndrome's cognitive profile 3) discuss the language and executive function profiles associated with Down syndrome and two sex chromosome disorders (Klinefelter and Trisomy X syndrome) 4) Explain the importance of screening for different medical and psychiatric comorbidities when evaluating individuals with Down syndrome and sex chromosome disorders  
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**CE Workshop 07: Poverty and the Developing Brain****Presenter: Pilyoung Kim****8:00 AM - 9:30 AM****P. KIM. Poverty and the Developing Brain.**

Poverty is a public health concern because individuals exposed to disadvantaged backgrounds are at a greater risk for morbidity and mortality across the lifespan as well as negative developmental outcomes in children. To unfold the neurobiological mechanisms underlying health inequalities, researchers have examined how poverty exposure negatively influences brain development. Now a substantial body of neuroimaging literature consistently suggests that poverty in childhood has adverse impacts on brain development. The negative outcomes in the brain structure, function, and connectivity have been further associated with increased risks for difficulties in emotional and cognitive controls and lower academic performance. First, I review how poverty influences brain structure and function in childhood. Second, I review how childhood poverty may have a long-lasting effect and be prospectively associated with brain

outcomes across the lifespan. Third, I discuss the potential neurobiological and environmental factors that may mediate the associations between poverty and brain development.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Discuss the science relevant to the negative impact of poverty on brain development 2) List environment factors that influence brain development among children living in poverty 3) Apply an evidence-based framework to describe the mechanisms by which poverty is associated with negative cognitive and health outcomes in childhood and beyond.

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### **CE Workshop 08: Cognitive Assessment among Diverse Latinos in SOL-INCA (Study of Latinos-Investigation of Cognition Aging)**

**Presenters: Hector M. González, Wassim Tarraf**

**8:00 AM - 9:30 AM**

#### **H. M. GONZÁLEZ, W. TARRAF. Cognitive Assessment among Diverse Latinos in SOL-INCA (Study of Latinos-Investigation of Cognition Aging).**

The Study of Latinos-Investigation of Cognitive Aging (SOL-INCA) is an ancillary study of the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Cognitive assessment data of 9,637 diverse middle-aged and older Latinos were collected at 4 HCHS/SOL clinics in Bronx, NY, Chicago, IL, Miami, FL, and San Diego, CA between 2008 and 2011 (Visit 1). The same cognitive battery was repeated as part of SOL-INCA between 2015 and 2018 during HCHS/SOL Visit 2. The SOL-INCA is the largest study of cognitive aging among diverse Latinos. We will describe the challenges and decision making that went into mounting SOL-INCA in the diverse Latin American cohort of HCHS/SOL. Moreover, we will discuss the deep cardiometabolic phenotyping and genotyping leveraged from HCHS/SOL that make the SOL-INCA a new and valuable resource for filling major gaps in scientific knowledge of this important, but understudied population.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe the gaps in normative data pertaining to Latino cognitive assessment 2) List the challenges posed by evaluating diverse language variations of Latin American Spanish-speakers 3) Explain the SOL-INCA sample characteristics and findings related to cognitive aging.

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### **Poster Session 1: Medical and Other Neurological Disorders**

**8:30 AM - 9:30 AM**

#### **H. SIRCUS. A Literature Review on Resilience and Posttraumatic Growth in Cancer Patients.**

Many people with cancer experience multiple stressors that may stem from both the illness and different external factors. When faced with a challenging or traumatic life event such as cancer, people may experience post-traumatic growth and/or resilience. To better care for patients, their friends, and family, it is important to understand the elements that may influence resilience and personal growth during the cancer experience. The purpose of this paper is to provide synthesis of the literature related to resilience and post-traumatic growth for those with cancer.

Peer-reviewed research databases were searched to gather information on the relationship between post-traumatic growth, resilience, and cancer. Search terms and keywords included the following: post-traumatic growth, resilience, cancer, people living with cancer, resilience and cancer, post-traumatic growth and resilience post-trauma, post-traumatic growth and cancer experience, protecting factors for resilience, protective factors for post-traumatic growth, risk factors for post-traumatic stress, children and adolescents with post-traumatic growth, and resilience training. Upon searching these terms, a total of 12,630 articles were found. Forty-nine of these research articles met my criteria and were used in this paper. Inclusion criteria consisted of research articles from scholarly journals that addressed the purpose of this paper and reported quantifiable data. The literature examined for this review was obtained from the search engines Google Scholar, PsychInfo, PsychArticles, and ProQuest Central. The reviewed articles will be referred to and discussed throughout this paper.

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**Keywords:** adaptive functioning, cancer

**S. V. GUPTA, J. PETERSEN, D. COBIA, M. E. DOKUCU, E. D. DONNELLY, W. J. GRADISHAR, M. MIHAILOVIC, J. A. PAICE, J. L. REILLY, J. L. VOSS, L. WAGNER, L. WANG. Cortical Gray Matter Alterations in Breast Cancer Patients Undergoing Hormone Therapy .**

**Objective:** Breast cancer patients have reported symptoms such as fatigue, insomnia, anxiety and depression while undergoing adjuvant therapy. Previous research has found that chemotherapy, a primary cancer treatment option for breast cancer patients, can lead to declining cognitive activity as well as a decrease in morphological measures. However, the neurologic effects of other adjuvant therapies have yet to be fully explored. One treatment in particular, hormone therapy, is a relatively new area of research, with few neuroimaging studies delineating the effects. Research on estrogen, which is targeted in hormone therapy, have found alterations in gray matter volume, cortical thickness, and cognition. The objective of this exploratory study was to explore the structural differences in breast cancer patients receiving hormone therapy compared to healthy controls.

**Participants and Methods:** Structural MRI was acquired from 24 breast cancer patients who were undergoing hormone therapy at the time of the study but did not receive chemotherapy and 32 healthy controls without a history of cancer. The structural MRI scans were obtained for each patient on a 3T MRI scanner and morphological measures were quantified brain-wide. T1 weighted MRI images were processed with Freesurfer based on the Desikan-Killiany atlas, which generated surface-based measures of cortical thickness and surface area. Groups were compared using a GLM. Correction for multiple comparisons was done by utilizing the Monte Carlo Null-Z simulation with vertex-wise cluster threshold of 1.3.

**Results:** The patient and control groups did not differ by age or education. Relative to the healthy controls, the breast cancer patients had a smaller surface area in the left fusiform gyrus

(patient mean = 4782.17mm<sup>2</sup>, SD = 69.86; control mean = 3028.34mm<sup>2</sup>, SD = 56.02; p=0.003) and left middle temporal gyrus (patient mean = 2925.79mm<sup>2</sup>, SD = 70.96; control mean = 2998.28mm<sup>2</sup>, SD = 63.88; p=0.001). Breast cancer patients had an increased cortical thickness in the left lateral occipital cortex (patient mean = 2.42 mm, SD = 0.03; control mean = 2.33mm, SD = 0.03; p=0.008) and right pericalcarine cortex (patient mean = 1.91mm, SD = 0.04; control mean = 1.85mm, SD = 0.03; p=0.006) in comparison to healthy controls.

**Conclusions:** This study found differences in morphological measures in breast cancer patients undergoing hormone therapy in comparison to healthy controls. Our findings are intriguing. Studies of patients receiving hormone therapy for menopause have shown temporal and occipital lobe abnormalities. It has been suggested that inhibition of estrogen's trophic effect in certain areas of the cortical brain tissue could lead to decreases in cortical surface area. One explanation for increased cortical thickness in the patient group is it represents an active disease-related inflammatory process. Understanding the ways in which hormone therapy affects the structure of the brain in patients with breast cancer is important in the development of treatments aimed at improving the quality of life for patients.

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**Keywords:** neuroimaging: structural, breast cancer, hormones

#### **F. JEBAHI, S. SHARMA, J. E. BLOSS, H. H. WRIGHT. Effects of Tamoxifen on Cognition and Language in Women with Breast Cancer: A Systematic Review.**

**Objective:** The purpose of the current systematic review is to (a) provide an update on the effects of tamoxifen on cognitive functions in women with breast cancer, (b) describe the language changes in women treated for breast cancer with tamoxifen, and (c) discuss potential roles of speech-language pathologists in the management of the aforementioned domains in women with breast cancer treated with tamoxifen.

#### **Methods:**

##### *Search strategy*

In June 2020, a thorough search was completed on PubMed, Cochrane CENTRAL, Cumulative Index to Nursing and Allied Health (CINAHL), PsycINFO, Scopus, EMBASE, and Grey Literature Database. Four main concepts were combined in the search: breast cancer, tamoxifen, cognition, and language.

##### *Screening and eligibility*

All studies were uploaded into Covidence software. Two reviewers independently screened titles and abstracts against the selection criteria. Full texts of articles were obtained for studies that met the inclusion criteria or where abstracts were not sufficient to determine eligibility. The full-text articles were then independently reviewed by two reviewers and the conflicts were resolved by the third reviewer. Studies were included in the final analyses if they met the following criteria: (1) included women with a breast cancer diagnosis; (2) used tamoxifen for the treatment of breast cancer without prior history of exposure to chemotherapy; (3) used objective measures for testing cognitive and/or language functions; (4) were written in English; and (5) were published during or after 2015 for the analysis of cognitive functions. The inter-rater agreement for title/abstract and full-text screening was 96% and 85% respectively.

##### *Data extraction*

Data extraction was performed by two authors (FJ and SS) independently using Microsoft Excel spreadsheets. After the screening process, data pertaining to the following information were

extracted: study design; sample size; and participants' demographic and relevant medical information including age, breast cancer treatment, and duration of treatment; cognitive tests used; language tests used; and study results concerning cognitive and language functions.

**Results:** The database search identified 13,484 studies after the removal of duplicates. A total of 13,408 articles were excluded after the title/abstract screening because they did not meet the inclusion criteria. Therefore, 76 articles were used for full-text screening, and a total of 14 studies were included in this review. Preliminary analyses from the studies included in this review suggest that tamoxifen is associated with negative outcomes in specific cognitive domains such as verbal abilities and working memory. Additionally, while language has not been extensively studied in women taking tamoxifen for breast cancer and thus conclusions cannot be derived, verbal abilities and some language domains have been documented to be deficient in this population. Further investigation of language changes is therefore needed.

**Conclusions:** The final results of this review will help advance our understanding of the trajectories of cognitive and language changes during tamoxifen treatment. Insight into these changes will be impactful because behavioral treatment may thus be accordingly warranted, setting the ground to advance and further the management and care provided to this population.

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**Keywords:** cognitive functioning, language, breast cancer

### **R. HANTLA, J. POWELL. A Case Series and Conversation Regarding the Integration of Psychosocial Support After a Brain Tumor Diagnosis.**

**Objective:** The Central Brain Tumor Registry of the United States reports 392,982 incidences of malignant and non-malignant brain tumors between 2011 and 2015. A recent meta-analysis, completed in 2017 by Huang and associates, revealed a 21.7% prevalence rate of depressive symptoms in individuals with a brain tumor diagnosis. Hence, the rate of depression in those with a brain tumor diagnosis is substantially higher than the estimated 4-8% prevalence rate in the general population as outlined in the DSM-5. Research has consistently demonstrated better outcomes in the treatment of cancer when emotional and mental healthcare is provided; therefore, it is the researcher's belief that each patient and their caregiver should have access to these evidence-based practices. Evidently, many patients are unaware of available mental health resources as this is not typically addressed with their medical treatment team. The purpose of this case series is to present preliminary data collected regarding the recommendation of mental health services to patients and their caregivers after diagnosis.

**Participants and Methods:** Participants in this study have been surveyed to determine a.) the presence or absence of dialogue with their medical team regarding mental health and b.) the availability of appropriate mental health services for their needs. Additional demographic and brief medical history has also been collected through the survey. Participants include those currently undergoing brain tumor treatments, survivors of brain tumors, and caregivers. Participants were recruited and continue to be recruited through Facebook community groups and online brain tumor support groups.

**Results:** For this case series we are including the initial 14 responses as we continue to recruit participants. Data within this initial case series shows that of these 14 participants only two, or about 14%, were recommended to pursue mental health treatment by a physician or medical professional after the diagnosis of a brain tumor. Additionally, both participants were able to utilize mental health services and indicated they were "helpful" or "extremely helpful". Of the

remaining 12 participants that were not recommended to mental healthcare six, or 50%, indicated mental health services would have been “helpful” or “extremely helpful” and the most common barrier to treatment was the “appropriateness of therapist for their needs”. Additionally, of the nine participants that chose to indicate the point at which mental health services would have been most useful, six or about 70%, indicated these services would have been most useful after the completion of brain tumor treatment. These results will be presented in numerical and table format, highlighting the presence and absence of mental health service discussions and utilization, along with demographic information.

**Conclusions:** The most obvious limitation to this case series is the small sample size to date; however, this series represents the beginning of an important conversation about the presence, or absence, of psychosocial support for individuals with a brain tumor diagnosis. Therefore, the ultimate goal of this project is to emphasize ways in which the treatment of brain tumors can be improved through an integrated approach as individuals traverse through a difficult medical diagnosis.

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**Keywords:** brain tumor, depression

### **S. SHARMA, F. JEBABI, H. H. WRIGHT. Tamoxifen effects on Cognition and Language in women with Breast cancer.**

**Objective:** To study the trajectory of cognitive and language changes during early period of adjuvant endocrine treatment (tamoxifen) in women with breast cancer (BC) at two time periods (pre-treatment and two months after treatment begins).

**Participants and methods:** Data from five women with BC and ten cognitively healthy age-matched controls were collected. The inclusion criteria for BC group were: (1) women newly diagnosed with BC with estrogen receptor positive (ER+) tumors; (2) no prior history of chemotherapy; and (3) negative history of other cancers (except basal cell carcinoma), neurological disorders (i.e., dementia, stroke, Parkinson’s), moderate or severe head trauma, and/or psychiatric disorders. The control group included women who were age-, education-, and race/ethnicity-matched to the participants in the BC group and had negative histories for cancer (except basal cell carcinoma), neurological disorders, moderate or severe head trauma, and/or psychiatric disorder.

*Cognitive assessment:* Ecological momentary assessment (EMA) method was used to assess fatigue, sleep, and/or pain in BC participants and assess cognitive health for both the groups longitudinally. Cognitive testing was done using ambulatory cognitive assessments via smart phones. A measurement-burst design that included multiple measurements during a short time-period (i.e., 5 days), repeated at two time periods, was applied. These included: pre-adjuvant endocrine treatment and ideally pre-surgery and/or radiation treatment (Period 1) and two months after beginning treatment (Period 2). Participants completed three cognitive tasks – symbol search, dot memory, and colored dots and the cognitive constructs measured were *processing speed* and *working memory*. Response times were recorded in milliseconds. Each task was completed within one minute or less.

*Language assessment:* Two wordless picture books - *Good Dog Carl (GDC)* and *Picnic* were used to collect discourse samples from study participants. Participants viewed the book and narrated the story. Core lexicon analyses were used to assess the discourse samples. The core lexicons for *GDC* and *Picnic* were created by determining the 25 most frequently used words

produced for nouns, verbs, adjectives, and adverbs for 10-year age cohorts. Core lexicon lists are derived from language samples collected from 470 cognitively healthy participants (273 females, 197 males) ranging in age from 20 to 89 years – these core lexicons serve as the normative data for the measure. The dependent variable is percent agreement, calculated by dividing the number of agreements by the total number of core lexical items on each list.

**Results:** Preliminary analyses showed cognitive variability across all three EMA tasks for the BC group. Processing speed responses were slower for women with BC as compared to the control group for Period 2. Significant differences were not seen in the language for both the groups post-treatment ( $p=0.075$ ). Further analyses need to be done to study the trajectory of cognitive and linguistic changes in women with BC.

**Conclusions:** This study will advance our understanding of trajectories of cognitive and language changes during the initial course of adjuvant endocrine treatment for breast cancer.

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**Keywords:** breast cancer, cognitive functioning, language

#### **D. RACHES, H. M. CONKLIN. Investigating Severity of Symptoms Associated with Posterior Fossa Syndrome as Predictors of Long-Term Cognitive and Functional Outcomes: A Case Series.**

**Objective:** Posterior fossa syndrome (PFS) is characterized by speech/language changes, motor impairments, and emotional lability following cerebellar injury, often after posterior fossa tumor resection. Medulloblastoma is the most common malignant pediatric brain tumor and up to 29% of medulloblastoma patients experience postoperative PFS.

There has been disagreement regarding diagnostic criteria and measurement of severity among clinicians and researchers working with individuals with PFS. Some aspects of postoperative functioning have been associated with poorer long-term functional outcomes including history of clinician rated PFS, movement disorder, greater ataxia, and longer duration of initial deficits (i.e., mutism, ataxia, hypotonia, and irritability).

However, existing literature has inspected the influence of these variables only before and after treatment, without assessment across the course of treatment. The functional limitations of those with PFS also often precludes their participation in planned baseline testing. We review the history and assessment of two patients with PFS matched on variables previously associated with poorer long-term cognitive functioning. Patients were followed longitudinally with serial cognitive assessments across the course of treatment and for two years following diagnosis to explore factors contributing to differential long-term cognitive functioning.

**Participants and Methods:** Participants are two girls from intact families diagnosed with medulloblastoma and post-surgical PFS with mutism. They were matched for age at diagnosis (6 years), grade (kindergarten), disease factors (non-WNT/non-SHH molecular subgroup with leptomeningeal metastases), treatment (surgical resection, post-surgical craniospinal radiation therapy [36Gy] with tumor-bed boosts [54Gy, RT], and post-irradiation 7 courses of chemotherapy), and medical complications (cranial nerve deficits, grade-III ataxia, and bilateral hearing loss with hearing aids provided). Notably, they differed in duration of mutism (28 vs. 88 days). Both were evaluated cognitively as part of clinical standard of care for patients within our institution with PFS. Assessments occur at transitions between aspects of cancer-directed treatment including evaluations before RT, pre/post chemotherapy, 1 year after initial diagnosis, and 2 years after diagnosis. The Cognitive and Linguistic Scale (CALS) was used to assess

abilities throughout treatment. Standardized measures of cognitive, academic, motor, language, and behavioral/adaptive functioning were utilized following completion of treatment.

**Results:** Longer duration of mutism was associated with lower CALS scores before start of RT, which persisted at the pre-chemotherapy, and post-chemotherapy assessment points. Post-chemotherapy evaluations indicated similar verbal/visual reasoning, attention span and working memory for both participants. Longer duration of mutism was associated with weaker reading, math, and graphomotor speed/precision. Performance was similar for each patient at the 1 and 2 years post-diagnosis evaluations. Both had average or stronger verbal skills, compared to low average to average visual reasoning and visuomotor integration. Both had impaired fine-motor coordination. Longer duration of mutism continued to be associated with weaker reading, math, and graphomotor speed/precision.

**Conclusions:** It is well known that medulloblastoma survivors are at risk for significant cognitive late effects given tumor mass effect and aggressive treatment. The severity of PFS may predict long-term cognitive and motor outcomes more so than other well-established disease- and treatment-related factors, thus guiding surgical planning and caregiver education. Duration of mutism in particular may have important predictive value.

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**Keywords:** cancer, pediatric neuropsychology, cerebellum

### **L. K. THIBODAU, D. BREIGER. Cognitive Functioning in Pediatric Brain Tumor Survivors with Hearing Loss.**

**Objective:** Brain tumors are the most commonly occurring cancer in children ages 0-14. Treatment for brain tumors depends on the type and location of tumor. Available treatment options include surgical resection, chemotherapy, and cranial irradiation. These treatments, although life-saving, are associated with neurocognitive side effects. Specifically, platin-based chemotherapies are associated with sensorineural hearing loss (HL). A recent study examined the effect of HL on cognitive functioning. Findings indicated that patients with HL obtained lower scores on measures of cognitive functioning compared to their hearing peers. The recent study did not indicate whether patients were prescribed or wore hearing aids. Therefore, this study aims to examine scores on a measure of cognitive functioning across patients with and without HL. To extend the literature, this study will examine differences in scores for patients with HL who wore hearing aids and those that did not.

**Participants and method:** Data were obtained from an outpatient neuropsychology clinic. Data were collected for 33 patients (18 males and 15 females). Patients were evaluated approximately 4 years after brain tumor treatment completion. The patients within the sample included 10 patients with HL. All patients utilized spoken oral language as their primary communication modality. The Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II) was used to measure cognitive functioning. Demographic information was obtained via patients' medical records. Hearing aid use was documented on a test summary score sheet. Differences were examined via a t-test and ANCOVAs.

**Results:** Results indicated that scores obtained on the WASI-II were significantly different between patients with HL and hearing patients. Results were significant for the full scale IQ  $t(27) = 3.220$ ,  $p = 0.003$ , Verbal Comprehension Index  $t(26) = 2.374$ ,  $p = 0.025$ , and Perceptual Reasoning Index  $t(26) = 2.627$ ,  $p = 0.014$ . Results of the ANCOVAs did not indicate significant differences based on hearing aid use.

**Conclusions:** The findings of this study are consistent with recent research that has demonstrated within the pediatric brain tumor population, patients who have HL perform lower on measures of cognitive functioning compared to their hearing peers. The results of this study did not indicate that there was a difference for patients who utilized hearing aids and those that did not. However, this study did not examine the length of time between HL onset and receiving hearing aids or document patient hearing aid use in other settings. Research involving patients with HL often includes low sample sizes, and the additional inclusion criteria of a pediatric brain tumor led to a low sample size. It will be beneficial for future research to examine a larger sample of pediatric brain tumor patients with HL and include patients who use different communication modalities. It will also be beneficial to control for premorbid functioning to determine if access to information is impacting the scores on measures of cognitive functioning. If access is impacting these patients' scores, it will be important to ensure access to information at the earlier stages of brain tumor treatment to mitigate poor outcomes.

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**Keywords:** cognitive functioning, brain tumor

**E. A. WARREN, K. P. RAGHUBAR, C. F. STAFFORD, L. S. KAHALLEY. Verbal Memory Predicts Peer Relations in Pediatric Brain Tumor Survivors.**

**Objective:** While pediatric brain tumor survivors are at risk for cognitive deficits and poor social outcomes, little is known about cognitive predictors of social adjustment in this population. Further, the degree to which proton beam radiation therapy (PBRT) might spare cognitive function and reduce the risk of long-term social deficits relative to photon radiation therapy (XRT) remains unknown. We hypothesized that survivors treated with PBRT would exhibit better cognitive outcomes, in turn predicting better social functioning.

**Participants and Methods:** Survivors ( $n = 58$ ) who underwent PBRT ( $n = 38$ ) or XRT ( $n = 20$ ) completed cognitive evaluation > 1 year after radiation. Group differences in cognitive and social functioning were assessed using analysis of covariance (ANCOVA). Cognitive, demographic, and clinical variables were examined as predictors of primary social outcomes (BASC-2 Social Skills, Conners Peer Relations) using multiple linear regression. Further, the percentage of survivors rated as having impaired social outcomes ( $\leq -1.5$  SD) relative to normative expectations was assessed using chi-square analyses.

**Results:** PBRT and XRT groups did not differ with respect to sex, age at follow-up, or total radiation dose (all  $p > 0.05$ ). However, the PBRT group was older at diagnosis (PBRT  $M = 7.6$  years, XRT  $M = 5.0$  years) and had a shorter time since radiation interval (PBRT  $M = 4.6$  years, XRT  $M = 8.7$  years). The PBRT and XRT groups did not significantly differ on parent ratings of peer relations ( $p = 0.81$ ) or social skills ( $p = 0.85$ ); thus, the sample was not subdivided by RT group in subsequent modeling. Multiple linear regression identified verbal memory as a significant predictor of peer relations ( $\beta = -4.11$ ,  $p = 0.05$ ), while no cognitive variables significantly predicted social skills. The percentage of survivors meeting criteria for social impairment in peer relations (27.6%) exceeded expectation (6.68%).

**Conclusions:** Findings suggest social outcomes in survivorship may not differ as a result of radiation modality. Still, as a group, survivors are at risk for problems with peer relationships relative to same-age peers. Cognitive weaknesses may partially account for survivor social difficulties, with verbal memory emerging as a predictor of parent-rated survivor peer relations.

Results support the need for continued careful monitoring of social and cognitive functioning among pediatric brain tumor survivors.

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**Keywords:** pediatric neuropsychology, brain tumor

### **N. GABEL, S. IQBAL. Sex Differences in Cognition and Associations with Quality of Life in Patients with Brain Tumors.**

**Objective:** Brain tumors impact health-related quality of life (HRQOL; Gabel et al, 2019), but little is known about individual factors, such as sex, that may explain differences in HRQOL and cognitive functioning in these patients. For example, compared to men, women have been found to have worse HRQOL after stroke (Gall et al 2018), and onset of Parkinson's disease (Abraham et al 2019). The purpose of this project is to determine whether HRQOL and cognitive functioning in patients with brain tumors are impacted differently based on sex, and how self-report of HRQOL is related to objective cognitive performance.

**Participants And Methods:** Participants were 106 consecutively referred adult patients (ages 18-85) with brain tumors treated in a multidisciplinary neurosurgery clinic (49 women, 57 men). HRQOL was assessed via several self-report surveys (National Institute of Health Patient Reported Outcomes Measurement Information System, "PROMIS"; and the Quality of Life in Neurological Disorders; "NEURO-QOL"). Cognitive functioning was assessed using objective tests of memory, attention, processing speed, visual spatial skills, and executive functioning (Repeatable Battery for the Assessment of Neuropsychological Status, "RBANS"; and Trail Making Test).

**Results:** Using ANOVA, no significant group differences were found in HRQOL between women and men. Women performed better than men on a test of recall memory ( $M = -1.93$  vs.  $M = -2.27$  ( $p < .05$ )). Self-reported fatigue was associated with worse performance on a test of attention (RBANS digit span;  $r = -0.29$ ,  $p < .05$ ), and although self-reported fatigue and self-reported sleep disturbance were correlated ( $r = 0.25$   $p < .05$ ) there was no significant relationship between sleep disturbance and attention. Performance on a test of executive functioning (Trails B) was associated with self-reported ability to participate in social roles and activities ( $r = 0.82$ ,  $p < .05$ ).

**Conclusions:** Brain tumors affect a broad range of aspects of daily life, from participation in social roles and activities, to cognitive performance. We found that women and men with brain tumors endorse problems with HRQOL in a similar way. We also found that self-reported fatigue is associated with worse attention performance, and that worse executive functioning is associated with problems engaging in social roles and activities. Understanding these relationships can improve treatment planning for people with brain tumors and can assist in focusing future research on factors that are important to HRQOL for these patients.

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**Keywords:** brain tumor, cognitive functioning, quality of life

**I. M. OLSTHOORN, M. U. BAIG, R. S. ROBERT, G. YANG, W. ZAKY, P. L. STAVINOHA. Neurocognitive Outcome and its Relationship with Social Engagement in a Mixed Sample of Pediatric Brain Tumor Survivors.**

**Objective:** Pediatric brain tumor (PBT) survivors experience a range of late effects, including social difficulties. Previous studies found parent-rated attention problems associated with greater social difficulty in pediatric cancer survivors, as well as in a homogenous sample of medulloblastoma survivors. The purpose of the current study was to assess the relationship between objective cognitive measures and social functioning in a mixed group of PBT survivors.

**Participants and Methods:** Charts of 85 PBT survivors who underwent neuropsychological testing were retrospectively reviewed. All participants were between 6:4 and 18:9 years-old (76-225 months;  $M = 150.53$ ,  $SD = 37.41$ ) and completed treatment 0:5 to 15:2 years (5-182 months;  $M = 41.88$ ,  $SD = 35.27$ ) prior to their evaluation. Social competence, attention problems, and sluggish cognitive tempo were measured with the Child Behavior Checklist. The selected objective cognitive measures assessed cognitive ability (Wechsler General Ability Index), processing speed (Processing Speed Index), simple attention (Digit Span Forward), and working memory (Digit Span Backward). The Conner's Continuous Performance Test (CPT) was used to assess aspects of sustained attention, including omission errors, commission errors, reaction time, variability in reaction time, and detectability. Correlations were computed between social competence and all cognitive variables.

**Results:** Our study conforms with previous literature, showing greater parent-reported attention problems associating with lower levels of PBT survivor social competence ( $r = -.52$ ,  $p < .001$ ). Additionally, greater levels of parent-rated sluggish cognitive tempo associated with poorer ratings of social competence ( $r = -.37$ ,  $p < .001$ ). Social competence was positively associated with cognitive ability ( $r = .38$ ,  $p < .001$ ) and working memory ( $r = .19$ ,  $p < .05$ ). No significant association was observed for direct/objective measures of processing speed, simple attention, or aspects of sustained attention.

**Conclusions:** Results suggest a relationship between aspects of cognitive functioning vulnerable in PBT survivors and social engagement. Specifically, aspects of attention and working memory, as well as cognitive tempo, are associated with less social involvement. These findings suggest that cognitive vulnerabilities may contribute to the social difficulties experienced by PBT survivors. This has significant implications for intervention and management, as addressing social dysfunction in PBT survivors without consideration of cognitive contributors may not be optimally effective. Instead, a multidimensional approach considering and compensating for cognitive contributors may better improve outcomes. Future research is warranted to draw definitive conclusions about the causal direction of the relationship between social competence and cognitive functioning in this population. Understanding the nature of social difficulties in this group can help inform how to optimally identify and address these deficits.

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**Keywords:** cognitive, social processes, pediatric neuropsychology

**I. M. OLSTHOORN, G. YANG, P. L. STAVINOHA. Sleep Disturbance as a Predictor of Cognitive Functioning in a Mixed Sample of Pediatric Brain Tumor Survivors.**

**Objective:** Cognitive impairments in pediatric brain tumor (PBT) survivors are common and contribute to a reduced health-related quality of life. In addition to tumor- and treatment-related causes, it has been suggested that higher levels of sleep problems in PBT survivors are associated with cognitive dysfunction as well. However, there is a paucity of research addressing this topic and previous studies have yielded mixed results. One study found poorer sleep associated with worse parent-rated executive functioning in a mixed sample of PBT survivors, while other researchers observed no significant association between excessive daytime sleepiness and objective measures of sustained attention in children diagnosed with craniopharyngioma. The purpose of the current study was to assess the relationship between sleep disturbance and a broader range of cognitive domains in a mixed sample of PBT survivors.

**Participants and Methods:** Charts of 83 PBT survivors were retrospectively reviewed. All participants were between 6:4 and 18:9 years-old (76-225 months;  $M = 149.77$ ,  $SD = 37.41$ ) and completed treatment 0:5 to 15:2 years (5-182 months;  $M = 42.33$ ,  $SD = 35.54$ ) prior to their evaluation. Sleep disturbance, attention problems, and sluggish cognitive tempo were assessed with the parent-rated Child Behavior Checklist (CBCL). The sleep measure was based on a validated sleep composite comprised of 6 CBCL items reflecting various sleep disturbances. This factor has been shown to be sensitive to sleep problems in prior research with other pediatric populations. The selected objective cognitive measures assessed processing speed (Wechsler Processing Speed Index), simple attention (Digit Span Forward), and working memory (Digit Span Backward). The Conner's Continuous Performance Test (CPT) was used to evaluate aspects of attention, including omission errors, commission errors, reaction time, variability in reaction time, and detectability. Multiple linear regression analyses were performed to determine the extent to which sleep disturbances predict cognitive functioning after controlling for cognitive ability (General Ability Index).

**Results:** A higher overall level of sleep disturbance predicted higher parent-ratings of sluggish cognitive tempo ( $R^2_{Adjusted} = .40$ ,  $p < .001$ ) and attention problems ( $R^2_{Adjusted} = .32$ ,  $p < .001$ ). However, sleep disturbance did not significantly predict performance on objective cognitive measures.

**Conclusions:** Results suggest a higher level of sleep disturbance predicts aspects of attention problems and psychomotor slowing. These findings indicate disrupted sleep may contribute to the cognitive difficulties experienced by PBT survivors. Overall, sleep problems predicted parent-rated cognitive complaints rather than performance on objective measures. One explanation of these findings is that subjective and objective measures may tap into different aspects of the assessed constructs. Specifically, sleep in this population may affect typical performance in daily life – such as by impacting effort on activities – rather than causing impaired optimal performance as demonstrated on objective tasks. Future research is warranted to determine whether sleep is causally related to cognitive difficulties in this population. Additionally, objective measures of sleep can assist in excluding rater bias as an explanation of these findings. Understanding the nature of the relationship between sleep and cognition in PBT survivors can assist in optimizing assessment and treatment aimed at maximizing quality of life.

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**Keywords:** cognitive, sleep, pediatric neuropsychology

**H. WEISMAN, C. M. SHARKEY, K. WALSH, K. K. HARDY. Externalizing Problems and Working Memory: Comparing Pediatric Cancer Survivors and Children with Neurodevelopmental ADHD.**

**Objective:** Pediatric cancer survivors have increased risk for both cognitive and psychological late effects, including impairments in attention and working memory, and elevated internalizing and externalizing symptoms. Yet, there is limited data illustrating the relationship between these different outcomes. Even less is known about externalizing symptoms among pediatric cancer survivors, despite the well-documented comorbidity between externalizing symptoms and neurodevelopmental ADHD. Thus, the current study aimed to examine the relationship between externalizing problems and working memory and compare this relationship between (1) pediatric cancer survivors, (2) pediatric cancer survivors with attention difficulties, and (3) youth with neurodevelopmental ADHD.

**Participant and Methods:** Neuropsychological data were abstracted from clinically referred pediatric cancer survivors ( $n = 310$ ,  $M$  age = 11.41 y, 50.6% male), pediatric cancer survivors with clinically significant attention difficulties ( $n = 78$ ,  $M$  age = 11.46 y, 67.9% male), and children with ADHD ( $n = 178$ ,  $M$  age = 11.1 y, 64.0% male). Data consist of a battery of parent- and teacher-report questionnaires (e.g., CBCL, BRIEF) and performance-based neuropsychological measures (e.g., WISC, TOL).

**Results:** Youth with cancer only had significantly lower externalizing and working memory problems, per parent and teacher report ( $p < 0.001$ ). Youth with cancer and attention difficulties and youth with neurodevelopmental ADHD did not differ. Parent-teacher concordance on externalizing problems and working memory varied between groups. Parent-reported externalizing symptoms was associated with parent-reported working memory problems ( $F(5,390) = 44.90$ ,  $p < 0.001$ ,  $R^2 = .37$ ), and this relationship was moderated by diagnostic category, with a stronger relationship for those with cancer only. The same relationship was observed for teacher-reported externalizing symptoms and working memory problems ( $F(5,292) = 21.36$ ,  $p < 0.001$ ,  $R^2 = .27$ ). Neither parent- nor teacher-reported externalizing problems were associated with performance-based measures of working memory.

**Conclusions:** Pediatric cancer survivors with attention difficulties appear to have functional profiles that are similar to youth with neurodevelopmental ADHD. Externalizing problems are significantly related to informant-based, but not performance-based, working memory difficulties among a sample of youth with pediatric cancer, and neurodevelopmental ADHD. However, this relationship differs between groups, suggesting that externalizing problems may have a greater impact on neurocognitive outcomes among survivors who do not have documented attention difficulties. Screening for psychosocial difficulties, including externalizing problems, appears important for understanding the full profile of survivor late effects.

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**Keywords:** cancer, attention deficit hyperactivity disorder, working memory

**A. HANEDA, F. LAPITAN, M. LACY. Examining Comorbidities and Cognition in Older Adult's Pre-Stem Cell Transplant.**

**Objective:** Extensive research has documented cognitive deficits in young adults with hematological disorders prior to stem cell transplant. At present there is little research involving

older adults with hematological cancer despite the call for inclusion and the fact that they are most vulnerable to cognitive decline. Specifically, older oncology patients are cognitively vulnerable due to the high prevalence of medical comorbidities and related independent impact on cognition (Murad et al., 2015). Notably, the prognosis for older patients diagnosed with hematological disorders is poorer when combined with medical comorbidities (Klepin, 2013). Due to the importance of intact memory functioning for older adults in maintaining a high quality of life (Castel et al., 2007, Pandeirada, J.N.S, 2014, Woods et al., 2015), this study aimed to assess the differential roles of medical comorbidities on memory in a sample of older adults with hematological disorders.

**Participants and Methods:** This retrospective study examined memory performances of older adults (>60) referred for neuropsychological evaluation by their oncologist as part of a pre stem-cell transplantation care plan. Memory was assessed with the Hopkins Verbal Learning Test-Revised (HVLT-R) with impairment defined by a z-score of -1.5 below the mean. Medical comorbidities were gleaned from a review of the neuropsychological report and medical records. These included cerebrovascular disease, diabetes, hypertension, and hyperlipidemia. A regression analysis will be used to examine the relationship between medical comorbidity and memory impairment.

**Results:** 93 consecutive evaluations (58 male; 35 female) were reviewed with a mean sample age of  $66 \pm 4$  years, with a mean average estimated intellect. Examination of the delayed recall trial revealed that twenty-nine percent of participants displayed impaired verbal memory. Cerebrovascular disease seen in 88 patients (94.6%), diabetes in 74 patients (79.6%), hypertension in 50 patients (63.8%), and hyperlipidemia in 63 (67.7%). Cerebrovascular disease ( $p=0.741$ ), diabetes ( $p=0.516$ ), and hypertension ( $p=0.348$ ) did not significantly predict impaired verbal memory performance. Notably, hyperlipidemia ( $p=0.054$ ) was found to be a weak but significant predictor for verbal memory impairment.

**Conclusions:** The current study examined memory functioning in the largest cohort of older adults with hematological conditions pre-stem cell transplant. Approximately 1 in 3 participants displayed short term memory impairment grossly similar to rates documented amongst younger cohorts. Regression analysis indicated that vascular comorbidities were not a predictor of memory impairment, albeit there was a trend towards hyperlipidemia playing a role. As such, chemotherapy or underlying cancer appears to account for memory impairment more than comorbidities in older adults.

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**Keywords:** cancer

**J. ALI, J. BASS, F. WANG, H. PAN, J. M. ASHFORD, N. JURBERGS, N. SALMAN, T. E. MERCHANT, H. M. CONKLIN. The Impact of Hearing Loss on Cognitive Outcomes among Children Treated with Radiation Therapy for Ependymoma.**

**Objectives:** Sensorineural hearing loss (SNHL) is a common adverse effect among children treated for brain tumors. Treatment with platinum-based chemotherapy, younger age at treatment, and infratentorial tumor location increase SNHL risk. The risk and severity of SNHL also increases with greater radiation dose to the temporal bone. Children who experience severe SNHL after treatment with both craniospinal radiation therapy (RT) and chemotherapy for medulloblastoma demonstrate greater difficulties with reading-based skills, working memory, and processing speed. However, neurocognitive and academic functioning among children for

whom RT is the primary SNHL risk has received limited attention. Ependymoma is often diagnosed in very young children with predominantly infratentorial tumor location and RT as preferred treatment modality. Accordingly, this study investigated neurocognitive outcomes as a function of SNHL among children treated for ependymoma with RT.

**Participants and Methods:** Prospective, serial, neurocognitive, and audiology assessments were conducted with 145 children diagnosed with ependymoma and enrolled on a Phase II trial of conformal photon RT (53% female; 83% white; mean age at RT= 5.04 ± 4.47 years). Neurocognitive testing included intellectual functioning (Wechsler Estimated IQ [EIQ] and Full Scale IQ [FSIQ]), reading skills (WIAT), verbal learning (CVLT), parent ratings of internalizing problems (CBCL) and communication (VABS), and socioeconomic status (SES). SNHL was dichotomized as normal/mild-to-moderate or severe (Chang grade <2b vs. ≥2b). For these analyses we focused on severe SNHL in either ear (n = 48) and only included participants who had one or more neurocognitive assessments, at least one year after hearing loss was detected.

**Results:** SNHL was not associated with gender, race or SES; however, severe SNHL was associated with presence of hydrocephalus (n= 97), less extensive surgical resection, greater number of surgeries, pre-RT chemotherapy (n= 30), and younger age at RT. Univariate linear mixed models revealed baseline (prior to RT) FSIQ, CVLT and VABS Communication were lower than normative expectations (p< .05), with a significant decline in FSIQ, EIQ, WIAT Reading, and VABS Communication over time. FSIQ and VABS Communication were worse among those children with severe SNHL across all time points (p< .05); whereas, EIQ showed a greater decline over time in those with severe SNHL (p< .0005). Multivariate linear mixed models including demographic and clinical variables that were significant in univariate models (i.e., age at RT, pre-RT chemotherapy, race, and SES), demonstrated severe SNHL remained associated with a greater decline in EIQ (p< .005).

**Conclusions:** Children with severe SNHL demonstrated worse intellectual functioning (FSIQ) and communication skills across assessment time points. Severe SNHL was associated with hydrocephalus, number of surgeries, pre-RT chemotherapy, and young age at RT, such that lower FSIQ and communication skills could reflect cognitive risk shared amongst these established risk factors. Surprisingly, a decline in EIQ, rather than reading skills, emerged among those with severe SNHL. This effect remained after accounting for demographic and clinical risk factors, which suggests increased risk related specifically to hearing loss. Severe SNHL following treatment for ependymoma, even if only in one ear, is a cognitive risk factor requiring monitoring and intervention.

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**Keywords:** pediatric neuropsychology, brain tumor, cancer

## **R. PETERSON, L. JACOBSON. Sluggish Cognitive Tempo in Survivors of Pediatric Brain Tumor Compared to ADHD-Inattentive Presentation.**

**Objective:** Neurocognitive late effects including inattention and slow processing speed have been reported in survivors of pediatric brain tumors (BT). Controversy exists regarding whether these late effects are similar to symptoms of Attention Deficit/Hyperactivity Disorder (ADHD) or Sluggish Cognitive Tempo (SCT). This study examined SCT symptoms in pediatric BT survivors compared to clinically-referred children who met diagnostic criteria for ADHD inattentive presentation (ADHD-I).

**Participants and Methods:** A sample of 308 children with caregiver-completed SCT ratings (154 BT; 154 ADHD-I), were matched on age [BT  $M=12.65$  years, ADHD  $M=12.63$  years] and sex (50% female).

**Results:** SCT total scores differed between groups [ $t(306)=9.73$ ,  $p<0.001$ ], with BT survivors showing fewer total symptoms (ADHD-I:  $M=1.60$ ,  $SD=0.60$ ; BT:  $M=0.92$ ,  $SD=0.64$ ). Diagnosis had a similar effect on SCT subscale scores, including lower sleepy/sluggish [ $F(1,306)=12.03$ ,  $p<0.001$ , partial  $\eta^2=0.04$ ], low initiation [ $F(1,306)=155.32$ ,  $p<0.001$ , partial  $\eta^2=0.34$ ], and daydreamy [ $F(1,306)=74.35$ ,  $p<0.001$ , partial  $\eta^2=0.20$ ] scores in BT survivors. Moreover, greatest differences between diagnoses were noted on items assessing time to complete assignments (ADHD-I:  $M=2.51$ , BT:  $M=1.44$ ) and effort fades quickly (ADHD-I:  $M=2.16$ , BT:  $M=0.99$ ). In addition, younger age [ $F(5,268)=20.73$ ,  $p<0.001$ ,  $R^2=0.28$ ], but not sex, race, or public/commercial insurance, were associated with greater total SCT symptoms (all  $p>0.05$ ).

**Conclusions:** Parents of children with ADHD-I report greater SCT symptoms than parents of pediatric BT survivors. Results suggest that BT survivors' symptoms of slowed processing appear different from those of children with ADHD-I. Additional research on SCT in BT survivors and its overlap with ADHD-I is warranted.

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**Keywords:** cancer, pediatric neuropsychology, attention deficit hyperactivity disorder

## **H. M. HASLER, J. L. KLOSKY, J. L. FLYNN, M. HUDSON, B. POTTER, L. JACOLA.** **NIH Toolbox for Cognitive Screening in Survivors of Childhood Cancer.**

**Objective:** To assess outcomes from a quality improvement initiative aimed at developing a process to screen children and young adult cancer survivors for cognitive late effects in the context of a follow-up visit to a multidisciplinary survivorship clinic.

**Participants and Methods:** Survivors completed the NIH Toolbox Cognition Battery (NIHTB-C) during follow-up in the St. Jude Children's Research Hospital After Completion of Therapy (ACT) Clinic. Survivors were at least 5 years post diagnosis and had completed all cancer-directed therapy. During the 20-month enrollment period, 335 survivors were screened with the age-appropriate NIHTB-C (Dimensional Change Card Sort, Picture Vocabulary, Flanker Inhibitory Control and Attention, List Sorting Working Memory, Pattern Comparison Processing Speed, Picture Sequence Memory, and Oral Reading Recognition). Screening failure was defined as a composite (Crystallized, Fluid, or Overall Cognitive) standard score  $\leq 1$  standard deviation (SD) below the normative mean or subtest score  $\leq 2$  SD below the mean. Results from the NIHTB-C were used in decision making regarding indications for follow-up cognitive testing.

**Results:** A total of 335 survivors (mean [SD] age at assessment= $15.3$  [ $5.9$ ] years; female= $52.2\%$ ) completed the NIHTB-C measures as part of this project. The majority of survivors were treated for hematologic malignancies, primarily leukemia and lymphoma (LE= $41.2\%$ ; mean [SD] age= $16.1$  [ $5.2$ ]; female= $54.3\%$ ), followed by solid tumors (ST= $31.9\%$ ; mean [SD] age= $12.6$  [ $5.9$ ]; female= $53.3\%$ ), and central nervous system tumors (CNS =  $26.9\%$ ; mean [SD] age= $17.3$  [ $5.9$ ]; female= $47.8\%$ ). Overall,  $33\%$  of survivors failed the screen, most commonly due to scores below the cutoff on the Overall Cognitive Composite ( $75.9\%$ ). The frequency of screening failures did not significantly differ by sex ( $\chi^2=.052$ ,  $p=.908$ ) or age at assessment ( $F(1,333)=.018$ ,  $p=.894$ ); however, there was a significant difference by diagnosis (LE= $27.5\%$ ; ST= $28.0\%$ ; CNS = $47.8\%$ ;  $\chi^2=11.92$ ,  $p=.003$ ). Of the 112 survivors who demonstrated difficulties on the NIHTB-C, 42 ( $33.9\%$ ) reported having current academic or

vocational accommodations, with no statistically significant difference by diagnosis (LE=50.0%; ST=78.9%; CNS=75.8%;  $\chi^2=5.83$   $p=.054$ ).

**Conclusions:** Survivors of childhood cancer are at risk for cognitive late effects following treatment, which can adversely affect quality of life and functional outcomes during adulthood. Traditional neuropsychology services are time- and resource-intensive and may not be appropriate for all survivors. Efficient screening methods are necessary to identify need for clinical follow-up to appropriately direct resources. Findings from this quality improvement initiative suggest potential utility of the NIHTB-C for use in a program aimed at screening for cognitive late effects in childhood cancer survivors. The reported rates of cognitive difficulties are largely consistent with the literature regarding the prevalence of difficulties in these populations; however, these results indicate a relatively high frequency of cognitive difficulties in patients with less CNS-directed therapy (i.e., ST). Future directions include investigating the clinical utility of the NIHTB-C by comparing screening results of patients who completed additional clinical assessment to diagnostic outcome and scores on follow-up in order to help establish the sensitivity and specificity of the NIHTB-C for detecting cognitive late effects and need for additional assessment.

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**Keywords:** cancer, cognitive screening, neuropsychological outcome

**M. D. MCCURDY, K. P. RAGHUBAR, K. CHRISTOPHER, H. STANCEL, C. F. STAFFORD, L. S. KAHALLEY. Executive Control and Emotional/Behavioral Functioning Partially Mediate the Effects of Tumor- and Treatment-Related Risk Factors on Psychosocial Health-Related Quality of Life in Survivors of Pediatric Brain Tumor.**

**Objective:** Survivors of pediatric brain tumor are at increased risk for experiencing neuropsychological impairments that adversely impact social adjustment and health-related quality of life (HRQoL). Tumor-directed treatments are a well-established risk factor for poor psychosocial HRQoL in this population, though aspects of social competence potentially underlying this relationship are less well understood. Using a developmental model of social competence (Yeates et al., 2007), the current study sought to establish the relationship between disease/treatment intensity and psychosocial HRQoL in this population, and evaluate if this relationship is mediated through executive control (EC) and emotional/behavioral functioning. We hypothesized that 1) greater disease/treatment intensity (Neurological Predictor Scale; NPS) would be associated with worse caregiver-reported psychosocial HRQoL (PedsQL), and 2) this relationship would be mediated by EC (D-KEFS) and emotional/behavioral functioning (BASC-2), sequentially.

**Participants and Methods:** The final sample (N=57) included pediatric brain tumor survivors (53% female) aged 8 to 20 years (M=14.10, SD=3.73) who were 3 to 8 years (M=4.80, SD=1.13) post-treatment. NPS scores were generated from medical and treatment data, with higher values reflecting greater cumulative exposure to neurological comorbidities and tumor-directed therapies. Scores across D-KEFS subscales (Number-Letter Switching, Color-Word Inhibition, Color-Word Inhibition/Switching) were averaged to form an EC Composite. Caregivers completed the BASC-2 to evaluate overall socioemotional functioning (Behavioral Symptoms Index) as well as emotional (Internalizing Problems Index) and behavioral (Externalizing Problems Index) functioning, independently. Psychosocial HRQoL was assessed by caregiver ratings on the PedsQL (Psychosocial Summary). Serial mediation analyses were used to evaluate

the indirect sequential effects of EC Composite performance ( $M_1$ ) and BASC-2 indices ( $M_2$ ) on the relationship between NPS scores ( $X$ ) and PedsQL ratings ( $Y$ ).

**Results:** The total effect of NPS scores on PedsQL Psychosocial Summary ratings was significant,  $b=-2.52$ ,  $p=.040$ , 95%CI [-4.92,-0.12], indicating greater disease/treatment intensity was associated with lower/worse psychosocial HRQoL. Higher NPS scores also predicted worse D-KEFS EC Composite performance,  $b=-0.54$ ,  $p=.006$ , 95%CI [-0.91,-0.16]. The full indirect pathway evaluating the effect of NPS scores on PedsQL Psychosocial Summary ratings via the D-KEFS EC Composite and the BASC-2 Behavioral Symptoms Index was significant,  $b=-1.29$ , 95%CI [-2.64,-0.34], as were the full indirect pathways for models that included the BASC-2 Externalizing Problems Index,  $b=-0.65$ , 95%CI [-1.41,-0.08], and Internalizing Problems Index,  $b=-0.77$ , 95%CI [-1.84,-0.05]. However, the total direct effect of NPS scores on PedsQL ratings remained significant for each model, suggesting EC and socioemotional/behavioral functioning only partially mediate this relationship.

**Conclusions:** Results of the present study suggest that cumulative exposure to tumor-directed treatments and neurological comorbidities is associated with reduced psychosocial HRQoL in survivors of pediatric brain tumor. This relationship may be partially mediated by survivors' EC, and secondarily, internalizing and externalizing behavioral functioning. That is, EC deficits may underlie emotional and behavioral difficulties which subsequently contributes to diminished psychosocial HRQoL in this population. Findings lend support to Yeates et al.'s theoretical model of social competence and indicate that EC and emotional/behavioral functioning may be appropriate targets for interventions designed to improve psychosocial HRQoL in survivors of pediatric brain tumor.

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**Keywords:** brain tumor, quality of life, executive functions

### **E. SEMMEL, T. QUADRI, T. Z. KING. Graph Theoretical Analysis of Brain Network Characteristics in Brain Tumor: A Review.**

**Objective:** Graph theory is a branch of mathematics that allows for the characterization of complex networks, which has rapidly grown in popularity in network neuroscience in recent years. It can be used to describe functional and structural networks using a variety of methodologies including MRI, EEG, and MEG. Based on these data, a variety of metrics describing the integration and segregation of networks can be calculated. Researchers have begun to use graph theory to describe the brain networks of individuals with brain tumors to shed light on the ways in which networks are disrupted in this population. While the body of research is in its infancy, this review aims to integrate the existing findings and make recommendations for future research. This systematic review summarizes the current literature on graph theoretical analysis in the brain tumor population with particular attention paid to treatment effects and other clinical factors.

**Participants and Methods:** This review was conducted in accordance with PRISMA guidelines. Included papers were published through June 24<sup>th</sup>, 2020. Searches were conducted on Pubmed, PsycInfo, and Web of Science using the search terms (*graph theory* OR *graph analysis*) AND (*brain tumor* OR *brain tumour* OR *brain neoplasm*) AND (*MRI* OR *EEG* OR *MEG*). Studies were eligible for inclusion if they: evaluated participants with a primary brain tumor; used graph theoretical analyses on structural and/or functional MRI data, MEG, or EEG; were in English; and were an original research study. Seventeen papers met

criteria for inclusion. Data of interest were extracted from each manuscript and analyzed qualitatively due to the variability in graph theory metrics that were reported. Studies were also systematically evaluated for quality based on predetermined criteria.

**Results:** Alterations in network properties are often found in the brain tumor population, although the directions of differences are inconsistent. For example, studies with comparable methodologies found both increased and decreased global efficiency. However, the most consistent findings suggest increased network segregation with higher neurological risk (i.e., tumor vs. healthy controls, higher- vs. lower-grade tumor, more neurotoxic treatment, etc.). Network alterations are most common in the context of more intense treatment, with tumor- or treatment-related disruption of hub regions, and with tumor-specific factors such as faster tumor growth.

**Conclusions:** The use of graph theory to study brain tumor patients is an emerging area of inquiry, though some conclusions can be drawn. Future studies should focus on treatment factors, changes over time, and correlations with functional outcomes to better identify those in need of early intervention. Additionally, in order to address the heterogeneity of the existing literature, efforts should be made to standardize methods and report a uniform set of metrics across manuscripts (including effect sizes) to increase the direct comparability of individual studies.

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**Keywords:** brain tumor, neuroimaging: functional, neuroimaging: structural

**S. M. BURSTEIN, S. F. ELYOUNSSI, M. PULSIFER, C. EVANS. Long Term Attention, Intelligence, and Processing Speed Outcomes Following Proton Radiation for Pediatric Brain Tumor Survivors.**

**Objective:** Approximately 4,600 children are diagnosed with brain tumors annually in the United States. Radiation is integral to treatment, yet pediatric patients fare poorly in neurocognitive domains, such as processing speed and aspects of executive functioning, following photon radiation (XRT). In particular, previous research has found lower attention scores for children treated with XRT for pediatric brain tumor when compared to the normative population. Compared to XRT, proton radiation (PBRT), enables better targeting of tumors and thus may entail fewer cognitive sequelae. Antonini et al. (2017) reported pediatric brain tumor survivors treated with craniospinal PBRT did not differ in attention performance but performed lower on aspects of processing speed than the normative population. The current study aimed to longitudinally investigate aspects of attention (including sustained attention and reported attention problems), in relation to intelligence (IQ) and processing speed (PSI) in a sample of children treated with PBRT for medulloblastoma.

**Participants and Methods:** The sample consisted of 23 patients diagnosed with medulloblastoma evaluated at PBRT initiation (baseline;  $M_{\text{age}}=13.12$ ,  $SD=4.04$ ) & follow-up ( $M_{\text{age}}=18.23$ ,  $SD=5.18$ ). All patients received surgical resection, craniospinal irradiation (CSI; 54 gray), and chemotherapy. 52% were male. 60% had hydrocephalus at diagnosis. The mean interval between baseline and follow-up was 5.07 years ( $SD=3.39$ ). Patients received a comprehensive neuropsychological test battery at each time point. The Conners' Continuous Performance Test (CPT-II), the Attention Problems scale on the Behavior Assessment for Children (BASC), and an age-appropriate Wechsler intelligence scale were used for the current

analyses. On the CPT-II, a Clinical Confidence Index below 50 indicates a non-clinical profile. Scores were analyzed using paired sample t-tests and bivariate correlations.

**Results:** There was not a significant difference in CPT Clinical Confidence Index scores at baseline ( $M=42.24$ ,  $SD=19.06$ ) and follow-up ( $M=45.63$ ,  $SD=20.39$ );  $t(22)=-.670$ ,  $p=.510$ . Mean scores were in the non-clinical range. All CPT subscales were stable from baseline to follow-up (Omissions:  $p=.974$ ; Reaction Time:  $p=.118$ ; Variability:  $p=.527$ ; Detectability:  $p=1.00$ ; Response Time:  $p=.329$ ; and Perseverations:  $p=.571$ ). There was not a significant difference in BASC Attention Problems scores at baseline ( $M=48.00$ ,  $SD=12.64$ ) and follow-up ( $M=48.56$ ,  $SD=12.41$ );  $t(17)=-.256$ ,  $p=.801$ . Mean scores were within the normal range. There was not a significant difference in Full Scale IQ at baseline ( $M=106.13$ ,  $SD=13.32$ ) and follow-up ( $M=103.70$ ,  $SD=13.02$ );  $t(22)=1.44$ ,  $p=.164$ . Mean scores were within the normal range. Processing speed was significantly lower at follow-up ( $M=86.19$ ,  $SD=2.42$ ), than at baseline ( $M=94.24$ ,  $SD=17.22$ ,  $t(22)=3.49$ ,  $p=.002$ ).

**Conclusions:** Approximately 5 years after PBRT initiation, attention (sustained performance and reported) and IQ were stable, on average, and remained within the average range or higher, a favorable outcome to XRT. Processing speed was significantly lower at follow-up, but CPT-II reaction time and response times were not significantly different. Current results are consistent with previous studies showing a decline in processing speed but no change in aspects of sustained attention several years following PBRT treatment. In conclusion, this study lends support to a growing body of literature demonstrating fewer negative neurocognitive sequelae associated with PBRT treatment for pediatric brain tumor.

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**Keywords:** attention, intelligence

### **J. A. CHIANG, A. SAAVEDRA, P. T. FEGHALI, A. M. WHITAKER. Insufficient Sleep Duration and Adaptive Functioning Deficits in Patients with Pediatric Brain Tumor.**

**Objective:** Patients with pediatric brain tumor (PBT) are at increased risk of sleep disturbances (both sleep initiation and maintenance) due to tumor location and treatment-related circadian rhythm disruption. It is well documented that adequate sleep is needed to function properly, yet despite poor adaptive functioning being a known late effect of pediatric cancer, the association between insufficient sleep and adaptive functioning deficits among patients with PBT has yet to be explored.

**Participants and Methods:** 185 patients with PBT (54% male) ages 1-23 ( $\bar{x}=11.9$  yrs;  $SD=5.1$  yrs) underwent neuropsychological evaluation, including assessment of adaptive functioning as measured by the *Adaptive Behavior Assessment System (ABAS)*: General Adaptive Composite (GAC;  $\bar{x}=100$ ;  $SD=15$ ), as well as report of subjective sleep concerns and sleep duration. Sleep duration was analyzed both alone and relative to well documented mean age-based recommendations.

**Results:** 21.6% of patients had reported sleep concerns. Sleep duration was on average one hour below age expectations ( $SD=1.4$  hrs), with younger age groups attaining relatively less sleep than recommended (toddler  $\bar{x}=3.2$  hrs below guidelines; preschooler  $\bar{x}=1.9$  hrs below; childhood  $\bar{x}=0.7$  hrs below; adolescent  $\bar{x}=1.0$  hrs below). Adaptive functioning was also lower than age-based normative data (GAC  $\bar{x}=86.3$ ;  $SD=17.8$ ). Sleep duration was correlated with GAC,  $r(86)=.23$ ,  $p<.05$ , particularly for patients with reported sleep concerns,  $r(18)=.55$ ,  $p<.01$ . Furthermore, post-hoc analyses revealed lower than expected scores across adaptive functioning

subdomains (Conceptual  $\bar{x}=88.4$ ,  $SD=17.2$ ; Social  $\bar{x}=91.4$ ,  $SD=16.4$ ; Practical  $\bar{x}=85.8$ ,  $SD=18.3$ ), as well as significant relationships between sleep duration and all three subdomains using false discovery rates: Conceptual,  $r(89)=.28$ ,  $p<.01$ ; Social,  $r(88)=.19$ ,  $p<.05$ ; Practical,  $r(89)=.23$ ,  $p<.05$ . Females' sleep duration was overall significantly higher than their male counterparts,  $F(1,176)= 5.15$ ,  $p<.05$ , yet despite different sleep durations based on sex, general adaptive functioning did not vary between males and females.

**Conclusions:** Results indicate insufficient sleep duration is prevalent among patients with PBT (particularly younger patients) and is associated with impairment across aspects of their adaptive functioning. Consistent with previous literature exploring sleep among typically developing children, females with PBT were found to sleep more than males with PBT; however, no significant differences were noted in adaptive functioning between sexes, with both groups performing below normative expectations. These findings suggest females with PBT may require more sleep to achieve similar levels of everyday functioning as their male counterparts. Given general neuropsychological outcomes in girls with childhood cancer are poorer as compared to boys, additional research is needed to better understand the above findings. Further exploration of the role sleep plays in adaptive functioning of patients with PBT beyond other contributing factors, as well as identification of protective factors, is also needed to establish a more comprehensive model and inform future directions.

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**Keywords:** brain tumor, adaptive functioning, sleep

### **J. A. CHIANG, P. T. FEGHALI, A. SAAVEDRA, A. M. WHITAKER. Sleep Disturbance and Executive Dysfunction in Patients with Pediatric Brain Tumor.**

**Objective:** Sufficient sleep is essential for cognitive development, with failure to achieve age-based recommendations for sleep duration resulting in negative consequences, especially for complex cognitive domains such as executive functioning (a group of higher order skills that matures throughout childhood, adolescence, and early adulthood). Sleep disturbances are common in childhood cancer (particularly among patients with pediatric brain tumor), and executive dysfunction is a well documented late effect of brain tumor and associated treatments. However, the nature of the relationship between sleep and executive functioning among children with brain tumor warrants additional study.

**Participants and Methods:** 165 patients with pediatric brain tumor (48.5% male) ages 2-21 ( $\bar{x}=12.02$  yrs;  $SD=4.84$  yrs) were administered the *Behavior Rating Inventory of Executive Function (BRIEF)*, a parent-report measure of executive functioning. Higher Global Executive Composite (GEC) T-scores ( $\bar{x}=50$ ;  $SD=10$ ) indicated increased general executive dysfunction. Sleep data were also collected from 139 of these patients and compared to well established age-based sleep guidelines to determine deviation from the current recommendations.

**Results:** Deviation from aged-based sleep guidelines predicted GEC,  $F(1,137)=4.36$ ,  $p<.05$ . Post-hoc analyses revealed the relationship between sleep deviation and GEC was better characterized by a curvilinear model [ $R^2$  change=.04,  $F(1, 136)=5.88$ ,  $p<.05$ ], with increased executive dysfunction predicted by too little or too much sleep and less concern noted for patients who attained recommended sleep duration,  $F(2,136)=5.20$ ,  $p<.01$ . Patients sleeping  $\geq 4$  hours,  $\geq 3$  hours, or  $\geq 2$  hours from recommended guidelines (in either direction) had mean GECs of  $T=67.0$ ,  $61.9$ , and  $55.2$ , respectively, whereas those within 2 hours of age-based sleep recommendations had a mean GEC of  $T=52.0$ . While radiation therapy predicted GEC,

$F(1,137)=8.33$ ,  $p<.01$ , hierarchical regression revealed the curvilinear model described above accounted for a significant amount of variance in GEC ( $R^2$  change=.053) above and beyond irradiation alone,  $F(2,135)=4.04$ ,  $p<.05$ .

**Conclusions:** Results revealed abnormal sleep duration is associated with executive dysfunction in children with brain tumor. Interestingly, a curvilinear model better characterizes this relationship such that patients whose sleep duration deviates from recommended guidelines in either direction (e.g., under sleeping or over sleeping) tend to demonstrate more executive dysfunction than those who attain the recommended number of hours of sleep based on age. Nonlinear associations between various aspects of sleep and generalized functioning throughout childhood are documented in recent literature; however, investigation of these relationships to date has primarily been limited to typically developing children. As such, future research focusing on better understanding the nature of these findings is warranted. Given known relationships between cancer treatments (e.g., radiation therapy), damage to white matter integrity, and executive functioning, further study of how sleep impacts these relationships (e.g., potentially exacerbating white matter damage vs. separately contributing to executive dysfunction) would also be beneficial.

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**Keywords:** brain tumor, executive functions, sleep

### **B. GIMBEL, E. OLSEN. Group and Individual Level Changes in Neuropsychological Functioning After Epilepsy Surgery in a Pediatric Sample.**

**Objective:** Prior research has demonstrated a pattern of improved overall cognitive abilities following focal resective surgery in some pediatric epilepsy samples. It is unclear if these changes represent clinically significant differences from baseline functioning and what component skills contribute to overall changes in IQ. This study examined both group level and intra-individual changes in neuropsychological functioning in a group of high functioning youth ( $FSIQ>70$ ) following epilepsy surgery.

**Participants and Methods:** 17 children with focal epilepsy completed neuropsychological evaluations as part of routine pre- and post-surgical (average 18 months following surgery) workups and were administered the WISC-IV/WISC-V and either the CVLT-C or WRAML-2. Changes from pre- to post-surgery were examined at the group level with paired samples  $t$ -tests and Wilcoxon signed-rank tests, and at the intra-individual level with the reliable change index (RCI). Spearman's rank order correlations were used to examine the relation between neuropsychological functioning and clinical characteristics.

**Results:** Participants demonstrated significant improvements post-surgically in overall IQ [ $t(16) = -2.52$ ,  $p = .023$ ], verbal cognitive skills (VCI) [ $t(16) = -2.78$ ,  $p = .013$ ], visual-spatial skills (VSI) [ $t(16) = -2.63$ ,  $p = .039$ ], and immediate verbal memory ( $z = 2.14$ ,  $p = .033$ ). Fluid/perceptual reasoning, working memory, processing speed, other verbal memory domains did not change significantly. Age of seizure onset was positively related to post-surgical IQ ( $r_s = .58$ ,  $p = .017$ ) but no other neuropsychological variables. Fifty-four percent of patients showed no reliable change in IQ following surgery, while 38% improved, and 8% declined. Of those showing reliable change in IQ, 67% and 50% showed improved verbal ability and processing speed, respectively.

**Conclusions:** Results suggest favorable neuropsychological outcomes following epilepsy surgery. At the group level, patients showed improved IQ following resective surgery, while

fewer showed improvement or decline when an RCI analysis was employed, which is consistent with previous research. Furthermore, change in IQ may be partially due to improvement in verbal cognitive skills and processing speed.

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**Keywords:** epilepsy / seizure disorders - surgical treatment, intellectual functioning, epilepsy / seizure disorders

### **E. BARNARD, E. OLSEN. Semantic and Phonemic Fluency in Pediatric Temporal Lobe Epilepsy.**

**Objective:** Individuals with temporal lobe epilepsy (TLE) often present with language and memory impairments, regardless of laterality. Individuals with dominant (typically left) hemisphere TLE, however, frequently present with greater impairment than individuals with non-dominant (typically right) hemisphere TLE. Verbal Fluency is one such task that is often impacted. Among adults, semantic fluency is more susceptible to temporal lobe dysfunction than phonemic fluency, which is thought to relate to disruption in neuronal networks involved in semantic processing. This has been demonstrated in both dominant and non-dominant TLE. While this phenomenon has been explored in adults, it has not been studied in depth in the pediatric population. Given the plasticity of pediatric brains, the impact of TLE on semantic networks may differ from those of adult patients. This study examined if children with TLE demonstrate more impaired performance on semantic fluency compared to phonemic fluency. Given the frequency of neurocognitive deficits seen in multiple forms of pediatric epilepsy, children with TLE were compared to children with generalized epilepsy (GE) to identify the specific impact of temporal lobe epilepsy.

**Participants and Methods:** A series of independent sample t-tests were used to examine group differences in semantic fluency, phonemic fluency, FSIQ, VCI, and verbal memory performance in youth with GE ( $n=15$ ) and TLE (LTLE  $n=11$ , RTLE  $n=5$ ). Linear regression analyses were conducted to examine the relative contributions of seizure group, FSIQ, verbal intelligence (VCI), working memory (WMI), and verbal memory on verbal fluency performance.

**Results:** Individuals with TLE ( $M=6.44$ ,  $SD=3.12$ ) demonstrated significantly lower scores on semantic fluency,  $t(29)=2.12$ ,  $p=.043$ , as compared to individuals with GE ( $M=9.60$ ,  $SD=5.03$ ). No significant group differences were observed for phonemic fluency, FSIQ, VCI, WMI, or verbal memory. In regression models, semantic fluency scores were significantly associated with stronger delayed verbal memory ( $\beta=0.55$ ,  $t(23)=3.52$ ,  $P=.002$ ). Phonetic fluency scores were associated with stronger performance in FSIQ ( $\beta=0.37$ ,  $t(27)=2.07$ ,  $P=.048$ ), verbal intelligence ( $\beta=0.34$ ,  $t(24)=1.89$ ,  $P=.069$ ), and verbal memory ((immediate ( $\beta=0.42$ ,  $t(24)=2.15$ ,  $P=.042$ ), recognition ( $\beta=0.37$ ,  $t(24)=1.93$ ,  $P=.066$ )). No interaction effects between seizure group and neuropsychological performance were observed.

**Conclusions:** When compared to children with GE, children with TLE demonstrate significantly lower scores on semantic fluency but not phonemic fluency despite equivalent performance across other neurocognitive domains including IQ, verbal ability, and verbal memory. Performance on verbal fluency was related to FSIQ, verbal intelligence, and verbal memory to varying degrees. These results suggest temporal lobe language networks in youth are susceptible to similar epileptogenic insults seen in adults and play a specific role in accessing semantic knowledge. Results highlight the interplay of semantic memory networks and language networks in processing and accessing semantic knowledge.

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**Keywords:** epilepsy / seizure disorders, language

**G. MONCRIEF, S. L. AITA, M. ABECASSIS, R. ROTH, T. A. CALLER, S. S. SCHMIDT, B. C. JOBST. Self-Rated Executive Dysfunction in Adults with Epilepsy and Effects of a Cognitive-Behavioral Intervention (HOBSCOTCH).**

**Objective:** Subjective and objective cognitive problems are common in adults with epilepsy and significantly affect their quality of life. HOBSCOTCH (HOMe Based Self-management and Cognitive Training CHanges lives) was developed to teach problem-solving strategies and compensatory memory strategies to these individuals. Prior research has shown that completion of HOBSCOTCH is associated with improved quality of life, but not a composite score subjective executive functioning [Global Executive Composite of the BRIEF-A (Behavior Rating Inventory of Executive Function – Adult version)]. Here, we examined whether HOBSCOTCH is associated with changes in specific aspects of subjective executive functions as assessed using the BRIEF-A.

**Participants and Methods:** Fifty-one adults age 18-65 with epilepsy and subjective cognitive complaints (not based on the BRIEF-A) were randomized to receive HOBSCOTCH, HOBSCOTCH+ (which adds working memory training) or care as usual. These completed the BRIEF-A, as well as the PHQ-9 to assess depression. As we previously found no difference on outcomes between the HOBSCOTCH and HOBSCOTCH+ subgroups, these were collapsed for the purpose of the present analyses. Rates of elevated BRIEF-A scores were examined at baseline, and pre-post score changes for the nine subscales were evaluated. Significance was set at  $\alpha=.05$ , one-tailed, given our directional hypothesis.

**Results:** At baseline, base rates of scores in the elevated (i.e., impaired) range ( $T \geq 65$ ) across scales were as follows: Inhibit=28%, Shift=51%, Emotional Control=45%, Self-Monitor=33%, Initiate=35%, Working Memory=88%, Plan/Organize=45%, Task Monitor=47%, Organization of Materials=28%. Within the treatment group ( $n = 31$ ; 1 participant missing post-data), there was a significant decrease in Inhibit ( $p=.03$ ,  $d=0.36$ ), Shift ( $p=.02$ ,  $d=0.39$ ), Initiate ( $p=.03$ ,  $d=0.35$ ), and Working Memory ( $p=.01$ ,  $d=0.44$ ); Organization of Materials approached significance ( $p=.06$ ,  $d=0.30$ ). The Control group ( $n = 20$ ) only showed significant decrease in subjective problems on the Working Memory scale ( $p=.02$ ,  $d=.48$ ). Change in depression scores was not observed for either group.

**Conclusions:** At baseline, a sizeable subset of patients report executive dysfunction on the BRIEF-A, especially for Working Memory. HOBSCOTCH was associated with mild to moderate improvement in several areas of subjective executive functioning. These findings were independent of changes in mood. In sum, subjective executive dysfunction is common in those with epilepsy and improves with HOBSCOTCH.

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**Keywords:** epilepsy / seizure disorders, executive functions

**C. M. BOSCH, L. M. KOEHL, F. A. SCHMITT. Distinguishing Psychogenic Nonepileptic Seizures from Epilepsy Using the Personality Assessment Inventory: A Meta-Analysis.**

**Objective:** The published literature on the Personality Assessment Inventory (PAI) for psychogenic nonepileptic seizure (PNES) diagnosis includes a variety of interpretation approaches to distinguish PNES from epileptic seizures (ES). The purpose of this analysis is to provide a meta-analytic examination of response differences between multiple PNES and ES samples to assist in diagnostic classification. This meta-analysis focuses on differences in the Somatic Complaints (SOM), Anxiety (ANX), and Depression (DEP) scales and subscales given their conceptual and empirical relevance to PNES.

**Participants and Methods:** PsycINFO and PubMed databases were searched for studies examining personality and psychopathology differences between PNES and ES patients with the PAI, and reference lists of retrieved studies were scanned for additional articles. A total of 12 studies fulfilled the inclusion criteria, namely those with reported PAI data for PNES and ES groups, exclusion of participants with comorbid PNES and ES, participants aged 18 and older, and published in English. Each article underwent a formal quality appraisal.

**Results:** Large effect sizes were observed for SOM ( $g = 0.82$ ), SOM-C ( $g = 1.02$ ), and SOM-S ( $g = 0.92$ ), and medium effects were noted for ANX-P ( $g = 0.56$ ) and DEP-P ( $g = 0.66$ ). Weighted mean scores showed clinical elevations for PNES patients on SOM ( $M = 74.0T$ ), SOM-C ( $M = 75.8T$ ), and SOM-H ( $M = 70.6T$ ). There were no clinical scale elevations for ES patients. Additional analyses indicated no heterogeneity in clinical scales and no evidence of publication bias. Quality appraisal indicated eight articles were medium and four articles were low quality.

**Conclusions:** Results suggest PAI profiles with clinically elevated scores on SOM and SOM-C are more suggestive of PNES than ES. These elevations paired with moderate elevations on SOM-S, ANX-P, and DEP-P further contribute to establishing a PNES diagnosis. These findings provide the foundation for future research to establish firm decision rules for the PAI to differentiate PNES from ES.

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**Keywords:** seizures (psychogenic), epilepsy / seizure disorders, assessment

### **J. P. GONZALEZ, S. J. LALANI, J. P. ANDREWS, B. KOPALD. Changes in Cognition Following Surgical Resection for MRI Negative Temporal Lobe Epilepsy.**

**Objective:** Surgical resection is a common treatment for medically refractory temporal lobe epilepsy (TLE). Seizure outcomes improve when a seizure focus can be localized (e.g., hippocampal sclerosis); however, seizure localization is challenging for those who have a negative MRI (nMRI). Similarly, cognitive outcomes are more difficult to predict for nMRI and little has been reported beyond expected changes in memory and language functioning. Therefore, potential cognitive changes remain a negative risk factor for nMRI epilepsy surgery. The present study sought to quantify neuropsychological outcomes following nMRI surgery for TLE.

**Participants and Methods:** Thirty patients with nMRI TLE who underwent a comprehensive neuropsychological evaluation as part of surgical workup at both time points (pre- and post-surgically) were included in the present study. Neuropsychological measures assessing processing speed, attention and executive functioning, memory, language, and mood were included in the study. Sixteen patients underwent dominant resection, and fourteen had non-dominant resection. The average time from surgery to post-operative evaluation was 1.6 years. Patients were compared pre- and post-operatively as a group, as well as by laterality.

**Results:** Paired T-tests showed significant changes following surgery. When compared as a group, patients showed improvement in processing speed (TMT-A t-score:  $t(20) = -3.08$ ,  $p = .006$ ) and attention and executive function (DKEFS-CW Inhibition raw:  $t(10) = 2.94$ ,  $p = .015$ ; Inhibition/Switching raw:  $t(10) = 3.21$ ,  $p = .009$ ). Patients who underwent left-sided surgery exhibited decreases in verbal memory (CVLT SDFR raw:  $t(8) = 3.60$ ,  $p = .007$ ) and aspects of language including confrontational naming (BNT t-score:  $t(12) = 2.19$ ,  $p = .049$ ) and semantic fluency (DKEFS-CF ss:  $t(9) = 3.28$ ,  $p = .010$ ). On the other hand, patients who underwent right-sided TLE surgery exhibited improvements across domains, for example, in processing speed (TMT-A t-score:  $t(10) = -2.47$ ,  $p = .033$ ), attention and executive function (DKEFS-CW Inhibition ss:  $t(6) = -2.5$ ,  $p = .047$ ), paired associative learning and memory (VPA-I ss:  $t(5) = -4.54$ ,  $p = .006$ ; VPA-II ss:  $t(5) = -3.58$ ,  $p = .016$ ), and naming (BNT t-score:  $t(11) = -2.20$ ,  $p = .050$ ). There were no differences observed in visual learning and memory (BVMT-R; WMS-III Faces) or mood (BDI; BAI).

**Conclusions:** These data suggest that patients who undergo surgery for nMRI TLE demonstrate an overall improvement in processing speed. Additionally, whereas dominant (left-sided) resections lead to significant declines in memory and language performance, non-dominant resections show improvements across multiple domains. We discuss the relative risk of non-dominant compared to dominant resections, as well as the possible underlying causes for the cognitive changes observed in nMRI TLE surgical resections.

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**Keywords:** epilepsy / seizure disorders - surgical treatment

### **P. TSAI, Y. CHANG, . HUANG, N. GUO. The Executive Function Characteristics of School-Aged Epileptic Children with a History of Febrile Convulsions.**

**Objective:** Febrile convulsions (FC) are the most common seizure disorder in childhood, occurring in 2%-5% of children, and the recurrence rate is 30-40%, and the rate of subsequent epilepsy is 2%-7%. Many studies have shown that children with FC performed as well as other children in terms of academic, intelligence, and behavior, but epileptic children with a history of febrile convulsions was often reported that have learning, cognitive problems, and these may be related to executive function. This study aims to delineate the executive function characteristics of school-aged epileptic children with a history of febrile convulsions.

**Participants and Methods:** The study comprised children age 6-15, and divided into three groups: epileptic children with a history of FC group (FC-Epi group), FC only group, sibling controls of epileptic children with a history of FC (sibling group). All three groups were given Comprehensive Non-verbal Attention and Memory Test Battery (a computerized nonverbal neurocognitive battery), Wisconsin Card Sorting Task (WCST), and memory test to assess various subcomponents of attention efficacy, memory processing and executive function.

**Results:** There were 274 children included and all three groups had the same socioeconomic status. The mean age ( $\pm$ SD, months) of the three groups at assessment was as follows: 110 FC-epilepsy children group ( $104.03 \pm 27.98$ ), 94 FC only children group ( $104.2 \pm 24.12$ ), and 70 sibling children group ( $106.76 \pm 21.16$ ). Attention efficiency, memory processing, and executive function performance in FC-Epi group was significantly lower than FC only group ( $p < 0.05$ ) and sibling control group ( $p < 0.05$ ). Learning of memory processing performance in FC only group was significantly lower than sibling control group ( $p < 0.05$ ).

**Conclusions:** This study found that FC-Epi group demonstrated significantly poorer executive function than other groups. Epileptic children with a history of febrile convulsions have significantly difficult in executive function and may affect their learning.

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**Keywords:** executive functions, epilepsy / seizure disorders

**B. SCHNEIDER, L. CONANT, J. HEFFERNAN, J. MATHIS, V. NAIR, B. HERMANN, F. ANNA, D. ALMANE, A. NENCKA, M. RAGHAVAN, R. MAGANTI, A. STRUCK, E. FELTON, U. SHAH, V. N. SOSA, K. M. ARKUSH, E. DEYOE, V. PRABHAKARAN, M. E. MEYERAND, J. R. BINDER. The Neural Correlates of Social Cognition Deficits in Temporal Lobe Epilepsy.**

**Objective:** Temporal lobe epilepsy (TLE) is associated with deficits across multiple cognitive and behavioral domains, including social functioning, and prior studies have demonstrated reduced performance on measures of theory of mind (ToM), such as the Faux Pas Recognition Test (FPT), in both left and right TLE. ToM refers to the ability to infer the mental states of others, including others' beliefs and intentions (cognitive ToM) as well as others' emotions (affective ToM). However, past studies using the FPT in TLE have often relied upon an abbreviated version, and no studies to date have examined the relationship between FPT cognitive and affective indices and brain structure in TLE. We predicted TLE would be associated with deficits in both cognitive and affective ToM, and we expected performance to correlate positively with cortical thickness in areas implicated in social cognition and executive function, such as the inferior parietal lobule, superior temporal sulcus, anterior temporal cortex, and prefrontal cortex.

**Participants and Methods:** The FPT was administered to 119 adults (aged 18-60) with TLE (mean age = 39.37, 45 males/74 females) and 82 healthy controls (mean age = 33.82, 35 males/47 females). Group differences in FPT performances, while controlling for age and gender, as well as the impact of laterality of seizure focus on performance within the TLE group were examined. Additionally, high-resolution 0.8mm isotropic T1- and T2-weighted MRI scans obtained at 3T for the TLE patients and a subsample of 41 controls were analyzed using FreeSurfer to extract regionwise cortical thickness values based on the Desikan-Killiany atlas. Multiple regression was used to examine the relationships between FPT performance and cortical thickness in regions associated with social cognition and executive function, controlling for age and gender.

**Results:** Our results suggest that patients with TLE show significantly poorer comprehension performance overall on the stories containing a social faux pas compared to the HC group, while the groups did not significantly differ on stories without a faux pas. Additionally, the TLE group performed more poorly on indices assessing empathic understanding (affective ToM), understanding of why a behavior is inappropriate, and judgment of others' intentions (cognitive ToM). Regarding cortical thickness, after correction for multiple comparisons, there were no areas showing a significant group X performance interaction. Within the TLE group, better performances on both cognitive indices were associated with greater thickness in the right superior and middle frontal gyri. Performance on the empathy index was positively associated with thickness in the right superior temporal gyrus. No behavioral or structural differences were associated with laterality of the seizure focus.

**Conclusions:** Overall, these data provide additional evidence for deficits in both cognitive and affective ToM associated with TLE and suggest the presence of distinct neural correlates associated with these component processes. These correlates were right-lateralized for the full TLE sample, and included regions implicated in social cognition as well as, in the case of cognitive ToM, in executive functions.

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**Keywords:** social cognition, epilepsy / seizure disorders, neuroimaging: structural

### **A. HANEDA, H. KHAN, M. LACY. Laser Ablation for Epilepsy Surgery: Impact on Executive Function .**

**Objective:** Laser ablation has been an increasingly popular treatment option for intractable epilepsy. Much of the current published research has examined the surgical impact on memory and language skills, with little focus on executive function outcomes. Laser ablation allows precise destruction of deep tissue while bypassing the cortex and possibly minimizing adjacent white matter tract damage (White et al, 2020). This preservation of white matter has been shown to aid in greater recovery of functioning over time. Even so, risks of damaging white matter tracts still exist and little research has examined executive functioning outcome post-surgery, despite its relationship to quality of life (Uslu et al 2019; Ehrlich et a; 2019). The current study aims to examine the impact of surgical ablation on executive functioning in a cohort of adults with intractable temporal lobe epilepsy.

**Participants and Methods:** Adults with intractable epilepsy completed a battery of neurocognitive tests before and after surgery. Changes in performances across the Trail Making Test-B (TMT-B), Brief Test of Attention (BTA), and Wisconsin Card Sort Testing (WCST) perseverative errors was examined utilizing a Reliable Change Index analysis (95% confidence interval).

**Results:** 18 Patients (11 female; 7 male) with a mean age of 42.2 years (SD = 13.3) completed testing with an average time of 1.7 years between evaluations. Reliable change indices indicated relative stability over time: Trails B revealed 87% stability; BTA revealed 92% stability and WCST Perseverative Errors revealed 100% stability.

**Conclusions:** Overall laser ablation appears to have little aversive impact executive functioning for most patients consistent with the proposed sparing of white matter tracts. However, three patients displayed a decline on a measure of visual attention and mental flexibility. Surgical (e.g., thermal heat to optic and thalamic pathways) impact may explain these findings. Future studies with larger sample sizes are in process with longer term follow up needed as this option holds great promise for patients.

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**Keywords:** epilepsy / seizure disorders - surgical treatment

### **C. HAGUE, D. P. WABER, C. VEGA. Prevalence of Suicidality in Pediatric Patients with Epilepsy and Psychiatric Disorders .**

**Objective:** Children with a history of seizures are at-risk for a range of adverse emotional, behavioral, and social outcomes (Besag et al., 2016). Although approximately one-third of children with seizures experience depressive disorders (Dunn et al., 2016), less is know specifically about the prevalence of suicidality among these children. The goal of the present

study was to assess rates of suicidality and related symptoms in pediatric patients with co-morbid seizures and psychiatric disorders (depressive, anxiety, and bipolar disorders) and to compare these rates to those of patients with a history of psychiatric disorders without seizures in order to determine whether suicidality was more or less prevalent in the patients with comorbid epilepsy and psychiatric disorders.

**Participants and Methods:** We conducted a retrospective chart review of 100 pediatric patients with a history of seizures and psychiatric disorders and 100 patients with a history of psychiatric disorders without seizures. Cases were coded for psychiatric diagnosis, suicidality, suicidal ideation, suicide attempts, psychiatric hospitalizations, and self-injury. Chi-square tests of independence were performed to compare the distributions of these variables for the two groups.

**Results:** The age and sex distributions of the two groups were comparable. Patients with co-morbid psychiatric disorders and epilepsy did not differ from those with psychiatric disorders without epilepsy as follows: suicidality (69% versus 71%,  $p = 0.76$ ), suicidal ideation (69% versus 71%,  $p=0.76$ ), suicide attempts (24% versus 32%,  $p=.21$ ), or psychiatric hospitalizations (49% versus 50%,  $p=0.90$ ). However, patients with a history of psychiatric disorders without seizures were more likely to demonstrate self-injury (24%) than those with seizures (13%;  $p<0.05$ ).

**Conclusions:** Children with epilepsy and co-morbid psychiatric conditions are at significant risk for suicidality, ideation, attempts, and hospitalizations at rates that are very similar to those with psychiatric conditions without seizures. However, they are somewhat less likely to engage in other self-injurious behaviors. These findings support the need for careful monitoring of psychiatric status in children and adolescents with epilepsy.

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**Keywords:** epilepsy / seizure disorders, depression

**M. S. COHEN, A. E. SAAD, J. SPAT-LEMUS, H. A. BENDER. Unexpected Wada Results, SEEG Mapping, and Pre-Surgical Neuropsychological Findings in Relation to Functional Post-Surgical Outcome: A Case Study of a Patient with Medically Refractory Epilepsy.**

**Objective:** We describe a case study of a 49-year-old, right-handed, English-speaking patient with a history of medically refractory non-lesional epilepsy for two years. Semiology includes frequent “black outs,” occasional shaking/muscle jerking, and post-ictal peri-oral movements (e.g., “tongue smacking”). Bilateral SEEG captured seizures with a left hippocampal onset. Following failed trials of several AEDs and continuing to experience numerous daily seizures, the patient was referred for epilepsy surgery. He received a LITT left mesial temporal lobe ablation. Prior to his surgery, the patient underwent an intracarotid amobarbital (IAP) procedure to lateralize language and memory functions. The overarching goal of this case study was to investigate the unexpected Wada results and findings that were obtained pre-surgery in relation to pre-surgical neuropsychological testing and functional outcome in this 49-year-old man with refractory epilepsy.

**Participants and Methods:** Patient underwent neuropsychological testing, SEEG brain mapping, and an IAP procedure as part of a comprehensive pre-surgical work-up. During the IAP procedure, amobarbital (100 mg) was injected into the patient's right carotid artery, after which items were presented. The same procedure was completed following a second injection of amobarbital into the patient's left carotid artery. Immediate assessment of language included repetition, basic auditory comprehension, and confrontation naming. Memory testing following

each injection included spontaneous recall and recognition of stimuli in the presence of foils/distractors.

**Results:** Seizure onsets were found in the electrodes anterior and posterior to the lesion; both electrodes were slightly inferior to the lesion. The patient's typical aura of a sensation of an oncoming seizure with language comprehension difficulties were elicited with low current stimulation of the perilesional electrodes. In addition, the patient had difficulty with visual naming and repetition. The contacts were located in Heschl's gyrus and the medial portion of the superior temporal gyrus. Of note, more pronounced language findings were elicited in the posterior temporal depth. Awake language mapping revealed similar interruptions during auditory comprehension tasks. These were not consistent and the patient was able to complete the task intermittently. The lesion was resected along with the surrounding cortices, including the seizure onset zone, as well as brain tissue which, when stimulated, evoked the patient's typical aura and subtle language hits (both during the SEEG CSM and awake mapping). The patient's language was entirely intact directly after surgery.

**Conclusions:** SEEG is relatively new and we have limited experience with the results of brain mapping. Deficits found during SEEG mapping should not be considered an absolute contraindication to resection. As Heschl's gyrus and medial superior temporal gyrus are not the typical area for language, it is possible that the patient's seizure network contained parallel function (as his aura was correlated with epileptiform discharges); no post-operative cognitive deficits were noted status post resection.

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**Keywords:** epilepsy / seizure disorders, epilepsy / seizure disorders - surgical treatment

#### **A. TETI, J. GESS, J. KLEINER, L. ISAAC, C. FULLEN, L. LARSON-PRIOR. Lateralization in Phonemic Fluency, not Semantic Fluency in Temporal Lobe Epilepsy.**

**Objective:** Neuropsychology has been found to play a vital role in the assessment of epilepsy, particularly with regard to assessing the lateralization and localization of seizure onset and the risk of cognitive changes following surgery. Recent literature has begun to re-examine the predictive value of neuropsychological measures in lateralizing focal areas of impairment (e.g., Keary et al., 2007; Saling, 2009; Willment & Golby, 2013). However, research examining the lateralization of language measures is rather limited and has primarily focused on left temporal lobe epilepsy (LTLE). Thus, this study seeks to examine the difference between semantic and phonemic verbal fluency within those with either left or right temporal lobe epilepsy (RLTE).

**Participants and Methods:** The sample consisted of 21 individuals with TLE who presented for a neuropsychological evaluation. Majority of the sample was Caucasian (81%) and predominantly male (61.9%, Female: 38.1%, Other gender identities: 0%). Participants were administered the Wechsler Abbreviated Scale of Intelligence-II (WASI-II) and Verbal Fluency from the Delis-Kaplan Executive Functioning System, among a larger battery. The sample was made up of those who were right-handed and estimated to have a premorbid IQ between 70 and 130.

**Results:** A between-subjects analysis of covariance was run to assess the difference in phonemic and semantic generative fluency between those with left and right-sided seizures. There was no significant difference between LTLE and RLTE on category fluency ( $p=0.119$ ). But, there was a significant difference on phonemic fluency ( $p=0.013$ ). A significant difference was also found in

performance differences between semantic and phonemic fluency across left and right TLE ( $p=0.037$ ). Those with RTLE performed a 0.85 scaled score higher on phonemic fluency tasks than on semantic tasks, while those with LTLE performed 1.5 scaled score worse on phonemic fluency tasks than on semantic tasks.

**Conclusions:** Consistent with previous studies, those with RTLE performed significantly better on phonemic fluency tasks compared to semantic fluency tasks. However, LTLE individuals displayed better semantic compared to phonemic verbal fluency. Results potentially suggest that phonemic generative fluency has greater left temporal lobe involvement. Conversely, those with LTLE did not differ from RTLE in semantic verbal fluency performance, suggesting greater bilateral neural network involvement. Together, these results support the potential use of verbal fluency measures in establishing lateralization within epilepsy populations.

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**Keywords:** neuropsychological assessment, epilepsy / seizure disorders, laterality

**N. IBARRA, H. MURPHY, E. HAVLIK, J. JANECEK, L. UMFLEET, J. R. BINDER, M. RAGHAVAN, C. CARLSON, C. ANDERSON, W. M. MUELLER, K. A. MAU, S. SWANSON. Predictors of Quality of Life after Anterior Temporal Lobectomy.**

**Objective:** Anterior temporal lobectomy (ATL) is an effective treatment for epilepsy with 80% attaining seizure freedom. However, ATL is associated with cognitive morbidity and in some cases surgical complications. While epilepsy is associated with lower quality of life (QOL) in general, it is important to understand how QOL changes following ATL, and what factors are associated with improved or higher QOL. Previous studies (Englot et al, 2017; Ryvlin & Rheims, 2016) show that seizure freedom, pre-op QOL and mood are associated with improved post op QOL. The current study explores cognitive, seizure, and mood variables as predictors of QOL improvement after ATL. It was hypothesized that better mood, pre-operative QOL and seizure control as well as lower cognitive change scores after surgery would be associated with higher QOL after surgery.

**Participants and Methods:** Subjects included 216 patients (93 men, 123 women) who underwent ATL ( $n=121$  right and  $n=95$  left ATL), had  $IQ \geq 60$ , ages ranging from 17 to 72 (mean age = 38 years), right ( $n=177$ ), left ( $n=31$ ), or mixed ( $n=7$ ) handedness, and education ranging from 4 to 22 years (mean = 13 years of education). Measures included Quality of Life in Epilepsy (QOLIE-31) questionnaire (pre and post), Boston Naming Test (BNT), WMS Logical Memory, Selective Reminding Test, and MMPI-2 Depression scale. Seizure variables included at onset of seizures, age at recurrent seizures, duration of epilepsy, and Engel outcome classification at 6 months post ATL. A paired sample t-test was used to examine changes in QOL from pre to post surgery. Pearson's correlations were conducted to examine the relationship between cognitive change scores, mood, seizure variables, and post-operative QOLIE-31 scores. Linear multiple regression was performed to identify significant predictors for higher overall quality of life after surgical resection.

**Results:** The paired sample t-test results revealed significant improvements in depression and quality of life from pre to post-surgery. Pre-op QOL, pre and post-op depression, post-op seizure control (Engel score) and list learning change scores ( $p=.042$ ) were significantly correlated with overall quality of life. More specifically, lower change scores or less memory decline was correlated with better QOL after ATL. Linear multiple regression accounted for 56.9% of the variance in post ATL QOL with Pre-op QOL ( $p<.0001$ ), post-operative depression ( $p<.0001$ ),

seizure outcome ( $p=.001$ ), and pre-operative depression ( $p=.038$ ) contributing to the variance predicted. Cognitive change scores did not account for significant additional variance in QOL following ATL after these variables were entered.

**Conclusions:** QOL improves significantly following ATL. Variables associated with higher QOL scores after surgery include better QOL prior to ATL, better seizure freedom, and lower depression both prior to and following ATL. Cognitive change scores were correlated with QOL after ATL but did not contribute significantly to the predictive model after pre-operative QOL, depression, and seizure control variables were entered. This study suggests that while cognitive outcome after ATL is important, mood, QOL and seizure control are the strongest predictors of QOL for epilepsy patients undergoing ATL.

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**Keywords:** epilepsy / seizure disorders, quality of life

**A. D. LOKAI, N. S. RAJA , S. BROWN-ADAMS , I. MIAO, J. SPAT-LEMUS, H. A. BENDER, A. SACKS-ZIMMERMAN. Cultural Perspectives on the Neurosurgical Plan, Interventions, and Outcomes in a South-East Asian Patient with Epilepsy: A Case Study .**

**Objective:** According to the World Health Organization, there are approximately 15,000,000 cases of epilepsy in the South-East Asia region, representing 1% of the total population. However, there are significant differences in cultural perceptions of epilepsy in this world region, including felt and enacted stigma on the individual and their family system. For example, the religious connotation of a diagnosis of epilepsy is more pronounced in South-East Asian populations, the majority of whom practice Buddhism, in which this neurological condition may be perceived to be a ‘penance for sins committed in a previous life.’ Importantly, these cultural perceptions can influence the modality of treatment an individual from a South-East Asian population chooses to pursue. The present case study seeks to examine the patient’s cultural perceptions of epilepsy and the impact these had on their view of treatment and neurosurgical outcomes.

**Participants and Methods:** The patient is a 46-year old, bilingual (Thai and English-Speaking), female who was born and raised in central Thailand, referred for a neuropsychological pre-surgical evaluation for treatment of refractory epilepsy. Co-morbidities included: poor management of her diabetes and occasional non-compliance with AEDs. Symptoms consistent with severe depression with felt and enacted stigma were present. The patient’s unique view of chronic illness rooted in her deep belief in Karma and fatalism was addressed when further discussing treatment options, potential for post-surgical neuropsychological deficits, and quality of life.

**Results:** In concert with the neurosurgeon, the patient and her family were counseled in a culturally sensitive manner to further understand the impact of surgical intervention. Specifically, the concept of pain and suffering secondary to epilepsy was discussed in the context of her devout Buddhist faith. Following neurosurgical intervention, the patient presented with Engel Class IIIB outcome, having prolonged seizure-free intervals, but still with multiple seizures per month. Even though this surgical outcome was somewhat unanticipated, patient did not express distress or disappointment, but rather commented on her interpretation of fatalism and the ‘sacredness of life in any form.’

**Conclusions:** In this case study, we examined the underlying cultural-specific beliefs and perceptions in a South-East Asian patient with epilepsy. This case highlights the need for

neuropsychologists to move beyond their own cultural lens and more fully understand their patient's unique set of experiences, beliefs, and definitions of post-surgical success. There is a clear need to conduct high-quality, high-impact research in historically under-studied and under-represented racial and ethnic populations in an attempt to reduce the gap in service delivery and improve quality of life.

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**Keywords:** epilepsy / seizure disorders, diversity

### **T. JACOBSON, N. HEYDARI, M. J. HAMBERGER. Stimulation Identified Naming Sites in Patients with and Without Focal Cortical Dysplasia.**

**Objective:** Focal cortical dysplasia (FCD), the malformation of cortical tissue, is the third leading cause of seizures in adult patients and the leading cause of refractory epilepsy in pediatric patients. Despite the prevalence of this neurodevelopmental abnormality, little is known about its effects on function, and on the cortical representation of function. In pharmacologically refractory epilepsy patients who required preoperative electrocortical stimulation language mapping, we compared 1) the number of naming sites identified, and 2) auditory and visual naming performance, in patients with and without FCD. Based on clinical observations, we hypothesized that patients with FCD would have more naming sites, and poorer naming performance relative to those without FCD.

**Participants and Methods:** Participants were 21 patients (12 women) with FCD (mean (SD): Age: 26.3 years old (11.7), Education: 11.6 years (4.1), FSIQ: 86.3 (12.1); and 168 patients (80 women) without FCD (mean (SD): Age: 37 years old (15.3), Education: 14.5 years (3.5), Estimated IQ: 98.5 (15.4). Prior to language mapping, all patients were administered auditory naming (AN) and visual naming (VN) tests. Performance measures included accuracy (i.e., number correct), mean RT, and the number of Tip-of-the-tongues ('TOT'=responses  $\geq 2$  sec plus items requiring phonemic cue). Both groups underwent preoperative electrocortical stimulation based language mapping for clinical purposes. Groups were compared using independent samples T-tests and multivariate ANOVA. Age, years of education, FSIQ, and number of naming sites tested served as covariates.

**Results:** Age, years of education, and FSIQ were significantly higher in patients without FCD ( $p < .05$ ); however the number of sites tested were significantly higher in patients with FCD (mean (SD): with FCD: 27.6 (20.3), and without FCD: 20.8 (14.7),  $p < .05$ ). Results revealed significantly more naming sites identified in patients with FCD (mean (SD): with FCD: 3.3 (3.3), and without FCD: 1.9 (2.7),  $p = .002$ ). By contrast, there were no significant differences between the two groups in naming performance.

**Conclusion:** As hypothesized, patients with FCD had more naming sites than mapping patients without FCD; yet, inconsistent with our hypothesis, there were no differences between groups in auditory or visual naming performance. We speculate that the redundancy provided by the additional cortical naming sites in FCD patients might be needed to maintain adequate naming function. Further work with a larger FCD sample is needed to determine the clinical significance of the additional naming sites in FCD, and specifically, whether it is important to spare these sites from surgical resection.

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**Keywords:** epilepsy / seizure disorders, language, naming

**J. P. FILLAUER, S. M. TIERNEY, J. GRABYAN. Patients with Psychogenic Non-Epileptic Events vs. Epileptic Seizures Do Not Differentially Report Emotional Distress When Controlling for Symptom Validity Test Performance.**

**Objective:** While the use of performance validity testing (PVT) in neuropsychological assessments to assist in diagnostic differentiation between epileptic seizures (ES) and psychogenic non-epileptic events (PNEE) is becoming more accepted, considerations of symptom validity testing (SVT) regarding self-report of psychological symptoms is under-examined. Prior research has shown that those with PNEE and ES differentially report psychological symptom severity dependent upon PVTs: PNEE and ES have displayed comparable symptom reports both when collapsing across PVT results and when looking at those passing PVTs, but those with PNEE failing PVTs have displayed worse symptom severity than those passing, and those with ES failing PVTs. The present study seeks to replicate these results, but (more appropriately) utilizes SVTs to define the validity groups.

**Participants and Methods:** The present study's sample contains 240 Veterans who were evaluated during a 4-day inpatient admission to an epilepsy monitoring unit to assess for possible ES or PNEE. 157 were diagnosed with PNEE and 83 with ES (those diagnosed with mixed PNEE/ES, indeterminate, and physiological non-epileptic events were excluded). A pass/fail index of noncredible SVT results was created, defined as failures on at least two of three SVTs among: Health Attitudes Survey (HAS), Health History Checklist (HHC), and the Structured Inventory of Malingered Symptomology (SIMS). SVT failure cut-scores utilized were: HAS total score  $\geq 15$ , HHC total score  $\geq 14$ , and SIMS total score  $\geq 21$ . Participants were also administered the following four self-report measures of emotional functioning: Patient Health Questionnaire-9 (PHQ-9), Beck Depression Inventory-II (BDI-II), Generalized Anxiety Disorder-7 (GAD-7), and Satisfaction With Life Survey (SWLS). A series of 2 (diagnostic status: ES versus PNEE)  $\times$  2 (SVT index: pass versus fail) factorial analysis of variance designs were conducted to examine the measures of emotional functioning.

**Results:** 105 participants demonstrated valid SVT index performance, while 135 did not. Results indicated a main effect of SVT index on each measure, with SVT index failure associated with more severely reported emotional functioning- PHQ-9 ( $F(1,236) = 62.39, p < .001$ ), BDI-II ( $F(1,236) = 36.9, p < .001$ ), GAD-7 ( $F(1,236) = 39.50, p < .001$ ), SWLS ( $F(1,236) = 33.82, p < .001$ ). There was a main effect of diagnostic status on PHQ-9 (though not on BDI-II, GAD-7, or SWLS), with PNEE associated with greater PHQ-9 severity ( $F(1,236) = 7.63, p = .006$ ). There were no interaction effects between diagnostic status and SVT index performance for any of the emotional functioning measures.

**Conclusions:** The current study did not demonstrate an interaction between diagnostic status and SVT performance on the psychological self-report measures included, indicating they may not be useful from a diagnostic classification standpoint. As the present battery was focused on depression and anxiety; it is possible that a wider battery of self-report measures (to include daily activity and social functioning) may be more illuminating. Nevertheless, due to the stark difference between SVT pass and fail groups on all measures, SVTs should be considered an integral part of neuropsychological evaluations of those with ES or PNEE (especially in the latter, where SVT failure rates in the current study were over 60%).

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**Keywords:** epilepsy / seizure disorders, noncredible presentations, seizures (psychogenic)

**A. OLEJNIK, A. BALA, A. RYSZ, A. MARCHEL. Quality of life in patients with drug resistant epilepsy – clinical and neuropsychological correlations.**

**Objective:** Epilepsy is a chronic neurological disorder, which strongly affects patients' lives. It may have a negative impact on their cognition, emotions and social functioning and also cause physical disability. The study aimed at assessing health related quality of life (HRQoL) in patients with intractable epilepsy including the impact of some clinical variables.

**Participants and Methods:** The clinical group consisted of 120 subjects with drug resistant temporal lobe epilepsy: 58 women and 62 men in the mean age of  $31,45 \pm 12,86$  and  $12.47 \pm 2$ . years of education. The average duration of epilepsy was  $17,8 \pm 7,68$  years. For the assessment purposes a set of psychological tools was used, containing: quality of life questionnaire - QOLIE-31-P, theory of mind measure - Reading Mind in the Eyes Test (RMET), mood questionnaire – Hospital Anxiety and Depression Scale (HADS), and general cognitive screening test – Montreal Cognitive Assessment (MoCA). Moreover we gathered data about frequency of seizures, age of the onset of epilepsy, and time of duration of epilepsy.

**Results:** Patients with epilepsy achieved low scores in most of the quality of life subscales, with the lowest scores in Medication effects, Seizures worry and Distress scales and highest in Emotional well-being. Further analysis revealed significant correlations between some subscales of QOLIE-31-P and frequency of seizures, cognitive functioning (RMET, MoCA) as well as depression and anxiety scores in HADS. We found no significant correlations between quality of life and age of the onset of epilepsy, and time of duration of epilepsy.

**Conclusions:** The level of quality of life in patients with epilepsy, measured with the use of QOLIE-31-P is low and related with some clinical and neuropsychological variables.

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**Keywords:** epilepsy / seizure disorders, quality of life, social cognition

**A. BALA, A. OLEJNIK, A. RYSZ, A. MARCHEL. Social cognition deficits and how patients with TLE perceive it.**

**Objective:** Patients with epilepsy often present deficits in social cognition skills which can lead to the communication difficulties and interpersonal problems. Considering the complexity of this construct, it seems indispensable to widely explore this issue, looking for factors that can be crucial for proper social functioning of the patients. It is also interesting to explore how patients perceive their social cognition skills. The aim of the study was to investigate how patients with temporal lobe epilepsy (TLE) recognize emotions and intentions of others on the basis of facial expression, biological motion and what are their meta-emotional abilities.

**Participants and Methods:** The study included patients with temporal lobe epilepsy (TLE) (n=55) and a control group (n=55) consisting of demographically equal, healthy volunteers. The subjects from both groups were evaluated with a battery of tests evaluating: emotion recognition with the use of faces (SIE-T test) and eyes photographs (RMET), ability to understand the meaning of biological movement (CID-5) as well as meta-emotional abilities (TRE test). The Hospital Anxiety and Depression Scale (HADS) was used to control emotional state of the participants. PKIE questionnaire was used for self-description of their emotional intelligence.

**Results:** The results of the research revealed the lowered emotion recognition from whole faces ( $p < 0,05$ ) and eyes pictures ( $p < 0,02$ ) in patients with TLE. Moreover, in the clinical group emotion comprehension and meta-emotional abilities were also impaired ( $p < 0,01$ ). Patients had

problems with understanding intentions of an observed person in biological movement paradigm ( $p < 0,01$ ). HADS scores were only slightly lowered (statistically non-significantly) and did not correlate with other tests. PKIE results did not differ between groups.

**Conclusions:** TLE can affect the ability of recognizing and understanding emotions and biological movement. Emotional state does not explain the experienced difficulties. Patients are not aware of the social cognition deficits.

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**Keywords:** epilepsy / seizure disorders, social cognition, emotional processes

## **N. CAUGHERTY HAN, W. MACALLISTER. Relationship Between Epilepsy Risk Factors and Academic Achievement.**

**Objective:** Prior research suggests that children with epilepsy have higher rates of cognitive impairment, including learning disabilities, compared to the general population. Age of epilepsy onset, number of anti-epileptic drugs (AEDs), seizure frequency, and seizure location are risk factors associated with nature and severity of cognitive impairment. The purpose of this investigation was to examine academic achievement in epilepsy and examine the relationship between academic achievement and these epilepsy severity factors.

**Participants and Methods:** A total of 249 clinically referred children and adolescents with epilepsy (ages 6 -17 ([mean = 10.83,  $SD = 3.12$ ]; 122 females, 127 males) completed select subtests from the *Wechsler Individual Achievement Test* (WIAT-III), as well as a Wechsler intelligence test as part of a comprehensive neuropsychological evaluation. WIAT-III subtests included: Word Reading, Pseudoword Decoding, Numerical Operations, and Spelling. Rates of impairment in intellectual and academic functioning were determined using a threshold of 1.5 standard deviations, or greater, below the mean. Pearson correlation, one-way ANOVA, and independent T-test analyses were used to examine the relationships between epilepsy severity factors, overall intellectual functioning, and academic achievement.

**Results:** The sample demonstrated higher rates of cognitive and academic impairment as compared to the normative sample. Approximately 24.9% of patients demonstrated impaired intellectual functioning, 18.5% impaired Word Reading, 20.1% impaired Pseudoword Decoding, 22.9% impaired Numerical Operations, and 18.9% impaired Spelling. Of the risk factors examined, only age of epilepsy onset and number of AEDs were significantly correlated with academic and intellectual functioning ( $r = .21$  to  $.27$ ;  $r = -1.95$  to  $-.26$ , respectively), at the  $p < .01$  significance level. No significant differences were found between seizure location/lateralization and academic ability.

**Conclusions:** Consistent with previous research, this sample of pediatric patients with epilepsy demonstrated high rates of cognitive and academic impairment in comparison to the general population. In terms of the relationship between academic achievement and epilepsy severity factors, these findings suggest that age of epilepsy onset and number of AEDs are significantly correlated with some areas of academic achievement and overall intellectual functioning.

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**Keywords:** epilepsy / seizure disorders, academic achievement

**A. E. SAAD, L. V. MARCUSE, J. J. YOUNG, J. SPAT-LEMUS, M. S. COHEN, H. A. BENDER. Clinical Characteristics of Bilateral Memory Failure on Intracarotid Amobarbital Procedure .**

**Objective:** Historically, intracarotid amobarbital procedures (IAP) have been a gold standard in assisting lateralization of language and memory for presurgical patients with epilepsy. The expected IAP finding is that memory on the side of seizure onset (tested with a contralateral injection) is worse than memory on the contralateral side (tested with an ipsilateral injection). Occurrences of a “wrong way” IAP results when memory contralateral to seizure onset zone is worse than the memory ipsilateral to seizure onset zone. Additionally, patients have been observed to have IAP results that do not meet passing criteria for left or right hemisphere memory, resulting in an outcome that has often been referred to as a ‘failed IAP.’ The clinical implications for these observed patients can obscure treatment planning for surgery and presents a unique subset among IAP outcomes given the risk for post-surgical cognitive decline following atypical IAP findings. The present study sought to examine patients with epilepsy who had bilateral IAP failure compared to those with typical IAP findings in order to better characterize the profile of these patients to inform treatment planning.

**Participants and Methods:** The study included 10 patients with refractory epilepsy who were pursuing neurosurgical intervention. Five of the 10 patients who failed to meet passing criteria for both hemispheres on IAP procedure of language and/or memory were matched based on age, IQ, gender, and education to a comparison population of patients who underwent an IAP. Patients were interviewed prior to the IAP procedure and were determined to have met passing criteria for language and memory at their pre-IAP intake. Neurosurgical interventions included responsive neurostimulation, laser interstitial thermal therapy, and resective surgery.

**Results:** There were no significant differences found between patients on the basis of age, IQ, gender, or education, which indicated an appropriately matched sample of patients. Differences were observed between the failed IAP group and the typical IAP group regarding pass/fail rates of left hemisphere language and memory,  $t(4) = -3.12, p = .035$ ;  $t(4.42) = -7.53, p = .001$ , with the failed IAP group having significantly lower scores in both language and memory. No significant differences were found between groups for right hemisphere language and memory. Chi-square analysis indicated a relationship between lateralization based on scalp EEG seizure lateralization, ( $\chi^2(2, N = 10) = 6.67, p = .04$ ), with the failed IAP group being more likely to have left scalp EEG findings than the typical IAP group.

**Conclusions:** Given the observed phenomenon in patients who have “wrong way” IAP results, it is imperative to begin to categorize characteristics that may place an individual at an increased risk for a ‘failed IAP.’ Despite the small sample size, these initial findings indicate that patients who have right hemisphere pathology are less likely to have a bilaterally failed Wada result. Pursued neurosurgical intervention (e.g. resection, ablation, neurostimulation) should be informed by atypical IAP findings as relative benefits of seizure freedom should be carefully weighed against potential declines in cognitive functioning.

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**Keywords:** epilepsy / seizure disorders - surgical treatment

**S. TURNER, L. S. GAYNOR, R. M. BAUER. Relationship between medial temporal lobe volume and object recognition performance in epilepsy .**

**Objective:** Neuropsychological assessment of patients with intractable epilepsy has sought to localize areas of dysfunction and predict the cognitive effects of surgery. While the specialization of the dominant temporal lobe for language and verbal memory has long been established, considerable controversy exists about the memory functions of the language nondominant temporal lobe, since evidence of material-specific nonverbal memory impairment in right temporal lobe epilepsy (TLE) patients is inconsistent. Some patients display such impairments while others perform normally on nonverbal memory tasks. Here we sought to determine whether performance on a hippocampal-dependent nonverbal memory task (Mnemonic Similarity Task [MST]) and other standardized neuropsychological tests is associated with reduction in hippocampal and extra hippocampal cortical volumes in a population with temporal-lobe epilepsy.

**Participants and Methods:** In an ongoing study, four patients with left-hemisphere TLE and five patients with right-hemisphere TLE were recruited from the Epilepsy Monitoring Unit at UF. Patients were administered the MST during their inpatient stay (more are being enrolled). In the MST, participants study a series of pictures (e.g., “fork”), and are then, in a recognition task, asked to identify “old” (previously presented), “new” (not previously presented), and “similar” (a picture of a different “fork”) items. Patients underwent structural MRI scanning on a 3T Siemens Verio Scanner. Structural data included a T1-weighted magnetization prepared rapid acquisition gradient-echo (MPRAGE) sequence (1mm isotropic) for registration and T2-weighted turbo spin-echo (TSE) sequences (0.44 x 0.44 x 1.5mm) for hippocampal segmentation as part of clinical care. Hippocampal subfields, including CA2–CA3–DG, CA1, and the subiculum as well as the extrahippocampal structures of the entorhinal, perirhinal, and parahippocampal cortices, defined in the TSE images using the automatic segmentation of hippocampal subfields (ASHS) machine learning toolbox<sup>18</sup> and a database of manual medial temporal lobe (MTL) segmentations.

**Results:** As previously reported, no group differences were seen in recognition/identification of “new” and “similar” objects, but the two groups differed in their responses to “old” objects. The left hemisphere group was more likely to incorrectly label an “old” stimulus as “similar” [ $m$  (s.d.) = .333 (.100)] than was the right hemisphere group [ $m$ (s.d.) = .134 (.074);  $t(5) = 3.032$ ,  $P < .05$ ]. The right hemisphere group was more likely to correctly label an old object as “old” [ $m$  (s.d.) = .784 (.134)] than was the left hemisphere group [ $m$ (s.d.) = .436 (.106);  $t(5) = -3.688$ ,  $P < .05$ ]. Preliminary volumetric analyses revealed no significant difference between patients with dominant hemisphere TLE and those with non-dominant hemisphere TLE ( $p > .05$ ). In this sample, neither left (partial  $r = 0.074$ ,  $p = .791$ ) nor right (partial  $r = 0.062$ ,  $p = .126$ ) hippocampal volume was associated with performance on the “old” object recognition condition.

**Conclusions:** The results from the MST indicate that patients with seizures originating the left hemisphere performed more poorly at identifying exact renditions of previously-presented stimuli, which they more likely identify as “similar” to the ones they have seen. This suggests a selective deficit related to left hemisphere dysfunction that was not attributable to differences in the volume of hippocampus or other medial temporal structures.

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**Keywords:** epilepsy / seizure disorders, neuropsychological assessment, hippocampus

**E. K. RETTIG, S. R. YOUNG, W. A. SCHRAEGLE, J. TITUS, D. T. PULSIPHER. The Relationship Between Language and Memory Lateralization in Youth and Young Adults with Intractable Epilepsy: A Wada Study.**

**Objectives:** The relationship between language and memory lateralization patterns is inadequately understood in pediatric epilepsy. Recent research indicates that memory lateralization in youth may be fluid into adolescence. This likely has implications for memory lateralization and subsequent epilepsy surgery preoperative planning. The Wada procedure may offer unique insights into these functional relationships as a tool for interrogating functional lateralization patterns. Therefore, the purpose of this study was to examine the strength of the relationship between language and verbal and visual memory lateralization patterns as determined by Wada tests in pediatric and young adult epilepsy surgery candidates.

**Participants & Methods:** Participants included 38 youth and young adults between the ages of 10 and 22 years with intractable epilepsy who were referred for phase 2 presurgical evaluation at a large pediatric tertiary care health system. Laterality indices (LI) for language and verbal and visual memory were calculated using Wada performances. Two different LI cut-off scores were used to define categorical laterality. Positive LI that was greater than the cut-off score indicated left lateralization, negative LI that was less than the cut-off score indicated right lateralization, and LI that was in-between the cut-off score indicated bilateral representation. Bayesian contingency tables were used to examine the relationship between categorical language and memory laterality. Bayesian correlations between LI were examined with a follow up mediation analysis. Bayes factors (BF) are reported and quantify the level of support for one model/hypothesis over another.

**Results:** A LI cut-off score of 0.3 was associated with very strong evidential support (BF=370) for a relationship between language and verbal memory laterality. This relationship was greatly attenuated with a LI cut-off score of 0.2 (BF=4). A similar pattern with relatively weaker evidence was found for the relationship between language and visual memory laterality (BF=4.88 for 0.2; BF=0.63 for 0.3). A linear relationship between verbal and visual memory LI was statistically significantly mediated by language LI.

**Conclusions:** The strength of relationships between language and memory lateralization in youth and young adults with intractable epilepsy varies according to memory type and how laterality is defined using LI cut-off score. Language laterality, also, significantly influences the relationship between visual and verbal memory lateralization, a novel finding requiring further investigation. Taken together, the present study provides preliminary support for an age-dependent shift between language and memory lateralization, which may explain greater variability in laterality among patients treated at a pediatric care center.

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**Keywords:** epilepsy / seizure disorders - surgical treatment

**C. SPEELMAN, M. FISCHER, H. PRABHU, P. K. SHEAR. Impact of Race-Based Norms on Lateralization of Expressive Language in TLE Patients: A Pilot Study.**

**Objective:** Presurgical neuropsychological evaluations in temporal lobe epilepsy (TLE) are conducted in part to examine lateralization of brain dysfunction, using scores that are typically corrected for age, gender, and race (e.g., Heaton et al., 2004). However, race is known to have little biological bases and instead is a social construct that is also a proxy for underlying variables such as SES, quality of education, and effects of systematic racism (Roberts & Rizzo,

2020). Criticisms of race-correct norms include that these norms cannot fully measure the underlying factors that are being misclassified as race, with concern expressed that these norms lead to overcorrections that can lead to missed deficits in minority groups (Manly & Echemendia, 2007). The aim of this pilot study was to examine whether potential overcorrection of scores through race-based norms would impact lateralizing effects in TLE in a manner that might affect surgical decision-making. Specifically, we examined verbal expressive language measures to determine if Black/Mixed patients with left TLE exhibit impairment that would be expected on the basis of seizure localization after performance is corrected.

**Participants and Methods:** Patients were 81 adults with video-EEG verified, medically refractory TLE who completed presurgical neuropsychological examinations. Sixty-three of the participants were White and 18 were Black or Mixed race. The Black/Mixed group included 10 left and 8 right TLE (Mage = 42.0) and the White group included 41 left and 22 right TLE (Mage = 41.2). There were no significant differences between groups on age, gender, or education level. All participants provided written informed consent to be included in the Registry for Epilepsy Neuropsychology. Each participant was administered COWAT verbal fluency, animal fluency, and Boston Naming Test (BNT). T-scores were computed using age-, gender-, and race-corrected normative data (Heaton et al., 2004).

**Results:** Examining the Black/Mixed and White groups, analysis of variance did not detect significant effects of race or interaction of race and lateralization on normed tasks of verbal expressive language. The expected effect of lateralization with left TLE patients demonstrating greater impairment was found. However, within the Black/Mixed group, left TLE patients were significantly more impaired than right TLE patients on animals ( $p = .01$ ) and BNT ( $p = .03$ ) with approaching significance on COWAT. These findings suggest that even though scores are being corrected the left TLE group still demonstrates greater impairment on measures of verbal expressive language.

**Conclusions:** Within this limited data set, race-based norms did not on average correct the scores of Black/Mixed patients with TLE to a degree that obscured the expected pattern of poorer performance by those with left as compared to right-sided foci on expressive language measures. Further, the language scores for Black/Mixed patients with left TLE remained mildly impaired relative to norms even after demographic corrections were applied. We are encouraged that in this small sample the most common current normative procedures in current use preserved lateralizing information. However, we should emphasize that it is incumbent on our field to develop normative approaches that correct more directly for those cognitive risk and resiliency factors for which race is a highly incomplete proxy.

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**Keywords:** epilepsy / seizure disorders, psychometrics, laterality

**A. KULKARNI, I. AVILDSEN, E. Z. GAMMADA, L. T. GORELICK, M. POCSAI, L. E. GIBBONS, P. K. CRANE, N. S. FOLDI. Compensatory Cognitive Contributions in Healthy APOE-ε4 Carriers: A Stopgap to Potential Amnesic Decline.**

**Objective:** Presence of the ε4 allele of the apolipoprotein E gene (*APOE-ε4*) increases the risk of late-onset Alzheimer's disease (AD) by nearly three-to-four fold. However, the profiles and the timing of conversion in carriers who progress to disease remains unclear. One possibility is that healthy carriers appear to perform equivalently to non-carriers on memory tasks, but do so by recruiting compensatory cognitive resources. The study objective was to demonstrate that

carriers can buffer against amnesic decline and appear healthy by drawing on compensatory cognitive abilities. We investigated whether the cognitive domains of executive function, language, or visuospatial skills would equally influence or alter the trajectory of memory performance over time. We hypothesized that higher levels of executive and language skills — but not visuospatial skills — would significantly extend the memory benefit in carriers versus in non-carriers. **2. Participants and Methods:** Alzheimer's Disease Neuroimaging Initiative participants, diagnosed with normal cognition at baseline, were followed for a maximum of eight years ( $Mdn = 4$  years). Psychometrically derived composite scores of memory (ADNI-MEM), executive function (ADNI-EF), language (ADNI-LAN), and visuospatial function (ADNI-VS) were utilized. We ran three separate linear mixed models for ADNI-MEM, including *APOE-ε4* carrier status (carrier versus non-carrier), Time (years from baseline), either ADNI-EF, ADNI-LAN, or ADNI-VS, and all relevant interactions as fixed effects, and random slopes for Time and random intercepts for baseline ADNI-MEM. All models were adjusted for baseline age, education, and sex. **3. Results:** Both models of executive function [*APOE-ε4* x ADNI-EF x Time ( $b = 0.02, p = .01$ )] and language [*APOE-ε4* x ADNI-LAN x Time ( $b = 0.02, p = .04$ )] showed a significant three-way interaction on ADNI-MEM scores. Carriers with high baseline ADNI-EF or ADNI-LAN scores of +2 barely showed decline in memory scores over time, while carriers with low ADNI-EF or ADNI-LAN scores of -2 showed significant decline on memory scores, scoring 0.92-1.05 standard deviations lower than non-carriers at eight years from baseline. The visuospatial function model showed no significant main effect or interactions involving ADNI-VS on ADNI-MEM scores. **4. Conclusions:** The findings support our hypothesis that *APOE-ε4* carriers who could retain higher function for specific cognitive skills (executive and language) would be able to buffer memory decline for a period of time. First, we found that carriers with either high executive or high language skills could sustain their memory performance, and this reflected their ability to compensate using alternate resources and to appear healthy. Second, we showed that visuospatial ability, unlike language or executive function, did not significantly influence or help maintain memory performance for either carriers or non-carriers. Thus, only certain cognitive domains can influence compensation. We conclude that relying on "carrier status" alone misses the nuance of possible trajectories of amnesic decline. Rather, we propose that the disease course in healthy carriers varies as a function of the level of other cognitive abilities, where higher values of language or executive function can compensate for the memory decline. These findings suggest that genotype and compensatory cognitive profiles are interdependent.

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**Keywords:** apolipoprotein E, cognitive course, genetic neuropsychology

## **R. KAUTIAINEN, C. KEELER, B. DWIVEDI, T. MACDONALD, T. Z. KING. MTHFR Single Nucleotide Polymorphism Associated with Working Memory in Pediatric Medulloblastoma Survivors.**

**Objective:** Associations have been found between the presence of single nucleotide polymorphisms (SNPs) on the *MTHFR* gene and cognitive outcomes in cancer survivors. A *MTHFR* SNP leads to a reduction in folate and, subsequently, increased levels of homocysteine which is related to neuronal injury in cancer survivors. Prior research has demonstrated that the presence of *MTHFR* SNPs (specifically rs1801131 and rs1801133) in survivors of acute

lymphoblastic leukemia who receive chemotherapy treatment is correlated with impairment in attention and executive functioning. Radiation therapy will also increase homocysteine levels, and limited research has been conducted on medulloblastoma survivors, who receive both chemotherapy and radiation, and the influence of *MTHFR* polymorphisms. The current study examines the associations between rs1801131 and/or rs1801133 SNPs and cognitive performance in long-term medulloblastoma survivors.

**Participants and Methods:** Eighteen pediatric medulloblastoma long-term survivors, on average 12.42 years post-diagnosis, completed the Digit Span Forward, Digit Span Backward, California Verbal Learning Test-Second Edition (CVLT-II) Trial 1, and Auditory Consonant Trigrams (ACT) tests. *MTHFR* gene polymorphisms were detected using whole genome sequencing data and custom scripts within R software. Survivors were split into groups based on whether they had a homozygous or heterozygous polymorphism, which both decrease crucial folate enzyme activity, versus the wild-type genotype (survivors without a polymorphism).

**Results:** Survivors with a rs1801131 polymorphism ( $n=9$ ) performed significantly worse on Digit Span Backward than survivors without this polymorphism ( $p = 0.049$ ). Survivors with a rs1801131 polymorphism performed worse than survivors without the rs1801131 polymorphism on both Digit Span Forward ( $d = 0.478$ ) and the CVLT-II/CVLT-C ( $d = 0.417$ ), with medium effect sizes. There was not a relationship between survivors with a rs1801133 SNP ( $n=10$ ) and performances on attention span ( $p = 0.300$ ) or working memory ( $p = 0.339$ ).

**Conclusions:** Our findings demonstrate the potential links between a *MTHFR* SNP (rs1801131) and attention span and working memory outcomes in long-term pediatric medulloblastoma survivors. Our study establishes a distinction between rs1801131 and rs1801133 polymorphisms and their association with cognition, which aids future studies that focus on targeted biomarkers to improve long-term outcomes. Further studies are needed to cross-validate the relationships between rs1801131 polymorphisms and specific cognitive skills, which will inform precision medicine and targeted cognitive remediation. Cognitive remediation programs have shown significant improvements for attention, planning, and cognitive flexibility in brain tumor survivors. These skills support working memory and the everyday adaptive functioning of survivors. Survivors with genetic vulnerability for attention span and working memory deficits could be ideal candidates for personalized care in cognitive remediation programs.

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**Keywords:** brain tumor, working memory, genetic neuropsychology

### **A. ZATKALIK, A. WHITMARSH, K. FRENN, R. I. PIERPONT, D. KENNEY-JUNG. Associations Between Genotype, Seizure Presentation, and Adaptive Functioning in Individuals with Cardiofaciocutaneous Syndrome.**

**Objective:** Cardiofaciocutaneous syndrome (CFC) is a rare genetic condition that is caused by a pathogenic variant within one of five genes acting downstream in the RAS-MAPK signaling cascade. CFC is associated with physical, neurological and neurocognitive features, including complex and difficult to treat seizures (Pierpont et al., 2014). The impact of genotype and seizure severity on neurodevelopmental function is yet to be characterized in this population. The current study evaluated whether variability in seizure presentation, seizure severity, adaptive functioning, and/or gross motor functioning were accounted for by differences among the gene variants associated with CFC.

**Participants and Method:** A multinational cohort of caregivers (n=125) of individuals with genetically confirmed CFC (aged 7m to 28y) were recruited to complete a survey to obtain information about neurological and neurodevelopmental complications experienced by their child. Seizure severity was quantified via the E-Chess scale (Humphrey et al., 2008). Adaptive function was assessed via the GO4KIDDS scale (Perry et al., 2014), a measure developed to assess communication, social, and self-care skills among children with intellectual disabilities. Gross motor functioning was measured via the Gross Motor Function Classification System (Palisano et al., 2007), a 5-level classification system for describing the gross motor development of youth with orthopedic and motor impairment.

**Results:** Seizures were present in roughly 60% of patients with *BRAF* or *MAP2K1* variants, as compared to only 25% of participants with the *MAP2K2* variant. Seizures were not present in either of the children with *KRAS* variants. Gene variant was not reliably associated with seizure severity or level of adaptive functioning. Compared to the other gene variants, individuals with a *MAP2K1* variant showed higher impairment in gross motor functioning.

**Conclusions:** While seizures were more prevalent in individuals with *BRAF* and *MAP2K1* mutations, seizure severity and adaptive functioning were similar across the genotypes and displayed wide variability across individuals. In children with a high degree of multi-system medical complexity and neurological involvement like CFC, measures designed for children with intellectual impairment may better capture the full range of functioning than traditional neuropsychological testing. Gross motor impairment was especially prevalent among individuals with *MAP2K1* variants which could potentially reflect a higher rate of orthopedic concerns among individuals with this genotype.

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**Keywords:** genetic disorders, genetic neuropsychology, adaptive functioning

**A. WHITMARSH, A. ZATKALIK, K. FRENN, D. KENNEY-JUNG, R. I. PIERPONT. Neurodevelopmental Characterization of CFC Syndrome, an Epilepsy-Associated Neurogenetic Disorder.**

**Objective:** Cardiofaciocutaneous (CFC) syndrome is a rare disease of the RAS-MAPK pathway associated with a host of physical and developmental complications, including hallmark cardiac, facial, and ectodermal features. Compared to other RASopathies, CFC is associated with greater neurological impairment, though developmental outcomes are wide-ranging (Grebe and Clericuzio, 2000). Intractable seizures may have a particular impact on cumulative lifetime disease burden, neuropsychological morbidity, and mortality. The aim of the current study was to characterize the neurodevelopmental features of a multinational sample with varied medical involvement.

**Participants and Methods:** A large sample of caregivers for living and deceased individuals with genetically confirmed CFC (ages 5y-28y) via *BRAF* (n=72), *MAP2K1/MEK1* (n=28), *MAP2K2/MEK2* (n=4), and *KRAS* (n=1) pathogenic variants completed an online survey detailing developmental and medical backgrounds with ratings of behavioral, cognitive, adaptive, and gross motor functioning. Caregivers rated each individual's adaptive functioning using the GO4KIDDS, a validated brief assessment tool developed for those with severe intellectual disability (Perry et al. 2015), as well as the Gross Motor Classification System (Palisano et al., 2007). Lifetime seizure severity was quantified using the E-Chess scoring system (Humphrey et al. 2008). Sleep disturbances were assessed with a standardized sleep quality

assessment tool from PROMIS<sup>®</sup>. Available supplemental medical records, including neuropsychological testing, were reviewed by clinicians.

**Results:** Although most individuals with CFC (68%) were estimated to have mild to severe intellectual impairment (below a standard score of 70), a subset of individuals (32%) were indicated to have a degree of cognitive resilience (above a standard score of 70). Generally, higher rated cognitive ability was associated with less severe seizures. A notable case of average intellect and a high seizure burden was revealed. Seizure burden was generally associated with adaptive functioning, such that individuals with epilepsy had lower ratings of independent adaptive skills and gross motor skills. Further, among individuals with epilepsy, more severe seizures were associated with greater impairment in adaptive functioning and motor skills. Poor sleep quality was also associated with lower adaptive skills, though sleep quality was not tied to seizures. Prematurity was associated with lower adaptive ratings, though not with the presence of seizures.

**Conclusions:** There is considerable variability across genetically confirmed CFC participants with regard to intellectual and adaptive skills. A subset of cognitively resilient individuals was captured, consistent with select reports elsewhere. In the context of numerous potential medical complications, seizure control remains a top clinical priority. Improving and protecting sleep quality should also be incorporated into routine clinical care.

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**Keywords:** epilepsy / seizure disorders, genetic disorders, pediatric neuropsychology

### **A. LY, J. NAPAN. Exploring Associations Between Child Traumatic Stress, Depressive Symptoms, Metabolic Syndrome, and Working Memory in a National Sample of Young Adults.**

**Objective:** Childhood traumatic events (i.e. adverse childhood experiences (ACEs)) are exceedingly common yet often overlooked environmental factors that have potential immediate and long-term effects on health and development. Children who experience traumatic stress secrete higher levels of glucocorticoid cortisol, which can have neurotoxic effects on the brain areas involved in memory and executive functioning. In addition, ACEs have been linked with an increased risk of chronic illness (i.e., cancer, heart disease, diabetes, and mental illness) in adulthood. Moreover, metabolic factors are related to measures of working memory in adults and overall cognitive dysfunction. Other social determinants of health, such as food insecurity, are suggested contributors to lower cognitive functioning as well. The current study sought to examine several biopsychosocial factors associated with working memory performance in a national sample of young adults.

**Participants and Methods:** Participants included 4,811 young adults aged 24 to 32 ( $M = 29.01$ ,  $SD = 1.78$ ) from the National Longitudinal Study of Adolescent to Adult Health (Add Health), a multi-wave longitudinal study of adolescents in the United States. Data were analyzed from Wave IV in-home interviews from the study. Memory measures, including a 15-item word recall task with immediate and delayed free-recall trials, and a 14-trial, 7-digit backward-digit span task, were administered during the interview. Participants completed a 10-item version of the Center for Epidemiologic Studies Depression Scale (CES-D) and provided self-report responses to questions regarding childhood traumatic stress (e.g. abuse, parental incarceration), food insecurity, neighborhood safety, the presence of metabolic syndrome (hypertension, hyperlipidemia, high blood sugar and/or diabetes mellitus, and cardiovascular disease), as well as

demographic information (income, education). A bivariate correlational analysis was conducted to evaluate Pearson product-moment correlations between traumatic stress, depressive symptoms, metabolic conditions, and measures of working memory.

**Results:** Metabolic conditions, depressive symptoms, and several environmental factors were associated with performance on working memory tasks. Specifically, hypertension, depressive symptoms, food insecurity, and neighborhood safety were negatively correlated with both word recall tasks and backwards digit span. High blood sugar/diabetes and cardiovascular disease were negatively correlated with backwards digit span. Income and education were positively correlated with both cognitive tasks. Childhood traumatic stress was not significantly correlated with any of the cognitive measures; however, it was positively correlated with depressive symptoms, hyperlipidemia, hypertension, high blood sugar/diabetes, food insecurity, neighborhood safety, and negatively correlated with income and education.

**Conclusions:** Findings suggest a biopsychosocial contribution to memory processes among young adults, giving light to the presence of a number of traumatic, environmental, metabolic, and psychological factors on working memory. Future research may seek to examine potential pathways involving these biopsychosocial factors on attenuated cognitive functioning in young adulthood. Likewise, an emphasis on focusing on children with adverse childhood experiences may have immediate and long-term effects at reducing the risk of chronic health conditions that may interact with cognitive status later in life.

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**Keywords:** working memory, medical disorders/illness, childhood maltreatment

**M. A. PAVOL, M. MAURER, A. K. BOEHME, M. YUZEFPOLSKAYA, J. CASIDA, J. R. FESTA, C. IBEH, J. Z. WILLEY. Cognition Predicts Days-Alive-Out-Of-Hospital After Implantation of Left Ventricular Assistive Device (LVAD).**

**Objective:** Left ventricular assistive devices (LVADs) have become the mainstay of therapy for advanced heart failure (HF). However, re-hospitalization post-LVAD is a common problem that hampers patient quality of life (QOL). We sought to examine the relationship between cognition and days-alive-out-of-hospital (DAOH) in a cohort of patients after LVAD. We hypothesized that cognition prior to LVAD surgery would predict DAOH after surgery.

**Participants and Methods:** We retrospectively identified 59 HF patients who had cognitive assessment prior to implant of continuous-flow (CF) or pulsatile (PF) LVADs. Cognitive assessment included measures of attention (WMS-III Digit Span (DSpan)), memory (Hopkins Verbal Learning Test-Revised (HVLT); Brief Visual Memory Test-Revised (BVMT); WMS-III Logical Memory I & II (LM)), visuospatial speed (Trail Making Test (TMT)-Part A), and executive function (TMT-Part B; verbal fluency-FAS; Rey Complex Figure-Copy). Raw scores were converted to z-scores derived by comparisons to published normative samples and averaged into one score per patient. DAOH was converted to a percentage based on total days from LVAD surgery to either heart transplant or 900 days post-LVAD surgery. Univariate analyses examined the association between DAOH, pre-LVAD cognition, and various demographic and medical characteristics. Mann-Whitney U tests were used for categorical variables and correlation analyses for continuous variables. Variables that were significantly associated with DAOH in univariate analyses were included in a linear regression model to predict percentage of DAOH.

**Results:** Average age for the cohort was 54 ( $\pm 13$ ) years, 85% were men, 58% had more than a high school education, and 76 % had CF LVADs. The average time between pre-surgical cognitive exam and LVAD implantation was 448 days. Average cognitive z-score was -0.99 ( $\pm 1$ ; range: -3.6 – 0.55). Univariate analyses found significant associations between DAOH and LVAD type (CF vs PF) and DAOH and average pre-LVAD cognitive z-score. CF LVAD was associated with higher DAOH and higher cognitive z-score was associated with higher DAOH. A linear regression model including LVAD type and the pre-LVAD cognitive score significantly predicted DAOH ( $F(2,54) = 6.44, p = .003, R^2 = .19$ ). Inspection of each variable indicated that cognition was a significant predictor in the model ( $t = 2.8, p = .007, B = .108$ ) but LVAD type was not a significant predictor ( $p = .08$ ).

**Conclusions:** Cognitive performance assessed prior to LVAD implantation predicted how much time patients spent out of the hospital following surgery, an important index of QOL. Further studies are warranted to identify the impact of pre-LVAD cognition on post-LVAD outcomes in order to optimize patient function.

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**Keywords:** quality of life, cardiovascular disease

**M. A. PAVOL, A. K. BOEHME, M. YUZEPOLSKAYA, J. CASIDA, J. R. FESTA, C. IBEH, J. Z. WILLEY, M. MAURER. Cognitive Profile of Patients with Stroke or Death After Implantation of Left Ventricular Assistive Device (LVAD).**

**Objective:** Left ventricular assistive devices (LVADs) have become the mainstay of therapy for advanced heart failure (HF). We aimed to study the relationship between cognition, stroke, and death in a cohort of LVAD patients. We hypothesized that patients who suffered stroke or died after LVAD would have a different profile of pre-LVAD cognitive scores than those without these complications.

**Participants and Methods:** We retrospectively identified 59 HF patients who had cognitive assessment prior to implant of continuous-flow (CF) or pulsatile LVADs. Cognitive assessment included measures of attention (WMS-III Digit Span (DSpan)), memory (Hopkins Verbal Learning Test-Revised (HVLTR); Brief Visual Memory Test-Revised (BVMT); WMS-III Logical Memory I & II (LM)), visuospatial speed (Trail Making Test (TMT)-Part A), and executive function (TMT-Part B; verbal fluency-FAS; Rey Complex Figure-Copy). Raw scores were converted to z-scores derived by comparisons to published normative samples. Mann-Whitney U analyses (without correction for multiple comparisons) were performed to compare groups with and without post-LVAD stroke and death within a follow-up period of time-to-heart transplant or 900 days post-LVAD surgery.

**Results:** Average age for the cohort was 54 ( $\pm 13$ ) years, 85% were men, 58% had more than a high school education, and 76 % had CF LVADs. The average time between pre-surgical cognitive exam and LVAD surgery was 448 days. The average test scores for groups without stroke or death were generally within the lower range of normal (z-score range -1.3 to 0.1) with the exception of TMT-Part B which was impaired for all groups (z-score  $< -2.1$ ). Patients who suffered stroke in the follow up period had significantly lower scores for these tests: DSpan ( $p=.008$ ); HVLTR-Recognition ( $p=.033$ ); BVMT-Recognition ( $p=.039$ ); LM-I ( $p=.030$ ). Patients who died had significantly lower scores for these tests: DSpan ( $p=.034$ ); HVLTR-Learning ( $p=.006$ ); HVLTR-Recall ( $p=.007$ ); HVLTR-Recognition ( $p=.003$ ); BVMT-Learning ( $p=.004$ ); BVMT-Recall ( $p=.004$ ); LM-I ( $p=.010$ ); LM-II ( $p=.002$ ); TMT-Part B ( $p=.001$ ).

**Conclusions:** Patients with post-LVAD stroke or death had significant differences in pre-LVAD cognition compared to those who did not suffer these outcomes. Specifically, patients with post-LVAD stroke showed reductions in pre-LVAD attention and recognition memory. Patients with post-LVAD death had reductions in pre-LVAD attention and many aspects of memory (learning, recall, recognition). Findings suggest that patients who suffer post-LVAD stroke or death have a pre-LVAD cognitive profile consistent with Amnesic Mild Cognitive Impairment, a frequent precursor to dementia. Prospective studies are needed to clarify the pre-LVAD cognitive profile for patients who develop poor post-LVAD outcomes. Successful identification of patients at risk for adverse post-LVAD outcomes has potential to improve pre-surgical patient selection and post-surgical management for this care-intensive therapy.

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**Keywords:** cardiovascular disease, mild cognitive impairment

**J. HAMMOND, M. HERZOG, J. G. PORTNOY, B. C. LEMONDA. Posterior Reversible Encephalopathy Syndrome (PRES) in a Recovered COVID-19 Patient with Sickle Cell Anemia: A Neuropsychological Case Study.**

**Objective:** Corona Virus Disease 2019 (COVID-19) has been declared a global pandemic, with over 4 million people infected with the disease worldwide at the end of summer of 2020. Rare neurological complications of COVID-19, such as posterior reversible encephalopathy syndrome (PRES), have been documented in the literature. PRES, which is associated with a distinctive parieto-occipital pattern on neuroimaging reflecting vasogenic edema, includes features such as headache, seizure, stroke, and visuospatial changes. Little is known regarding recovery of cognitive function in PRES patients in general, with even less knowledge relating to outcomes in COVID-19 patients. We present the case of a woman with a history of sickle cell anemia (SCA) who developed a PRES-like syndrome following diagnosis of COVID-19. This case study seeks to add to the literature on neuropsychological functioning among patients with COVID-19 related neurological complications.

**Participants and Methods:** Patient is a 55-year-old African-American woman with a history of SCA who presented to a NYC hospital with a COVID-19+ diagnosis. Hospital course was complicated by status epilepticus, kidney disease, and increased risk of stroke secondary to SCA. She was readmitted the following month with right leg weakness. Neuroimaging at that time revealed new infarcts (watershed areas, PCA territory, and right cerebellum), parietal lobe hemorrhage, and suspicion of PRES-like syndrome (T2/FLAIR signal in frontal and parietal white matter). Given concern for ongoing seizure activity, she was admitted to the EMU for vEEG monitoring four months later. At that time she was referred for comprehensive neuropsychological evaluation in light of ongoing complaints of visuo-perceptual difficulties, short-memory changes, slowed processing, and word-finding difficulties.

**Results:** General intellectual functioning was within expectations. Attention, working memory, processing speed, and language abilities were well preserved. Weaknesses in executive functioning were present, (difficulties with set-shifting, novel problem-solving, and visual planning and organization, as well as perseverative tendencies). Verbal memory was intact; nonverbal memory was weak secondary to visuoconstructional deficits noted above. She denied significant affective distress and appeared well-adjusted psychologically.

**Conclusions:** We present on the cognitive profile of a 55-year old African American woman with a history of SCA, kidney disease, and rare neurological sequelae secondary to a diagnosis of

COVID-19. Her neurocognitive profile revealed frontal inefficiencies and visuospatial-organizational weaknesses, consistent with the limited literature on neurocognitive functioning in PRES. In this case, findings are presumed to be related to her recent multi-infarcts and PRES-like findings on MRI. Results suggest moderate resolution of cognitive symptoms. Repeat MRI is recommended to examine correlation of behavioral data with neuroimaging. Careful monitoring of cerebrovascular risk factors and management of SCA are important to reduce risk of future stroke. As additional COVID-19 associated PRES cases emerge, longitudinal cognitive assessment of these patients can provide more insight into the course, trajectory, and recovery of cognitive function in this population. At present, we provide evidence of a guarded recovery of function from one patient with evidence of PRES following COVID diagnosis.

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**Keywords:** infectious disease, sickle cell disease, cerebrovascular injury

### **M. A. FERNANDES, S. NA, A. IOACHIMESCU, S. PENNA. Contributions of Attention to Memory Deficits in Patients with Cushing's Syndrome.**

**Objective:** Cushing's syndrome (CS) is an endocrine disorder characterized by chronic hypercortisolism resulting from a pituitary, adrenal, or neuroendocrine tumor. Research has linked chronic hypercortisolism with brain structure changes, as well as neuropsychological dysfunction. In its active phase, CS is associated with impairments in memory, concentration, visuospatial functioning, and language functioning. Prior research in this area has focused on memory impairment due to patient complaints of memory loss, hippocampal sensitivity to cortisol, and imaging studies showing reduced hippocampal volumes; however, studies generally report a summative score of memory functioning. This precludes us from evaluating specificities of memory deficits, given that encoding of information relies heavily on attention processes. This study aimed to assess the role of attention in component processes of memory, including encoding, retention, and recognition.

**Participants and Methods:** The participants of this retrospective study consisted of 18 adult patients diagnosed with CS (mean age 41.6 years, SD=10.6, 72% Caucasian, 83% female) assessed at an outpatient neuropsychology clinic as part of their standard medical care. Patients were administered a battery of age-normed measures assessing attention, processing speed, visuospatial functioning, memory, language, and executive functioning. We conducted bivariate Pearson correlations among performance metrics of a sustained attention task (Conners Continuous Performance Test- 2<sup>nd</sup> Edition), including speed, accuracy, and consistency of performance across the task, and performance metrics of a verbal list-learning task (California Verbal Learning Test-2<sup>nd</sup> Edition), including learning (Trials 1-5), retention (short and long delay recalls), and recognition. Given the small sample size due to the rarity of the condition, significance was set at the uncorrected  $p$  value  $< 0.05$ .

**Results:** Performance on Trial 1 of the CVLT-2 was significantly associated with faster reaction time (Hit Reaction Time ( $r = 0.556$ ,  $p < 0.05$ )), more consistent response times (Hit Reaction Time Standard Errors ( $r = 0.597$ ,  $p < 0.05$ )), and fewer perseverative responses ( $r = 0.659$ ,  $p < 0.01$ ) on the CPT II. Higher commission errors on the CPT II were associated with lower performance on CVLT Total Learning ( $r = -0.522$ ,  $p < 0.05$ ) and List B Recall ( $r = -0.651$ ,  $p < 0.01$ ).

**Conclusions:** Our findings suggest that attention difficulties might contribute to deficits in initial information encoding. Specifically, faster processing speed and better consistency of sustained

attention, but not accuracy, were associated with initial encoding. Faster processing speed may facilitate the amount of words that patients attend to during the first trial. Additionally, the association between higher commission errors and poorer List B Recall performance suggests a shared neurobiological process of frontal dysfunction, which is consistent with alterations in prefrontal brain regions showed by neuroimaging. Our findings highlight the need for patient and clinician education regarding the interrelations between memory and attention and open the way for targeted interventions that improve attention, with potential downstream improvement of learning and recall. The small sample size of the present study is a notable limitation. Research is currently underway to replicate these findings in a prospective study with an appropriate control group and a larger sample.

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**Keywords:** Cushing's disease, cognitive functioning, neuropsychological assessment

### **A. WISINGER, N. HANSEN, M. STIKA. The Role of Cognition in the Functional Assessment of Daily Living Abilities in Older Adults with Spinal Cord Injuries: A Narrative Literature Review.**

**Objective:** Determining the degree to which an individual's cognitive deficits interfere with their activities of daily living (ADLs), both basic and instrumental (IADLs), is a key criteria of diagnosing a neurocognitive disorder. As such, adequately assessing functional capabilities becomes a critical component of a comprehensive neuropsychological evaluation, particularly when assessing older adults as part of a dementia work-up. However, this task can be particularly challenging in a physically compromised population, including patients with spinal cord injury (SCI), whose change in functional ability can be more attributable to motor limitations as opposed to cognitive decline. Importantly, due to advances in rehabilitation medicine, individuals with SCI are living longer and thus there is an increased number of individuals living with both SCI and dementia. Parsing apart the contributions of cognitive changes versus limited motor capabilities in one's functioning is difficult, yet vital to avoid over-/under-pathologizing a patient's current functional presentation. The current study reviewed the literature regarding measures used to quantify the functional assessment of ADLs and IADLs in a comprehensive neuropsychological evaluation in patients with SCI.

**Participants and Methods:** A narrative style literature review was conducted to synthesize current findings in both the neuropsychological and physical disability literature related to functional assessment of those with SCI. Keywords including the following were identified: "Spinal Cord Injury", "SCI", "paraplegia", "quadriplegia", "tetraplegia", "neuropsychology", "neuropsychological assessment", "dementia", "cognitive assessment", "cognitive functioning", "function", "functional assessment", "IADL", and "ADL". The following databases were searched: PubMed, EBSCO Host, and Cochrane Library.

**Results:** Our narrative review identified multiple studies that utilized functional assessment measures that have been adapted to or modified for SCI populations: Spinal Cord Independence Measure (SCIM), Modified Barthel Index (MBI), Functional Independence Measure (FIM), and Quadriplegia Index of Function (QIF). Notably, the majority of these articles were published in the 1990s, and there has been a significant gap in the literature on this topic since. Main themes identified in our review were an increase in the number of older adults living with SCI, a lack of focus on cognitive change in functional assessment post-SCI more broadly, and limited ecological validity of cognitive aspects in current functional measures of SCI.

**Conclusions:** In the past several decades, there has been limited research on the functional assessment of ADL/IADL functioning in individuals with physical disabilities, including SCI. While many of the existing measures of functional assessment in SCI speak to the general capacity of one's physical recovery and level of physical functioning post-injury, few address one's recovery and capacity from a cognitive perspective. Further, these measures often do not address the ecological validity of cognitive functioning. Additional research is needed exploring the extent to which one's cognitive abilities, rather than their physical limitations, impacts daily living abilities in older individuals with SCI. Finally, the results of this narrative literature review speak more broadly to the need for the development of objective measures that are sensitive to patients with different physical and sensory abilities who experience cognitive concerns.

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**Keywords:** adaptive functioning, spinal cord injury, aging disorders

## **H. HEPPNER, H. FERENTZI, W. ALBERT. Postoperative Cognitive Dysfunction after Aortic Valve Surgery..**

**Objective:** Postoperative cognitive dysfunction (POCD) is a frequent complication after cardiac surgery, particularly in the elderly population. However, the assessment of POCD in the current scientific literature shows a profound lack of consensus. Duration of cardiopulmonary bypass (HLM) during surgery and preoperative depressive symptoms have frequently been identified as relevant risk factors, though the relationship with POCD is not regularly agreed upon. Most research regarding POCD is currently done with patients undergoing bypass surgery; however, these findings cannot be readily generalized to other cardiac surgeries such as aortic valve surgery. The aim of this study was thus to investigate the relationship between POCD and aortic valve surgery in the elderly population.

**Participants and Methods:** A total of 19 elderly patients ( $M = 71.58$  years,  $SD = 7.07$  years) were included in the study, using a prospective observational cohort design without a control group. Cognitive performance was measured via the Syndrom-Kurz-Test and Stroop Color and Word Test. Depressive symptoms were measured using the Hospital Anxiety and Depression Scale.

**Results:** Results of the repeated measures analysis of variance showed a significant reduction of cognitive performance in the domains attention ( $p < 0.01$ ;  $\eta^2p = 0.65$ ) and memory ( $p = 0.014$ ;  $\eta^2p = 0.29$ ). No such relationship was observed in the domain executive function. No significant relationship was found between intraoperative HLM or preoperative depression score and a reduction in cognitive performance in any of the tested domains ( $p > 0.05$ ). No relationship between POCD and HLM or preoperative depressive symptoms was found.

**Conclusions:** POCD could be observed in this study. The results from this suggest that previous findings from other types of heart surgeries regarding post-operative cognitive decline apply to aortic valve surgeries as well. Future studies should use a homogenous definition of POCD and differentiate between cardiac surgeries.

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**Keywords:** cardiopulmonary disease, depression, cognitive functioning

**E. J. POLLNER, K. YERNENI, C. MOSTI, J. STRATTON, Z. MARTINOVICH, M. BROOK. Neurocognitive Change over the Course of a 3-day External Lumbar Drain Trial in Patients with Suspected Normal Pressure Hydrocephalus.**

**Neurocognitive change over the course of a 3-day external lumbar drain trial in patients with suspected normal pressure hydrocephalus**

**Objective:** Normal Pressure Hydrocephalus (NPH) is characterized by ventriculomegaly and a clinical symptom triad of gait disturbance, urinary incontinence, and cognitive impairment. Permanent shunt implantation to divert excess CSF from the brain is the first-line treatment for NPH. To evaluate candidacy for shunting, a patient may be admitted for a 3-day external lumbar drain (ELD) trial, whereby excess CSF is gradually drained via a lumbar tap catheter. Improvement in gait and cognition over the course of the ELD trial is considered a positive prognostic indicator for shunt responsiveness. However, there is little empirical evidence to suggest that standard neurocognitive measures can reliably detect change in cognition over the course of a 3-day ELD trial. The current study was designed to address this gap.

**Participants and Methods:** We conducted a retrospective chart review of N=70 inpatients with suspected NPH who were admitted to a neurology step-down unit of a large academic medical center for an ELD trial. Cognition and gait were assessed at two time points, before and after lumbar tap placement. Patients were administered a brief repeatable battery of neurocognitive measures that assessed attention and executive functions, immediate and delayed memory, language, and visuospatial processing. The Balance Berg Test was used to measure gait. Neuroimaging data was also collected from baseline MRI and CT scans. Statistical analyses examined change in neurocognitive test scores over the course of the 3-day ELD trial. Relationships between change in cognitive test scores and gait as well as baseline neuroimaging data will be assessed in future analyses.

**Results:** Preliminary analyses suggested statistically significant improvements ( $p < .05$ ) on WAIS forward span, phonemic fluency, and select RBANS subtests including coding, semantic fluency, immediate list recall, immediate and delayed story recall, and delayed figure recall. Effects sizes ranged from small to medium. In contrast, participants made significantly more false positive errors on delayed list recognition, post-ELD.

**Conclusions:** Findings suggest that standard neuropsychological measures may be sufficiently sensitive in detecting change in cognition over the course of a multiday ELD trial for patients with suspected NPH. Future analyses will examine whether these changes are associated with baseline neuroimaging and changes in gait during ELD trials.

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**Keywords:** aging disorders, brain disorder, neuropsychological assessment

**B. CARSON, E. J. CONNORS, A. O. HAUSON, N. P. STELMACH, A. A. POLLARD, N. S. PATEL, C. FLORA-TOSTADO, A. RUIZ. Processing Speed in Patients with Heart Failure: A Meta-Analysis and Research Synthesis.**

**Objective:** Heart failure (HF) has been associated with changes in cognitive functioning; however, the extent of these changes remains unknown. Processing speed plays a role in the ability to perform higher-order cognitive tasks and therefore plays a central role in many other neuropsychological abilities. This meta-analysis investigates the relationship between HF and processing speed using the Trail Making Test-Part A (TMT-A).

**Participants and Methods:** Two researchers examined eight databases, extracted data, and calculated effect sizes as part of a larger study on the neuropsychology of HF. Inclusion criteria were: (a) adults with a diagnosis of HF, (b) an active control group with comparable demographics (e.g., groups matched on age), (c) standardized neuropsychological/cognitive testing, and (d) data that allows for the calculation of effect size. Exclusion criteria were: (a) the HF group had other types of major organ failure (i.e., lung or liver failure), (b) the comparison was between different classes of HF (i.e., New York Heart Association (NYHA) Class II versus NYHA Class III), (c) the article was not published or translated into English, or (d) there was a risk of sample overlap with another included study. Ten articles were included in this study with a total sample of 1298 participants.

**Results:** Using the TMT-A to assess processing speed showed a statistically significant and small effect size ( $g = 0.477$ , 95% CI [0.277, -0.677],  $z = 4.681$ ,  $p < .001$ ). The heterogeneity of processing speed was statistically significant and high ( $I^2 = 58.274$ ,  $Q(9) = 21.569$ ,  $p = 0.010$ ,  $Tau^2 = 0.057$ ).

**Conclusions:** Given both the high heterogeneity and the small effect size of TMT-A, it is difficult to specifically link the results of the test itself to processing speed deficits in HF. For example, some HF patient groups studied in the articles that met inclusion criteria might have been impacted by motor difficulties unrelated to processing speed that resulted in poorer performance on TMT-A. Future research should examine potential confounding factors in order to explain such high heterogeneity and small effect sizes in the literature.

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**Keywords:** information processing speed, cardiovascular disease, vascular cognitive impairment

**N. S. LACKEY, A. O. HAUSON, E. J. CONNORS, N. NEMANIM, A. A. POLLARD, B. D. BARLET, C. FLORA-TOSTADO, C. M. CABRAL. Comparison of the Mini-Mental Status Examination Versus the Montreal Cognitive-Assessment in Patients with Heart Failure.**

**Objective:** Heart failure (HF) is associated with widespread changes in cognition. Administration of brief cognitive screeners such as the MMSE (Mini-Mental State Exam) and the MoCA (Montreal Cognitive-Assessment) have become common practice in clinical work to screen for such changes. This meta-analysis investigates these two cognitive screeners among individuals with HF.

**Participants and Methods:** Two researchers independently searched eight databases, extracted required data, and calculated effect sizes as part of a larger study on the neuropsychology of HF. Inclusion criteria were: (a) adults with a diagnosis of HF, (b) an active control group with comparable demographics (e.g., groups matched on age), (c) standardized neuropsychological/cognitive testing, and (d) data that allows for the calculation of effect size. Exclusion criteria were: (a) the HF group had other types of major organ failure (i.e., lung or liver failure), (b) the comparison was between different classes of HF (i.e., New York Heart Association (NYHA) Class II versus NYHA Class III), (c) the article was not published or translated into English, or (d) there was a risk of sample overlap with another included study.

**Results:** Thirteen articles used the MMSE (HF  $n = 1166$ , HC  $n = 1948$ ) and three articles used the MoCA (HF  $n = 107$ , HC  $n = 128$ ) were identified. The MMSE evidenced a moderate and statistically significant effect size ( $g = .630$ ,  $p < .001$ ) with high and significant heterogeneity ( $I^2$

= 79.648,  $p = .001$ ). The MoCA yielded a large and statistically significant effect size ( $g = .836$ ,  $p < .001$ ) with no evidence of heterogeneity ( $I^2 = 0.000$ ,  $p = .903$ ).

**Conclusions:** Deficits in cognitive functioning among individuals with HF were observed to be similar when using the MMSE and the MoCA. This suggests that these screeners equally detect gross cognitive changes in this population. These findings are limited by the small number of articles for MoCA and the significant heterogeneity in the MMSE. Future research should examine the sources of the heterogeneity in the MMSE findings. In addition, it is important to determine whether the lack of heterogeneity in the MoCA is simply the result of the small number of articles or some test-related characteristic that makes it better suited as a screener for cognitive decline in HF.

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**Keywords:** cognitive screening, cardiovascular disease, neuropsychological assessment

#### **D. KELLY, M. LACY. Cerebrovascular Risk Factors and Cognition in Idiopathic Normal Pressure Hydrocephalus.**

**Objective:** Idiopathic Normal Pressure Hydrocephalus (iNPH) is a neurological disorder that presents in older adulthood and can cause cognitive impairments including reduced learning or acquisition of information. Cerebrovascular risk factors are common amongst older adults and are an independent risk factor for cognitive decline. Research has shown that individuals with iNPH and at least one vascular risk factor are more likely to demonstrate cognitive impairments than those with iNPH and no vascular risk factors. The purpose of this study was to examine the individual and cumulative contributions of the most common vascular risk factors on cognition in individuals with iNPH.

**Participants and Methods:** This retrospective study included 49 individuals who were diagnosed with possible iNPH and referred for a neuropsychological evaluation. Demographics, medical comorbidities, and performances on the Mini-Mental State Examination [MMSE] and Repeatable Battery for Assessment of Neuropsychological Status [RBANS] were gleaned from a review of available medical records. Linear regressions and paired sample t-tests were conducted to investigate the relationship between five common vascular risk factors [hypertension, hyperlipidemia, diabetes, obstructive sleep apnea (OSA), and nicotine usage] and cognition. Vascular risk factors were examined individually (e.g., presence or absence of hypertension) and cumulatively (sum of factors ranging from 0-5).

**Results:** Participants were 49 educated [*Mean (M)*=15 years, *Standard Deviation (SD)*=2.8], older adults (Age: *M*=71.9 years, *SD*=10.1) with on average 2.6 (*SD*=1.3) vascular comorbidities (76% of the sample had hypertension, 67% had hyperlipidemia, 29% had diabetes, 25% had OSA, and 65% had a history of nicotine use). They had mildly impaired global cognition (MMSE: *M*=25.8, *SD*=4.9; RBANS Total Standard Score: *M*=75.9, *SD*=15.4). Controlling for age and education, the number of vascular comorbidities was not significantly related to RBANS Total score ( $R^2=0.04$ ,  $p=0.16$ ). However, the number of vascular comorbidities was significantly related to RBANS immediate memory (IM;  $R^2=.10$ ,  $p=.02$ ) such that having more risk factors was associated with a decrease in performance ( $b = -0.327$ ). No other RBANS domains were significantly predicted by cumulative vascular comorbidities. When investigating each risk factor individually, those with hyperlipidemia had lower scores on RBANS IM than those without (With: *M*=74.9, *SD*=19.2, Without: *M*=91.9, *SD*=16.5,  $t=3.06$ ,  $p=.004$ ). Comorbid diabetes also

trended in this direction ( $p=.051$ ). Comorbid hypertension ( $p=.13$ ), OSA ( $p=.62$ ), and history of nicotine use ( $p=.48$ ) were not significantly related to IM or any other RBANS domains.

**Conclusions:** In our iNPH cohort, the number of vascular comorbidities as well as hyperlipidemia independently were related to acquisition of information, a cognitive ability often interrupted by both iNPH and cerebrovascular disease. Awareness of these relationships may inform differential diagnoses and advise appropriate treatment recommendations. Future studies in this area should consider investigating the impact of cerebrovascular burden on neuroimaging (e.g., microvascular changes) and their relationship with cognition in individuals with iNPH.

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**Keywords:** hydrocephalus, vascular cognitive impairment

### **J. S. PRICE, K. J. KANGAS. Neuropsychological functioning and outcomes among heart failure patients referred for mechanical support and transplant: Insights from the Transplant Neuropsychology and Intervention Clinic.**

**Objective:** Individuals with heart failure have increased incidence of cognitive impairment, thought to be related to poor cerebral perfusion and/or microemboli. Cognitive deficits can negatively impact outcomes post- left ventricular assist device (LVAD)/heart transplant, including quality of life and adherence to a complex medical regimen. Further, patients with nonadherence may be deferred for treatment, which can result in additional neurologic and medical complications. Current literature is limited and often excludes patients with typical heart failure comorbidities, like stroke, poor literacy and psychiatric challenges. To address these issues, we developed a specialized, integrated clinic to conduct neuropsychological assessment and implement tailored treatments to optimize functioning. Here, we describe the service and report preliminary clinical data.

**Methods:** The Neuropsychology and Intervention Clinic is a subspecialty of the Transplant Psychology service, integrated within the solid organ transplant program. Patients were referred in the context of evaluation for LVAD/transplant or, if post-treatment, if cognitive concerns or functional/adherence challenges were identified. Streamlined neuropsychological assessment using standardized tests was completed in the inpatient or outpatient setting, depending on medical acuity; domains included reading ability, attention, processing speed, language fluency, verbal memory, visual memory and executive function. All aspects of clinical research were IRB-approved.

**Results:** Between 6/2018 and 9/2020, 21 heart failure patients were referred for evaluation; four were post-LVAD and 6 post-transplant. Among the 11 tested prior to LVAD/transplant, mean age was 55 years (34-69) with mean education 13.5 years (12-16). Sixty percent were female, 30% were black, 50% had a prior neurologic event, and 50% met criteria for a mood disorder. Mean performances across cognitive domains were low average to average ( $SS=80-95$ ). Women had significantly better executive function ( $p=.02$ ); there were no other gender differences. Four patients were declined for treatment, due to inadequate medical criteria (3/4) and nonadherence (1/4). Three patients (all white) received transplants, and 2 (black) received LVADs; one LVAD patient improved and underwent explant. One patient (white) died 5 days after total artificial heart implantation. When examining outcomes by race, despite similar education black patients had significantly worse reading ( $p=.04$ ) and phonemic fluency ( $p=.03$ ) and trended towards poorer verbal memory recall ( $p=.097$ ). Of the 4 patients who met criteria for a cognitive disorder,

2 were black and demonstrated nonadherence post-LVAD. Among those post-transplant, one patient with mild cognitive impairment demonstrated improved cognition but was rehospitalized due to nonadherence.

**Conclusions:** In the first two years of the Neuropsychology and Intervention Clinic, nearly half of referrals to the service were heart failure patients. Those pre-LVAD/transplant demonstrated overall intact cognitive functioning. However, there were discrepancies according to individual differences in this small sample, particularly by race. Consistent with the literature, poorer reading ability was observed among black patients, which likely reflects quality of education. Black patients in our sample were more likely to meet criteria for a cognitive disorder, receive an LVAD vs. transplant and have post-transplant nonadherence. Findings support ongoing examination of racial disparities, implementation of individualized interventions to optimize functioning and education to team members to support equitable access to life-saving transplant. Correspondence: *Keara Kangas, Division of Transplant Surgery, Department of Surgery & Department of Psychiatry Medical College of Wisconsin. Email: kkangas@mcw.edu*

**Keywords:** cardiovascular disease

**A. HEITZER, J. LONGORIA, V. OKHOMINA, W. WANG, D. RACHES, B. POTTER, L. JACOLA, J. SCHREIBER, A. KING, G. KANG, J. S. HANKINS. Neurocognitive Performance from School Age to Young Adulthood in Sickle Cell Disease .**

**Objectives:** Individuals with sickle cell disease (SCD) are at risk for slowed neuropsychological growth due to accumulated micro-infarcts, chronic hypoxemia, and repeated tissue ischemia. Yet, across the lifespan, little is known about age-related effects and specific domains of weakness. In this multi-age group cross-sectional study, we examine neuropsychological outcomes in individuals with SCD from school age through young adulthood and explored predictors of cognition across age groups.

**Participants and Methods:** 369 patients with SCD (59.9% Hb SS/HbS $\beta$ 0-thalassemia) ranging from ages 8–25 years received a neuropsychological screening as part of a prospective lifetime cohort study. Screenings were performed approximately every four years. If multiple screenings occurred for a single participant, only the most recent data were included. Neuropsychological outcomes included age-appropriate versions of the Wechsler Intelligence Scales, Delis Kaplan Executive Function System (Trail Making, Verbal Fluency, Color Word), Woodcock Johnson Achievement – Third Edition (Letter Word and Math Fluency), Wide Range Assessment of Memory and Learning – Second Edition (Story Memory), and Beery Visual Motor Integration Test – Sixth Edition. Multivariate linear regression models were used to assess the associations between neuropsychological outcomes and age at assessment (continuous), socioeconomic status (Social Vulnerability Index), sex, current status of hydroxyurea treatment (yes/no), and sickle genotype (Hb SS/HbS $\beta$ 0 thalassemia vs. HbSC/HbS $\beta$ + thalassemia). Age, sex, hydroxyurea treatment status, and sickle genotype were included in all models as covariates. The variation of each neuropsychological outcome explained by the factors above was calculated using the coefficient of multiple determination ( $R^2$ ). For all analyses involving multiple comparisons, FDR (false discovery rate) adjusted p-values (pFDR) were used to indicate the significance.

**Results:** Increased age was associated with poorer performance on measures of overall IQ, verbal/nonverbal reasoning, working memory, verbal fluency, verbal memory, visuospatial integration, and academics after adjusting for covariates (all pFDR < 0.05). After adjustment for covariates, lower socioeconomic status was associated with poorer performance on measures of overall IQ, verbal/nonverbal reasoning, visuospatial integration, executive, and academic

functioning (all  $pFDR < 0.05$ ). Compared with HbSC/HbS $\beta$ +thalassemia genotypes, severe sickle genotypes (HbSS/ bS $\beta$ +thalassemia) were associated with worse performance on measures of executive functioning and vocabulary at  $pFDR \leq 0.05$ . Similarly, when other covariates were accounted for, exposure to hydroxyurea treatment was associated with improved verbal and nonverbal reasoning at  $pFDR \leq 0.05$ . For each neuropsychological outcome, age explained most of its variation with a median  $R^2 = 3.2\%$  and maximum value  $R^2 = 18\%$  (academic achievement), followed by socioeconomic status with a median  $R^2 = 2\%$  and maximum value  $R^2 = 5.3\%$ , and sickle genotype with a median  $R^2 = 1\%$  and maximum value  $R^2 = 3.5\%$ .

**Conclusions:** From school-age to young adulthood, increased age was associated with slowed neuropsychological development. Age effects were greatest on measures of academic functioning, likely due to a combination of sociodemographic and medical factors. Treatment with hydroxyurea appears to be protective against the neurocognitive effects of SCD. Longitudinal studies that follow patients into adulthood are needed to better understand neuropsychological functioning across the lifespan in SCD.

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**Keywords:** sickle cell disease, academic achievement, child development disorders

### C. MERRILL, M. C. BALDERRAMA, D. WANG, T. ABOUEZZEDDINE. Predicting Attention Performance in Children with Sickle Cell Disease Using Parent Report of Physical and Psychological Functioning.

**Objective:** Sickle cell disease (SCD) is a class of genetic disorders that lead to the formation of abnormal red blood cells characterized by their sickle shape. SCD is associated with a wide range of complications that not only affect physical health (including pain crises and fatigue) but also psychological well-being. Additionally, children with SCD are at risk for neuropsychological morbidity (particularly attention/executive functioning and processing speed) due to these symptoms as well as disease-related complications. While previous studies have established a relationship between physical functioning and psychological well-being separately with brief attention/executive functioning (i.e., working memory) in this population, these studies did not explore the predictive relationship between both parent-reported physical functioning and psychological well-being as a model with sustained attention nor did they control for both socioeconomic status (SES) and hemoglobin (Hgb), which are important moderators of attention functioning in SCD. Therefore, the goal of this study was to update and expand upon previous research by examining the predictive relationship of parent-rated measures of emotional and physical health with measures of sustained attention while controlling for SES and Hgb.

**Participants and Methods:** Forty-nine patients aged 5 to 17 with SCD, with no known history of stroke, underwent a brief neuropsychological exam as a part of their regularly scheduled clinic visit. Physical and psychological functioning and attention were assessed using the PROMIS Parent Proxy and the age-appropriate Conners Continuous Performance Test (K-CPT2/CPT3), respectively.

**Results:** Multiple regression analyses were conducted to examine the predictive relationship between psychological (i.e., anxiety, depression) and physical (i.e., pain, fatigue) functioning and attention variables while controlling for SES (i.e., median household income by zip code) and Hgb. The four predictor variables (i.e., Anxiety, Depression, Pain, and Fatigue) produced four significant models: Commissions (Adj.  $R^2 = .121$ ,  $p < .05$ ); HRT SD (Adj.  $R^2 = .271$ ,  $p < .01$ );

Variability (Adj.  $R^2=.259$ ,  $p<.05$ ); and HRT ISI (Adj.  $R^2=.251$ ;  $p<.001$ ). However, Depression and Fatigue were the only two variables to significantly contribute to these models: (Commissions [Fatigue  $\beta =-.512$ ]; HRT SD [Depression  $\beta =.595$ ]; Variability [Depression  $\beta =.441$ ]; HRT ISI [Depression  $\beta =.576$ ; Fatigue  $\beta =-.337$ ]).

**Conclusion:** Patients whose parent reported greater levels of depression were at greater risk for deficits in attention functioning, particularly inattentiveness and vigilance. This was seen above and beyond the effects of socioeconomic status and Hgb levels. Unexpectedly, higher levels of parent-reported fatigue predicted better attention functioning in the form of decreased impulsivity and improved vigilance. According to these findings, the assessment and management of psychological symptoms (particularly depression) in children with SCD may provide additional avenues for improving attention functioning in this population. Given the unexpected negative predictive relationship between fatigue and attention, future studies may consider alternative means of assessing physical functioning (e.g., patient-report). Additionally, future studies should explore the relationship between psychological well-being and physical functioning with other areas of neuropsychological functioning known to be at risk in SCD (e.g., processing speed, executive functioning).

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**Keywords:** sickle cell disease, attention, pediatric neuropsychology

#### **A. GRADONE, K. O'TOOLE. Executive and Adaptive Functioning in Children with Kidney Disease.**

**Objective:** Chronic kidney disease (CKD) involves the progressive breakdown of kidney function primarily resulting in failure to properly filter toxins and waste in the blood. The combination of disease-specific factors (e.g., duration of CKD and age of onset) and other complicating medical factors (e.g., anemia, malnutrition, etc.) contribute to poorer neurocognitive outcomes in children with CKD. Mild deficits in executive functioning are consistently observed in children with CKD, even when controlling for intellectual functioning. Although research has demonstrated that kidney transplantation promotes cognitive improvement, pediatric kidney transplant recipients continue to show cognitive difficulties after transplantation. The current study investigated the relationship between parent-reported executive and adaptive functioning in a pediatric kidney transplant sample. It was hypothesized that executive deficits would be related to poorer adaptive functioning, especially in younger transplant recipients as these children typically have more severe CKD leading to poorer developmental outcomes.

**Participants and Methods:** This study included 12 children (ages 5 to 18) who underwent kidney transplantation at different points in development. Participants were evaluated at a pediatric medical center as part of routine clinical care. Parents completed questionnaires examining aspects of executive functioning (BRIEF-2) and adaptive skills (BASC-3).

**Results:** Patients were divided into two groups based on age of transplantation (0-5 years and 6+ years). Mean parent-reported working memory ( $M=67.8$ ), shift ( $M=64.5$ ), and task monitoring ( $M=63.0$ ) subscales on the BRIEF-2 were potentially clinically elevated and mildly elevated, respectively. Mean parent-reported leadership ( $M=37.5$ ) and functional communication ( $M=38.9$ ) subscales on the BASC-3 were at risk. Significant correlations were identified between activities of daily living and both organization of materials ( $r=-.72$ ,  $p=.01$ ) and emotional control ( $r=-.70$ ,

$p=.02$ ). Results revealed a pattern of poorer planning and organization skills on the BRIEF-2 for children who underwent kidney transplantation at earlier ages (i.e., 0-5 years).

**Conclusions:** These results indicate that executive and adaptive functioning remain compromised in children with CKD, even after transplantation. This is in line with the previous literature. Importantly, these findings indicate that some executive deficits (i.e., organization and emotional regulation challenges) are related to poorer adaptive functioning (i.e., skills associated with performing basic and routine daily tasks). Poorer planning and organization skills were identified for children who underwent transplantation before age 6, likely indicating more severe CKD as a risk factor. Caring for transplanted organs typically requires complex medical regimens, and executive functioning challenges may make regimen adherence more difficult. As a result, many pediatric kidney transplant recipients would benefit from cognitive remediation to enhance executive and adaptive abilities to preserve transplant viability.

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**Keywords:** pediatric neuropsychology, executive functions, adaptive functioning

### **E. TURNER, N. KOSKELA-STAPLES, C. T. EVANS, S. C. HEATON, D. A. FEDELE. Daytime Oxygen Saturation as A Marker of Cognitive Function in Pediatric Sickle Cell Disease.**

**Objective:** Reduced daytime oxygen saturation rates ( $SpO_2$ ) is a frequent pathophysiological manifestation of pediatric sickle cell disease (SCD). Low  $SpO_2$  is linked to poor white matter integrity and increased cerebral artery blood flow velocity, two known risk factors for cognitive impairment in pediatric SCD. Preliminary research in SCD examining associations between  $SpO_2$  and cognition has demonstrated a relationship with global intellectual function; however, it is unclear how reduced  $SpO_2$  impacts higher order cognitive functions associated with white matter disruption in pediatric SCD. The aim of the current study was to examine associations between  $SpO_2$  and executive and attentional function in a heterogeneous pediatric SCD sample.

**Participants and Methods:** Participants included 59 youth with SCD ages 8-18 years ( $M=13.17$ ,  $SD=3.09$ ) and their caregiver. Peripheral pulse oximetry was used to capture  $SpO_2$  values. Executive functioning was measured via the DKEFS Trail Making Test Number-Letter Sequencing condition (DKEFS) and the Parent Report Behavior Rating Inventory of Executive Function, Second Edition Global Executive Composite (BRIEF-2). The Psychomotor Vigilance Test (PVT) was used to assess sustained visual attention. Relevant medical information (e.g., genotype, stroke history, treatment) was collected via medical record review.

**Results:** Average  $SpO_2$  values ( $M=92.67$ ,  $SD=7.98$ ) represent mild desaturation; however, values were highly variable (range=81-99). Independent t-tests revealed that lower  $SpO_2$  values were significantly associated with a genotype with greater disease severity ( $HbSS$ ,  $Hb\beta^0$ ),  $p=0.04$ , and current hydroxyurea use,  $p=0.01$ . Chronic transfusion treatment was associated with higher  $SpO_2$  values,  $p<0.01$ . History of stroke and abnormal Transcranial Doppler Ultrasonography were unrelated to  $SpO_2$ , all  $p>0.05$ .  $SpO_2$  values explained significant variance in the number of lapses on the PVT (reaction time  $>500ms$ ),  $F(1, 52)=3.85$ ,  $p=0.003$ ,  $R^2=0.23$ , beyond contributions from genotype and current treatments (e.g., hydroxyurea and chronic transfusions). Lower  $SpO_2$  values were associated with a greater frequency of minor lapses ( $\beta=-1.15$ ).  $SpO_2$  values were not associated with BRIEF-2, DKEFS or PVT mean reaction time, omission and false start outcomes, all  $p>0.05$ .

**Conclusions:** Findings suggest that SpO<sub>2</sub> may contribute to minor lapses in visual sustained attention in youth with SCD; however, it was largely unrelated to other measures of attentional and executive function. It is unclear whether SpO<sub>2</sub> is a relevant biomarker and future research should confirm its utility as a risk factor for attentional impairment.

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**Keywords:** pediatric neuropsychology, attention, sickle cell disease

**Y. JASSAL, E. CHRISTOFFERSON, M. EVERITT, K. R. WOLFE. Specific Patterns of Executive Functioning Weaknesses Amongst Children After Heart Transplant.**

**Objective:** While previous research reports executive functioning (EF) deficits amongst children after heart transplant (HT), specific EF weaknesses have not been identified. Anchored in Peter Anderson's Developmental Model of Executive Function (2008), the present study addresses this gap by providing detailed analyses of goal-setting, cognitive flexibility, attentional control, and information processing for a clinically-referred sample of children post-HT.

**Participants and Method:** This sample included pediatric patients with history of HT who were referred for neuropsychological testing from 2011-2020. Of note, our center refers HT patients systematically for neuropsychological evaluation as standard clinical care. Of the identified HT recipients, most were male (53%) and identified as White (85%). Congenital heart disease (CHD) was the HT indication in 71%, and cardiomyopathy in 29%. The mean age at HT was four years (SD = 4.8 years), and mean age at testing was 9.75 years (SD = 3.79 years).

Demographic, medical, and neuropsychological information was abstracted from electronic medical records. The full-scale IQ (FSIQ), as well as the Verbal Comprehension (VCI), Visual-Spatial (VSI), and General Ability Indices (GAI) were measured with the age-appropriate versions of the Wechsler scales (WAIS-IV, WISC-IV/V, WPPSI-IV).

Cognitive flexibility was measured with the Wechsler Working Memory (WMI) and Cognitive Regulation Indices (CRI) of the Behavior Rating Inventory of Executive Functioning (BRIEF). Goal-setting was measured by the Drexel Tower of London (ToL; Total Moves). Information processing was measured with the Wechsler Processing Speed Index (PSI) and verbal fluency (letter and category) subtests from the DKEFS/NEPSY-II. Attentional control was measured by the ADHD Rating Scale and the BRIEF Behavior Regulation (BRI) and Emotion Regulation Indices (ERI).

We employed non-parametric statistical methods (e.g., Spearman's Rho, Mann-Whitney), when feasible, due to the modest sample size. One-sample T-tests compared sample neuropsychological testing results with published test norms. A two-tailed value of  $p < 0.05$  was used for all hypothesis testing.

**Results:** Regarding group differences, children with CHD received a HT at a younger age than those with cardiomyopathy, with no other significant group differences amongst demographic/medical variables and EF outcomes. Significant demographic/medical predictors of EF included maternal education, female sex, days on ECMO, and re-transplant.

Cognitive functioning was below normative means across all domains ( $ps < 0.05$ ). Within this sample, the GAI and VCI were significantly higher than the PSI. The GAI was also significantly higher than the FSIQ.

Sample performance across all cognitive flexibility and goal-setting measures was below normative means ( $ps < 0.05$ ). Attentional control measures indicated elevated behavioral ( $p < 0.05$ ), but not emotional, regulation difficulties, with no differences between degree of parent-

reported inattentive and hyperactive/impulsive symptoms. Information processing was variable, as the PSI was lower than normative values ( $p < 0.05$ ) in the context of average verbal fluency.

**Conclusions:** Results of this study demonstrate that EF difficulties amongst children after HT are not global. Rather, they are most prominent in goal-setting and cognitive flexibility. Such knowledge better informs treatment and academic recommendations for this population as they navigate the complex milieu of life following a HT.

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**Keywords:** cardiovascular disease, congenital disorders, executive functions

### **C. SHIELDS, C. WEST, K. HULTSTRAND , M. FRANK, J. GUNSTAD, A. SATO. Adolescent Eating in the Absence of Hunger: The Contributing Influence of Executive Functions .**

**Objective:** Eating in the absence of hunger (EAH) is a disinhibited eating behavior marked by the consumption of highly palatable foods when satiated. EAH is one proposed mechanism for obesity risk among youth. Executive functions are proposed to aid in eating regulation and may be an essential emerging factor associated with EAH in youth. However, few studies have objectively examined the association between executive functions and EAH in adolescents from low-income backgrounds at the highest risk for obesity. The study's primary aim was to examine associations between executive functions and objective EAH, controlling for BMI for age and sex (zBMI). Secondly, this study aimed to explore executive function associations with consumption of salty versus sweet snacks in the absence of hunger.

**Participants and Methods:** Adolescents (N=57; M age= 13.4; 54.4% females; 47.4% OW/OB) were part of a larger study in low-income families at or below the 200% U.S. Poverty Threshold. Participants completed computer-based NIH Toolbox measures of Inhibitory Control (i.e., Flanker), Cognitive Flexibility (i.e., Dimensional Change Card Sort), and Working Memory (i.e., List Sorting). EAH was assessed using a free access procedure of highly palatable snacks, which included 500 total kcals of Chips Ahoy Cookies, M & M's, Lays Chips, and Doritos. Adolescents consumed a Cliff granola bar one hour prior to study procedures to control for hunger. Objective height and weight were obtained and zBMI scores were calculated using CDC growth charts. Multiple regression analyses with bootstrapping were conducted with zBMI in block one and Flanker, Dimensional Change Card Sort, and List Sorting tests in block 2.

**Results:** Overall performance on the Flanker, Dimensional Change Card Sort, and List Sorting tests was significantly associated with total kcals consumed in the EAH task, beyond the effects of zBMI,  $F(4,52)=2.67$ ,  $p<.05$ , accounting for 17% of the variance. List Sorting was the only significant unique predictor of total kcals consumed,  $b=-5.61[-10.96, .01]$ ,  $p<.05$ . Overall Flanker, Dimensional Change Card Sort, and List Sorting performance on sweet snack intake in the absence of hunger was not significant; however, List Sorting uniquely predicted kcals of sweet snacks consumed,  $b= -3.44[-6.49, .09]$ ,  $p<.05$ . No associations were found between executive functions and kcal consumption of salty snacks.

**Conclusion:** Performance on objective tests of executive function, primarily List Sorting, was associated with intake of sweet snacks in the absence of hunger, whereas salty snack intake was not. These findings suggest that poorer executive functioning, may be a risk factor for higher caloric intake in the absence of hunger among adolescents and add to the small yet emerging literature that executive functions may be essential intervention targets for obesity prevention and weight management in youth.

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**Keywords:** adolescence, executive functions

**J. GRANT, L. J. RAPPORT, R. DARLING, B. WALDRON-PERRINE, E. BERNITSAS. Cognitive Enrichment and Education Quality Predict Cognitive Dysfunction in Multiple Sclerosis.**

**Objective:** Differences in cognitive reserve—psychosocial characteristics that preserve cognitive function in the presence of neuropathology—may explain why some individuals with multiple sclerosis (MS) do not show cognitive dysfunction despite experiencing progressive neurodegeneration. This study examined the extent to which three indices of cognitive reserve (years of education, education quality, and cognitive enrichment) provide unique value towards predicting cognitive dysfunction in adults with MS.

**Participants and Methods:** The sample included 79 adults with MS (77.2% relapsing-remitting) with an average of 15 years of education and 12 years since diagnosis. Participants underwent a neurological examination and a neuropsychological evaluation. Symbol Digit Modalities Test (SDMT) served as a proxy of global cognitive functioning. Education quality was estimated via irregular word reading ability with the Wechsler Test of Adult Reading (WTAR). Participants reported their lifetime participation in various cognitively enriching activities using the Cognitive Reserve Scale (CRS). Neurological disability was assessed using the Expanded Disability Status Scale (EDSS), completed by a neurologist.

**Results:** Cognitive functioning was associated with age ( $r = -.32$ ), disease duration ( $r = -.36$ ), neurological disability ( $r = -.59$ ), education quality ( $r = .28$ ), and cognitive enrichment ( $r = .28$ ), but was not significantly associated with years of education ( $r = .12$ ). A hierarchical multiple regression examined whether psychosocial characteristics—years of education, education quality, and cognitive enrichment—improved prediction of cognitive functioning beyond typical medical predictors, including age, disease duration, and neurological disability. Age, disease duration, and neurological disability (Model 1) significantly predicted 39% of the variance in cognitive functioning ( $p < .001$ ). The addition of years of education, education quality, and cognitive enrichment (Model 2) was significant ( $R^2$  change = .08,  $p = .016$ ). EDSS ( $sr^2 = .19$ ,  $p < .001$ ), reading ability ( $sr^2 = .05$ ,  $p = .010$ ), and cognitive enrichment ( $sr^2 = .03$ ,  $p = .048$ ) accounted for unique variance in cognitive functioning. Partial correlations controlling for age, disease duration, and neurological disability revealed that the effect for education quality was driven by individuals with 15 or fewer years of education ( $r_p = .43$ ) but was not observed among individuals with 16 or more years of education ( $r_p = .10$ ). Similarly, cognitive enrichment was significantly related to cognitive functioning among those with 15 or fewer years of education ( $r_p = .34$ ) but not among those with 16 or more years of education ( $r_p = .08$ ).

**Conclusions:** Psychosocial history plays an important role in buffering the adverse effects of neurodegeneration in MS. Cognitive enrichment and education quality provided unique value towards predicting cognitive dysfunction in adults with MS, beyond that accounted for by illness-related indices. These two indices may provide a more accurate estimate of cognitive reserve in MS than years of education, particularly among individuals with fewer than 4 years of college. More importantly, these psychosocial characteristics are potentially modifiable. However, the findings suggest a threshold effect of cognitive reserve among people with MS, such that cognitive enrichment and education quality may not provide additional reserve beyond years of education among those with a college degree.

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**Keywords:** cognitive reserve, multiple sclerosis, demographic effects on test performance

**J. MILLER, W. B. BARR, F. FOLEY, V. ZEMON. Cognition and Handedness in Multiple Sclerosis .**

**Objective:** Much remains to be known regarding the disease course in multiple sclerosis (MS), a complex neurological illness impacting over 2.5 million individuals worldwide. MS can affect physical, emotional, and cognitive functioning, yet much of the disease process, including potential hemispheric vulnerability in the brain, has not yet been studied. A thorough understanding of the disease course may aid in elucidating the manifestation of MS in the brain, ultimately impacting treatment.

**Participants and Methods:** This study assessed neuropsychological functioning as it relates to hemispheric vulnerability in MS. Specifically, domains of verbal and non-verbal IQ and memory acquisition, along with fine-motor abilities, were compared in right (dextral) and non-right (non-dextral) persons with MS (PwMS). Two contradicting theories were hypothesized: Theory A, an increased vulnerability to the pathological process of MS in the left brain or, Theory B, an increased vulnerability to the pathological process of MS in the right brain.

**Results:** Analysis was performed utilizing linear mixed effects modelling. Results indicated a significant main effect of handedness  $F(1, 195.35) = 3.95, p = .048$  when verbal and non-verbal IQ and memory acquisition measures were taken together, with better performance seen in dextral PwMS. Although no significant interaction between handedness and IQ  $F(3, 525.60) = 0.75, p = .523$  was found, the largest effect size existed in the neuropsychological measure assessing composite perceptual reasoning IQ  $F(1,341) = 12.163, p = .001$ . There was no significant difference with handedness and memory acquisition. In evaluating fine motor skills, a significant interaction between neuropsychological test and handedness was found; dextral participants had faster completion time (with their right hand) than non-dextral individuals (with their left hand). Non-dextrals were faster with their non-dominant (right) hand than dextrals were with their non-dominant (left) hand.

**Conclusions:** Findings from this study do not consistently support Theory A or B throughout all domains of neuropsychological performance. However, results of non-verbal measures of IQ across handedness profiles do suggest an increased vulnerability to the pathological process of MS in the left brain. Results have clinical treatment implications, highlight the importance of choosing the right neuropsychological measure, and may indicate differences between cognitive profiles of males and females with MS.

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**Keywords:** handedness, neuropsychological assessment, multiple sclerosis

**M. BRADSON, D. UKUEBERUWA, C. A. ROMÁN, P. A. ARNETT. Effects of ApoE-ε4 Allele on White Matter Structure in Multiple Sclerosis .**

**Objective:** Previous human and animal studies have found evidence to suggest that the epsilon-4 allele of the apolipoprotein E (ApoE-ε4) gene plays a role in myelin formation, myelin repair, and neuronal plasticity, which are processes relevant to multiple sclerosis (MS) pathophysiology. Despite evidence linking the ApoE-ε4 allele to myelin formation and repair processes, the limited literature exploring the effects of the ApoE-ε4 gene on white matter integrity in patients

with multiple sclerosis (PwMS) is inconsistent. The current study aimed to determine whether the  $\epsilon 4$  allele of the ApoE gene differentially affects white matter integrity in PwMS. We hypothesized that, compared to the ApoE- $\epsilon 4$  negative PwMS, ApoE- $\epsilon 4$  positive PwMS would exhibit significantly less white matter integrity on selected diffusion tensor imaging (DTI) parameters.

**Participants and Methods:** 53 adult PwMS recruited from community and outpatient settings completed a full neuropsychological assessment battery prior to undergoing structural and functional neuroimaging scans. The sample was comprised of 14 ApoE- $\epsilon 4$  positive and 39 ApoE- $\epsilon 4$  negative PwMS. Medical Imaging Navigation and Research Tool by INRIA (MedINRIA) was used to calculate the following DTI parameters: volume of white matter fibers, quantity of white matter fibers, fractional anisotropy (FA), relative anisotropy (RA), and apparent diffusion coefficient (ADC). Independent samples t-tests were used to compare white matter microstructures in ApoE gene groups. More specifically, mean differences in overall white matter fiber volume, quantity of fibers, FA, RA, and ADC, were evaluated in ApoE- $\epsilon 4$  positive PwMS compared to ApoE- $\epsilon 4$  negative PwMS. Cohen's  $d$  effect sizes were then calculated to examine the magnitude of the observed differences in white matter microstructure parameters between ApoE allele groups.

**Results:** Independent samples t-tests revealed that ApoE- $\epsilon 4$  positive PwMS, relative to ApoE- $\epsilon 4$  negative PwMS, exhibited significantly ( $p = 0.02$ ) less white matter fiber volume (moderate effect size,  $d = 0.73$ ), and significantly ( $p = 0.04$ ) fewer white matter fibers overall (moderate effect size,  $d = 0.71$ ). No significant group differences in mean FA, RA, or ADC, as a function of ApoE allele status, were observed.

**Conclusions:** We found that ApoE- $\epsilon 4$  positive PwMS exhibited less white matter fiber volume and fewer fibers overall, compared to their ApoE- $\epsilon 4$  negative counterparts. These findings extend the literature suggesting that ApoE- $\epsilon 4$  carriers may exhibit poorer white matter structural integrity in PwMS, which may be indicative of greater demyelination and axonal loss. Further investigation of the relationship between the ApoE- $\epsilon 4$  allele and structural integrity of white matter is necessary to improve understanding of the neural differences contributing to variations in disease process and severity when an individual is affected by MS combined with the ApoE- $\epsilon 4$  allele. Possible functional implications should also be explored.

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**Keywords:** multiple sclerosis, neuroimaging: structural, genetics

**L. BERRIGAN, E. MANNING, A. SALIH, M. MEGAN, F. ASHLEY, J. BISSONNETTE, K. HULL, L. PIMER, J. LECKEY, T. CAMPBELL, D. FISHER. EEG and ERP Correlates of Cognitive Functioning in Relapsing-Remitting Multiple Sclerosis.**

**Objective:** Multiple sclerosis (MS) involves an autoimmune inflammatory response that leads to demyelination, neuronal damage and death, as well as sclerotic plaque formation. MS is associated with a wide variety of symptoms, including cognitive dysfunction in up to 60% of patients. The sensitivity of tools available to diagnose and monitor changes in cognitive dysfunction is currently limited. Previous work has shown an association between electroencephalographic (EEG) measures and cognition in MS. We aimed to assess two correlates of neural activity, the theta/beta ratio and P3 event-related potential (ERP), to investigate their ability to serve as a biomarker for MS-related cognitive decline.

**Participants and Methods:** EEG recordings were made from 32 electrode sites during a resting state period and during a novelty oddball task. Participants included 18 individuals with relapsing-remitting MS and 21 controls. The novelty oddball task required participants to respond to rare target stimuli (P3b-eliciting) and ignore frequent non-target stimuli, as well as rare distractor stimuli (P3a-eliciting). Cognitive functioning was assessed using the Symbol Digit Modalities Test (SDMT). Theta/beta ratios were obtained from the resting state recordings and P3 ERP amplitudes and latencies were obtained from the novelty oddball task recordings. Theta/beta ratios and P3 characteristics were each compared across groups and correlations with SDMT performance were examined.

**Results:** Significant group differences were observed for the theta/beta ratio at the Pz site ( $p = .02$ ; Cohen's  $d = 0.78$ ), the P3a amplitude at the Cz site ( $p < .001$ , Cohen's  $d = 0.49$ ), and the P3b amplitude at the Pz site ( $p < .001$ , Cohen's  $d = 0.61$ ). The only significant correlation of any of the EEG or ERP measures with SDMT performance for MS participants was observed for P3b latency ( $r = -.54$ ,  $p = .02$ ).

**Conclusions:** While theta/beta ratios and P3 amplitudes differed according to the presence of MS, at least at certain sites, these measures were not related to cognitive functioning as indexed by the SDMT. In contrast, P3b latency was related to SDMT performance for the MS participants, but P3b latency did not differ depending on the presence of MS. This may have occurred because relatively few MS participants met the criteria for cognitive impairment. Further investigation with a greater number of cognitively impaired MS participants is needed to determine the ability of P3b latency and other EEG/ERP biomarkers to detect cognitive decline in MS.

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**Keywords:** multiple sclerosis, event-related potentials, attention

### **S. ZICCARDI, M. PITTERI, M. CALABRESE. Social Cognition Deficits in Newly Diagnosed Multiple Sclerosis Patients: a Preliminary Investigation.**

**Objective:** Multiple sclerosis (MS) is a chronic disease of the Central Nervous System characterized by inflammatory and neurodegenerative phenomena, affecting both white and grey matter (Calabrese et al., 2015). Several previous studies highlighted that cognitive and affective symptoms in MS patients might be not associated, considering them as distinct domains that can be independently impaired (Cotter et al., 2016; Pitteri et al., 2019a). Alterations in cognitive functioning have been described since the earliest stages of the disease, even in patients without evidence of cognitive impairment (Pitteri et al., 2019b). By contrast, to the best of our knowledge, social cognition domain has never been investigated in MS patients at the time of diagnosis.

**Participants and Methods:** Fifteen MS patients (11 females, mean $\pm$ SD age = 37.8 $\pm$ 10.8 years, mean $\pm$ SD education = 14.7 $\pm$ 3.2 years) were tested at the time of MS diagnosis with a social cognition battery, which consisted of the Test of Facial Emotion Recognition – Kessler Foundation (TOFER-KF; Genova et al., 2020), the Reading the Mind in the Eyes test (RME; Vellante et al., 2013), and the Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004). The Expanded Disability Status Scale (EDSS; Kurtzke, 1983) was used to evaluate physical disability (median = 1, range 0-4), while the Depression, Anxiety, and Stress Scale (DASS-21; Bottesi et al., 2015) was used to assess emotional state (median = 16, range 0-32). A group of 20 matched

healthy controls (HCs) (13 females, mean±SD age = 35.2±7.7 years, mean±SD education = 14.5±3.3 years) were tested with the same battery of social cognition tests.

**Results:** No correlations were found in the MS group between global scores of social cognition tests and clinical variables (physical disability and emotional aspects, all  $p>0.05$ ). Comparison analyses between MS and HCs were conducted, using t-tests or Mann-Whitney tests. The results showed that MS patients performed significantly lower than HCs in the TOFER-KF test (MS: median = 28, range 24-32; HCs: median = 30, range 25-33;  $p=0.006$ ): considering each emotion separately, we found no significant differences between MS and HCs in all the six primary emotions investigated (happiness:  $p=0.28$ , anger:  $p=0.73$ , fear:  $p=0.11$ , sadness:  $p=0.52$ , surprise:  $p=0.78$ , disgust:  $p=0.13$ ). No significant differences were found for the RME test ( $p=0.06$ ) and the EQ ( $p=0.34$ ).

**Conclusions:** These preliminary results suggest the presence of social cognition deficits in a group of MS patients at the time of diagnosis, particularly in the domain of facial emotion recognition. No selective impairment was found in the identification of primary emotions, suggesting a global affective alteration not driven by any specific emotion. However, other social cognition subdomains that involve distinct neural interconnections and more complex processes, such as theory of mind and empathy, were found to be not impaired at the time of MS diagnosis. These results highlighted the importance of investigating social cognition domain since the early stages of the disease in addition to traditional cognitive assessment.

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**Keywords:** multiple sclerosis, social cognition

**M. GUANDALINI, M. PITTEI, M. VANNUCCI, A. DAFFINÀ, M. CALABRESE. Automatic vs. controlled processing in Verbal Fluency tests in MS patients: a pilot study.**

**Objective:** Verbal Fluency (VF) tests provide sensitive measures of cognitive functioning in Multiple Sclerosis (MS). However, it remains unclear whether fluency deficits in MS are mainly related to an impairment of executive function (EF) or reduction in information processing speed (IPS). According to the lexical organization model (Crowe, 1996; Smith&Claxton, 1972), in healthy subjects the typical pattern of word generation in a VF task follows a decreasing curve: during the first 15-20 seconds, a ready pool of common words is available and is automatically activated for production (automatic processing). As time passes, this pool becomes exhausted and production becomes more guided and less productive because mainly dependent on executive functioning (controlled processes; Crowe, 1998). However, successful performance on a VF task seems to depend on the effectiveness of both automatic and controlled processing. The aim of this study was to verify whether quantitative analysis of word production, as a function of time, might reveal an impairment in the controlled processing in MS patients with respect to a group of Healthy Controls (HC). 2. Participants and Methods: We assessed 30 patients with MS (F 22; Age: 34.2±9.6; Education: 15.8±2.5; EDSS: 0.8, range 0-6) and 19 HC (F 13; Age: 37.9±11.3; Education: 16.8±2.2). All participants were administered the Brief Repeatable Battery (BRB-A; Amato et al., 2006) and the Verbal Fluency Test (Costa et al., 2014). The two groups were matched in terms of Age, Education, and SDMT. We conduct a quantitative analysis of word productivity by dividing the performance of the VF tests (phonemic and semantic) into 15 seconds time ranges (15, 30, 45, 60). These levels were studied as a function of time by using a 4 x 2 (Time intervals x Group) ANOVA repeated measures analyses and

multiple t-test comparisons. 3. Results: Independent samples t-tests revealed a significant differences between MS patients and HC in the total number of correct words generated in the phonemic VF task ( $p=.03$ ): patients generated fewer words compared to HC. No significant differences between the two groups were found in the semantic VF task ( $p=.78$ ). When we examined the effect of time on verbal fluency performance of MS and HC, we found that in both groups the performance decreased during both fluency tasks as a function of time ( $p<.001$ ). However, the difference between the two groups was more evident during the later phases of the phonemic verbal fluency, whereas no significant differences emerged in the initial phase of verbal fluency (0-15 sec). 4. Conclusions: We found distinct patterns of performance in phonemic and semantic VF tasks, with MS patients showing a reduced performance compared to HC in phonemic but not semantic fluency task. Moreover, the difference between the two groups in the phonemic fluency task was more evident when the search process becomes more challenging and requires more effortful controlled retrieval. These preliminary results are in line with the lexical organization model, suggesting that a deficit in the phonemic VF task might be related to impaired executive control instead of a deficit of IPS.

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**Keywords:** multiple sclerosis, executive functions, fluency

### **M. WEICK, J. POWELL, A. BREITMEYER. Military Spouses: The Vicarious Impact of a Service Member's Neurological Deficits.**

**Objective:** The goal of this research is to highlight the manner in which significant others of military service members, who sustained a combat-incurred traumatic brain injury, are adversely impacted. The primary objective of this research is to create a psychoeducational seminar that provides evidence-based information to significant others regarding the consequences of combat-incurred injuries that led to cognitive and neurological impairments.

**Participants and Methods:** This research was conducted using existing research. Relevant literature was found using the PsychINFO database, EBSCOhost, and Google Scholar. The following key words were incorporated and considered when evaluating available research: *cognitive difficulties impacting reintegration, combat-incurred TBI, neurological difficulties, combat-related difficulties impacting ease of transition, impact of reintegrating to civilian life, impact of neurological deficits on military spouses.*

**Results:** Much of the existing research for the military population examines the neurological consequences of posttraumatic stress disorder (PTSD) and combat-incurred traumatic brain injury (cTBI), specifically because PTSD and cTBI are diagnosed comorbidly at a rate of 28%. Moreover, it is estimated that 22% of all service members who have deployed to combat meet criteria for a TBI. While TBIs directly impact the individual, it also impacts the service member's family and their spouse/significant other. Nearly 52% of all active duty service members are married, and this does not account for those individuals in a committed relationship with a service member, nor those individuals who are divorced but share children with their former spouse. Studies have found that spouses of deployed service members report higher feelings of loneliness, worry, sadness, anxiety, anger, disordered eating, concentration difficulty, and insomnia, as well as increased risk for depressive disorders, adjustment disorders, sleep disorders, and anxiety disorders. An estimated 36% of spouses of military service members, who have deployed, meet criteria for a psychiatric condition.

**Conclusions:** Given the high rates of combat-incurred TBI and the associated neurological deficits, coupled with the number of service members married and in a committed relationship, it is necessary to evaluate the vicarious impact of combat-incurred TBI for the spouses and partners of military service members. Moreover, it is important to provide psychoeducation education and cultivate support for those spouses. Therefore, this author proposes a 5 module, psychoeducational seminar for military spouses with the objective of increasing knowledge about challenges faced by military service members, specifically combat-incurred injury and the potential vicarious impact on the spouse. Specific areas covered include military mental health and prevalence rates, barriers impacting ease of reintegration to civilian life (e.g., TBI, employment, psychiatric/physical health conditions, relationship stress), and more broadly, adjustment, empathy, stigma, and resilience.

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**Keywords:** traumatic brain injury, acculturation, adaptive functioning

**J. DRAKE, J. M. JAKICIC , R. J. ROGERS , S. L. AGHJAYAN, C. M. STILLMAN, D. SHANNON, K. A. ROECKLEIN, K. I. ERICKSON. Reduced Fronto-Striatal Activity during a Working Memory Task in Middle-Aged Apolipoprotein E  $\epsilon$ 4 Carriers with Overweight/Obesity .**

**Objective:** The Apolipoprotein E  $\epsilon$ 4 (*APOE*  $\epsilon$ 4) allele and mid-life overweight and obesity (body mass index [BMI]  $\geq 25$  kg/m<sup>2</sup>) are independent risk factors for Alzheimer's disease (AD). Both of these risk factors are also associated with alterations in brain activation and working memory deficits, which are also commonly observed in individuals with AD. Although the presence of both of these risk factors may have additive effects on brain activation and working memory abilities, no study to date has examined the effect of the  $\epsilon$ 4 allele on working memory related brain activation in a sample of individuals with overweight/obesity. Our primary aim was to determine whether the presence of the  $\epsilon$ 4 allele was associated with differences in task-evoked brain activation during working memory tasks in adults with overweight/obesity.

**Participants and Methods:** Participants included midlife adults ( $M_{age} = 44.63 \pm 8.36$  years) with overweight and obesity ( $M_{BMI} = 32.12 \pm 4.12$ ) who were enrolled in a 12-month behavioral weight loss intervention. Of the 125 participants enrolled in the trial, genotyping identified 24  $\epsilon$ 4 carriers. We then demographically matched the 24  $\epsilon$ 4 carriers with 24 non-carriers (i.e., age, sex, and BMI) for a total sample of 48 individuals. At baseline prior to randomization, participants completed a n-back working memory task while undergoing a functional MRI scan. Using a region of interest (ROI) approach, we focused our predictions and analyses on fronto-striatal regions (e.g., the middle frontal gyrus, precentral gyrus, anterior cingulate cortex, putamen, and pallidum) that support working memory processes and have been associated with adiposity in prior studies. One-way ANOVAs were used to test for differences between  $\epsilon$ 4 carriers and non-carriers in brain activation during each condition of the task.

**Results:** As predicted,  $\epsilon$ 4 carriers had significantly lower brain activation relative to non-carriers in the anterior cingulate cortex, middle frontal gyrus, precentral gyrus, putamen, and pallidum during the 1-back and 2-back conditions ( $p < .05$ ). There was no difference in accuracy nor reaction time on the 1-back and 2-back conditions of the task between  $\epsilon$ 4 carriers and non-carriers ( $p < .05$ ). However, among  $\epsilon$ 4 carriers, lower activation of the left putamen ( $p = .0195$ ) and right pallidum ( $p = .0343$ ) was associated with faster reaction times during the 2-back

condition. BMI was not associated with activation in the ROIs, and  $\epsilon 4$  carriers did not significantly differ from non-carriers on age, race/ethnicity, BMI, or sex ( $p$ 's > .05).

**Conclusion:** Carrying the  $\epsilon 4$  allele was associated with lower activation in several fronto-striatal regions during a n-back working memory task. Despite this finding, both groups performed similarly on the task. Additionally,  $\epsilon 4$  carriers with lower 2-back activation performed better than  $\epsilon 4$  carriers with greater activation, which may suggest that lower activation is serving a compensatory role for  $\epsilon 4$  carriers. Longitudinal research is needed to determine the long-term impact of lower task-evoked frontal-striatal activity in midlife overweight and obesity, and how these results relate to risk for AD in late adulthood.

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**Keywords:** working memory, brain function, dementia - Alzheimer's disease

**B. HO, S. BOTTARI, C. DION, A. G. O'NEAL, J. WILLIAMSON, R. A. COHEN. Cytokines may be Related to Brain N-acetylaspartate Levels in Patients with Obesity.**

**Objective:** Severe and chronic obesity is a risk factor for decline in brain health. Weight loss in these individuals frequently coincides with improvements in systemic factors that may influence brain health. However, the underlying mechanisms for these changes are not fully understood. In the present study, we explore the relationship between systematic cytokines and N-acetylaspartate (NAA), an indicator of neuronal health. Data were collected as part of a larger study at the University of Florida.

**Participants and Methods:** The final sample includes 38 adults with obesity (BMI > 35kg/m<sup>2</sup>) aged 24 to 67 years (mean = 45.08). Exclusion criteria: a total score of <20 on the Montreal Cognitive Assessment (MoCA), history of neurological disorder or injury, severe psychiatric or unstable medical condition, and history of substance abuse. Participants completed a blood cytokine panel consisting of IFN $\alpha$ , IL-10, IL-12p70, IL-13, IL-17, IL-1 $\beta$ , IL-2, IL-4, IL-5, IL-6, IL-7, IL-8, TNF $\alpha$ , IL-21, IL-23 and underwent proton magnetic resonance spectroscopy to acquire metabolites from the frontal lobe.

**Results:** The blood cytokines were entered into a least absolute shrinkage and selection operator (LASSO) model to predict frontal lobe NAA levels. The LASSO selected IL-1  $\beta$ , IL-2, IL-7, IL-10, IL-12p70, IL-17, IFN $\alpha$  and TNF $\alpha$  as important predictors of NAA levels.

**Conclusions:** Our findings suggest the body's immunological and inflammatory conditions in people with obesity may be associated with brain health. Furthermore, there may be opposing directional relationships on NAA levels dependent upon particular cytokines. Future research should explore how these relationships relate to cognition, and how changes in systemic function such as decreases in insulin resistance, better sleep and blood pressure control associated with weight loss affect brain health.

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**Keywords:** brain function

**J. PAREDES, M. DANIEL. Neuropsychological Performance and MRI White-Matter Hyperintensities in a Clinical Sample.**

**Objective:** Investigate the association of white-matter hyperintensities (WMH) on routine clinical MRI and neuropsychological test performance in non-demented outpatients referred for neuropsychological assessment.

**Participants and Methods:** From a sample of 607 patients that underwent comprehensive neuropsychological evaluation, two groups were selected based on MRI results: 1) normal ( $n = 62$  (37 females),  $M_{\text{age}} = 50.21$ ,  $M_{\text{edu}} = 14.89$ ) and 2) WMH without other MRI abnormality ( $n = 56$  (38 females),  $M_{\text{age}} = 55.43$ ,  $M_{\text{edu}} = 14.04$ ). Exclusion criteria included dementia, other brain neuropathology (e.g. stroke, neurodegeneration, traumatic brain injury, multiple sclerosis, etc.), and below normal scores on performance validity tests.

**Results:** Independent samples t-tests revealed statistically significant group differences for: Block Design ( $d=.56$ ), Rey-Osterrieth Complex Figure (RCFT) Copy ( $d=.38$ ), Spatial Span Backward ( $d=.53$ ), DKEFS Trails Number ( $d=.80$ ), DKEFS Trails Letter ( $d=.74$ ), Logical Memory I ( $d=.39$ ), RCFT Delayed Recall ( $d=.46$ ), and Matrix Reasoning ( $d=.39$ ); although, means for both group were within the average range for all neuropsychological tests.

Neuropsychological index scores were calculated for five cognitive domains (language, visual-spatial/construction, attention/working memory, memory, executive functions) and were categorized in the following clinical ranges: well below average = z-score  $\leq -2.35$ ; below average = z-score  $-2.34$  to  $-1.3$ ; low-average = z-score  $-1.29$  to  $-0.67$ ; average = z-score  $-0.66$  to  $0.66$ ; above average = z-score  $\geq 0.67$ . Chi-square analysis comparing base rates for the WMH and normal groups across these clinical ranges revealed significant base rate differences only for attention/working memory ( $\chi^2=14.01$ ,  $df = 4$ ,  $p < .01$ ), with more WMH patients in the below average ranges.

Using logistic regression analyses, odds ratios were calculated for a person with WMH having an impaired index score relative to a person without WMH using two z-score cut-offs:  $-1.67$  and  $-1.00$ . WMH were associated with having an index z-score  $\leq -1.00$  on attention/working memory tests (OR = 3.95, 95% CI: 1.19-13.10) and on Matrix Reasoning (OR = 4.83, 95% CI: 1.27-18.44). Odds ratios were not significant at  $-1.67$  z-score cut-off.

**Conclusions:** Similar to prior literature, as a group, individuals with WMH had statistically significant worse performance on measures of attention, speed, memory, and select executive functions. However, the clinical significance of group differences often is unclear for the individual patient. Base rate analysis indicated significant differences for patients with and without WMH only in the domain of attention/working memory, with WMH patients overrepresented in the below average ranges. Odds ratios indicate a patient with WMH has a three- to fourfold increased risk of obtaining an index z-score  $\leq -1.00$  on attention/working memory tests and a visually mediated test of reasoning. In this clinical group, patients with WMH were no more likely than normals to have an index z-score  $\leq -1.67$ . Taken together, these findings indicate that among referred outpatients, MRI WMH are associated with relatively mild decreased attention and processing speed for some, but not all, patients.

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**Keywords:** cerebrovascular disease, neuropsychological assessment

**A. K. DILLAHUNT, S. DELDONNO, S. POCIUS, M. KASSEL, S. B. FRANSEN, B. L. SCHUBERT, K. L. BESSETTE, L. THOMAS, J. STANGE, L. M. JENKINS, S. A. LANGENECKER, M. WESTLUND SCHREINER. Case-control Differences in Neural Activation During Processing of Subliminal and Supraliminal Emotional Faces.**

**Objective:** Unconscious emotion processing is an important aspect to investigate in the context of mood disorders. This has often been looked at in active major depressive disorder (MDD) and bipolar disorder (BD), but not remitted MDD and BD. It is important to define what emotional processes persist among those in a euthymic state compared to those who have never experienced any mood disorders (AMD), to determine potential neurobiologically-based vulnerability factors.

**Participants and Methods:** Participants between the ages of 18 and 30 were recruited from the Chicago and Ann Arbor areas. There were 107 participants included in this sample [30 healthy controls (HC) and 77 with a history of any mood disorder (AMD)]. Of the AMD group, 63 had remitted MDD and 14 had euthymic BD. All participants completed a task within the MRI scanner. The participants were presented with a supraliminal sad, happy or neutral face for a continuous block of time, when it changed to a new supraliminal face, participants had to indicate what had changed: emotion or person. During each block, the continuous face is interrupted 2-3 times by a subliminal sad or happy face or a shape for 33ms. First level models for each participant included all supraliminal trials that the participants had correct identification and all subliminal trials, irrespective of performance. Next, we investigated group differences in activation for subliminal minus supraliminal happy and sad trials for BD vs HC and AMD vs HC. We used a cluster threshold of  $p < .005$  (uncorrected) and size ( $k$ )  $> 50$  voxels.

**Results:** Compared to controls, participants with a history of BD showed greater activation to subliminal relative to supraliminal happy faces in posterior cingulate, inferior frontal gyrus, middle temporal gyrus, premotor cortex and supplementary motor cortex, and associative visual cortex. Participants with a history of BD showed greater activation to subliminal relative to supraliminal sad faces compared to controls in ventral posterior cingulate, associative visual cortex, pars triangularis and angular gyrus. Participants with a history of AMD showed greater activation to subliminal relative to supraliminal sad faces compared to controls in associative visual cortex, premotor cortex and supplementary motor cortex, left fusiform gyrus, and left primary sensory cortex.

**Conclusions:** Participants with a history of BD, as compared to controls, show greater activation to subliminal versus supraliminal happy faces in areas involved in speech processing, semantic memory processing and the default mode network (DMN). For sad faces, participants with a history of BD show greater activation than controls to subliminal versus supraliminal in areas involved in the DMN, phonological processing, complex language functions, and visual processing. Participants with a history of AMD, as compared to controls, show greater activation to subliminal versus supraliminal sad faces in areas involved in facial recognition, processing somatic sensations, visual processing and planning motor movements. There are neural level differences among individuals with mood disorders that persist in the remitted state and provide support for implementing adaptive emotion processing techniques as a means of intervention.

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**Keywords:** mood disorders, emotional processes

**C. D. MORALES, I. C. TURNEY, P. LAO, K. IGWE, M. ARCE RENTERÍA, J. M. VONK, J. AVILA-RIEGER, D. SEBLOVA, A. RIVERA, J. BERROA, M. MARTINEZ, K. NIEVES-QUINONES, J. J. MANLY, A. M. BRICKMAN. MRI Markers of Brain Health Across Race and Ethnicity in Middle Age.**

**Objective:** Racial and ethnic disparities in dementia risk and cognition in late life are well documented. Studies of middle-aged adults are necessary to identify the earliest biological changes associated with suboptimal brain aging and to determine the temporality of these disparities. The purpose of this study was to examine differences in MRI markers of brain health across racial/ethnic/language groups, which reflect social determinants of health, in middle age.

**Participants and Methods:** Participants came from the ongoing Offspring Study, which enrolls middle-aged adult children of participants in the Washington Heights Inwood Columbia Aging Project (WHICAP), a community-based study of cognitive aging and dementia in older residents of upper Manhattan representing the three major racial/ethnic groups (non-Hispanic White, non-Hispanic Black, and Hispanic/Latinx). A subset of Offspring Study participants (n=528, mean age=54.73+/-10.55, 325 women, non-Hispanic White n=32, non-Hispanic Black n=113, Hispanic/Latinx n=357) has received high-resolution magnetic resonance imaging (MRI). We derived markers of neurodegeneration (cortical thickness of AD-signature regions, hippocampal volume) and vascular lesions (white matter hyperintensities, presence of infarcts, cerebral microbleeds) and compared them across racial/ethnic groups. Because language preference among Hispanic/Latinx participants captures relevant aspects of psychosocial experience, we treated Hispanic/Latinx participants tested in English (n=127) and Spanish (n=230) as distinct groups.

**Results:** There was a trend for cortical thickness to differ across groups: non-Hispanic White participants had the thickest cortical regions and Hispanic/Latinx participants tested in English had the thinnest, with non-Hispanic Black and Hispanic/Latinx participants tested in Spanish as intermediate. The same pattern was observed for measures of hippocampal volume. White matter hyperintensity volume differed across racial/ethnic/language groups, with non-Hispanic White participants evidencing the lowest volume, non-Hispanic Black and Hispanic/Latinx participants tested in English intermediate, and Hispanic/Latinx participants tested in Spanish evidencing the highest. Microbleed frequency also increased across these groups with the lowest rates in non-Hispanic Whites followed by Hispanic/Latinx tested in English, Hispanic/Latinx tested in Spanish, and non-Hispanic Black participants, but infarct frequency did not vary by group.

**Conclusion:** These findings show that race/ethnicity/language differences in neurodegenerative and cerebrovascular markers of brain health are already detectable in middle age. Social inequalities, for which race/ethnicity is a proxy, occur throughout the lifespan and may drive disparities in cognitive aging and dementia in later life.

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**Keywords:** neuroimaging: structural, ethnicity

#### **D. FERNANDEZ, X. WANG, Z. WADE, H. LIU, F. GONZALEZ-LIMA. Electrophysiological Effects of Transcranial Infrared Laser Stimulation.**

**Objective:** Transcranial Infrared Laser Stimulation (TILS) is a non-invasive intervention that has been found to modulate mitochondrial respiration and cellular functions in brain neurons. In healthy adults, eight minutes of TILS to the right prefrontal cortex has been shown to improve memory and attention. This technology is being tested as a possible intervention against cognitive decline in dementia, including Alzheimer's disease. However, little is known about what electrophysiological effect TILS has on the brain. Thus, the objective of this study was to

map and image electrophysiological effects in the cerebral cortex during and after TILS to the right prefrontal cortex.

**Participants and Methods:** A transcranial infrared laser beam at 1064 nm was used on 14 healthy human adult participants. Participants were randomly assigned to one of two conditions, which they were blind to: TILS to the right side of the forehead, or a sham TILS treatment. The participants' electrophysiological oscillations were recorded from the scalp using 64-channel electroencephalograms (EEG) with eyes closed during a 5-minute baseline, 8-minute TILS or sham treatment, and five-minute post-treatment recording.

**Results:** The results show that TILS significantly increased the density of alpha and beta waves as compared to sham, with the largest increases seen in the alpha waves. Increases in alpha and beta waves were seen bilaterally in anterior and posterior regions of the brain. Changes were dose-dependent but did not continue after the TILS treatment ended.

**Conclusions:** The results from this study help us to further understand the mechanistic link between photobiomodulation and the cognitive enhancing benefits from TILS and can help guide future clinical applications of TILS.

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**Keywords:** electroencephalography, cognitive neuroscience, neurostimulation

**A. D. WALKER, E. J. CONNORS, A. O. HAUSON, A. A. POLLARD, S. SARKISSIANS, N. P. STELMACH, N. NEMANIM, B. CARSON. Performance on Tasks of Inhibition in Heart Failure: A Meta-Analysis and Research Synthesis .**

**Objective:** Previous research has found executive dysfunction in patients with heart failure (HF); however, the specific impact of HF on the subdomain of inhibition remains unclear. This study serves to meta-analytically examine the performance on tasks of inhibition in adults with a diagnosis of HF and identify which test is more sensitive to detecting impairment on tasks of inhibition in a HF population.

**Participants and Methods:** Two researchers independently searched eight databases, extracted required data, and calculated effect sizes as part of a larger study on the neuropsychology of HF. Inclusion criteria were: (a) adults with a diagnosis of HF, (b) an active control group with comparable demographics (e.g., groups matched on age), (c) standardized neuropsychological/cognitive testing, and (d) data that allows for the calculation of effect size. Exclusion criteria were: (a) the HF group had other types of major organ failure (i.e., lung or liver failure), (b) the comparison was between different classes of HF (i.e., New York Heart Association (NYHA) Class II versus NYHA Class III), (c) the article was not published or translated into English, or (d) there was a risk of sample overlap with another included study.

**Results:** Seven studies were meta-analyzed, yielding a total sample of 463 individuals, assessed inhibition using the Stroop-Interference Score, Hayling Sentence Completion, and Response Inhibition Test. Results evidenced a statistically significant and medium effect size estimate for overall inhibition ( $g = .680$ , 95% CI [0.452-0.908],  $z = 5.833$ ,  $p < .001$ ) with low heterogeneity ( $I^2 = 31.145\%$ ,  $Q(6) = 8.714$ ,  $p = 0.190$ ,  $Tau^2 = 0.029$ ). Stroop-Interference Score evidenced a statistically significant and medium effect size estimate ( $k = 5$ ,  $g = 0.602$ ,  $p < 0.001$ ). The heterogeneity of Stroop-Interference was not statistically significant and was in the small range ( $I^2 = 0\%$ ,  $p = .481$ ). Hayling Sentence Completion evidenced a statistically significant and large effect size estimate ( $k = 1$ ,  $g = 1.32$ ,  $p < .001$ ). Response Inhibition Test evidenced a statistically significant and medium effect size estimate ( $k = 1$ ,  $g = .609$ ,  $p < .05$ ).

**Conclusions:** HF patients perform poorly on tests of inhibition compared to healthy controls. These results highlight the importance of a comprehensive and detailed executive function evaluation in a heart failure population. Additionally, the Hayling Sentence Completion test had the largest effect size. Since there was only a single study of the Hayling Sentence Completion test, future research should attempt to replicate this finding and determine whether it is truly more sensitive to the impact of HF on inhibitory control.

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**Keywords:** executive functions, cerebrovascular disease, vascular cognitive impairment

**A. A. POLLARD, E. J. CONNORS, A. O. HAUSON, A. D. WALKER, E. ZHANG, E. J. GARMON, A. HOLT, K. REZEGI. Assessing Cognitive Flexibility in Heart Failure Using the Trails Making Test Part B.**

**Objective:** Cognitive flexibility, a sub-domain of executive functioning, requires individuals to have intact attention, processing speed, and working memory to inhibit prepotent responses (Suchy, 2015). There is some evidence that heart failure (HF) can impact cognitive flexibility and might have significant practical implications on patients' lifestyle adjustments due to HF. This meta-analysis will examine cognitive flexibility in HF using the Trail Making Test-Part B (TMT-B).

**Participants and Methods:** Two researchers independently searched eight databases, extracted required data, and calculated effect sizes as part of a larger study on the neuropsychology of HF. Inclusion criteria were: (a) adults with a diagnosis of HF, (b) an active control group with comparable demographics (e.g., groups matched on age), (c) standardized neuropsychological/cognitive testing, and (d) data that allows for the calculation of effect size. Exclusion criteria were: (a) the HF group had other types of major organ failure (i.e., lung or liver failure), (b) the comparison was between different classes of HF (i.e., New York Heart Association (NYHA) Class II versus NYHA Class III), (c) the article was not published or translated into English, or (d) there was a risk of sample overlap with another included study. A total of 10 articles (Total HF  $n = 631$  and HC  $n = 609$ ) were included in this sub-study.

**Results:** TMT-B evidenced a statistically significant and medium effect size estimate ( $g = 0.631$ ,  $p < 0.001$ ). The heterogeneity of TMT-B was not statistically significant.

**Conclusions:** Individuals with HF performed poorly on TMT-B compared to controls. According to the heterogeneity analysis, most of the research had similar findings. These results demonstrate the necessity for a complete assessment of executive functioning in HF with specific attention to cognitive flexibility. Such assessment might aid in predicting the patients' ability to adjust to changes associated with the disease.

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**Keywords:** executive functions, cardiovascular disease, neuropsychological assessment

**N. NEMANIM, A. O. HAUSON, E. J. CONNORS, S. SARKISSIANS, A. A. POLLARD, E. ZHANG, M. N. MILLER, A. RUIZ, C. M. CABRAL. Comparison of Phonemic Versus Semantic Fluency in Patients with Heart Failure.**

**Objective:** Heart failure (HF) is associated with widespread changes in cognitive abilities, including impairments in language. Fluency is often examined as part of a complete neuropsychological battery. There are two types of measures that are used, phonemic and

semantic. The current meta-analysis examines the possible use of fluency measures to characterize the impact of HF on the brain.

**Participants and Methods:** Two researchers independently searched eight databases, extracted required data, and calculated effect sizes as part of a larger study on the neuropsychology of HF. Inclusion criteria were: (a) adults with a diagnosis of HF, (b) an active control group with comparable demographics (e.g., groups matched on age), (c) standardized neuropsychological/cognitive testing, and (d) data that allows for the calculation of effect size. Exclusion criteria were: (a) the HF group had other types of major organ failure (e.g., lung or liver failure), (b) the comparison was between different classes of HF (i.e., New York Heart Association (NYHA) Class II versus NYHA Class III), (c) the article was not published or translated into English, or (d) there was a risk of sample overlap with another included study. A total of 9 articles (Total HF  $n = 1,530$  and HC  $n = 1,014$ ) were included in this sub-study.

**Results:** Phonemic fluency evidenced a statistically significant medium effect size estimate ( $k = 8$ ,  $g = .613$ ,  $p < .001$ ). The heterogeneity of phonemic fluency was moderate and statistically significant ( $I^2 = 64.049$ ,  $p = .007$ ). Semantic Fluency yielded a statistically significant medium effect size estimate ( $g = .702$ ,  $p < .001$ ). The heterogeneity of semantic fluency was high and statistically significant ( $k = 4$ ,  $I^2 = 89.437$ ,  $p < .001$ ).

**Conclusions:** Individuals with HF performed more poorly on tasks involving both semantic fluency and phonemic fluency compared to controls. The effect sizes were in the medium range, however the heterogeneity was moderate-to-high and statistically significant. Future research should examine the sources of this heterogeneity in the literature before deciding whether fluency measures are recommended in the assessment of the impact of HF on the brain.

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**Keywords:** fluency, language, cardiovascular disease

## **E. ZHANG, A. O. HAUSON, E. J. CONNORS, B. D. BARLET, K. REZEGI, A. A. POLLARD, A. D. WALKER, N. S. LACKEY. Verbal Memory Impairment in Heart Failure: A Meta-Analysis and Research Synthesis.**

**Objective:** According to previous research, verbal memory impairment is associated with medial temporal lobe atrophy in heart failure (HF) patients. A meta-analysis was conducted to examine the impact of HF on immediate and delayed verbal memory and recognition.

**Participants and Methods:** Two researchers independently searched eight databases, extracted required data, and calculated effect sizes as part of a larger study on the neuropsychology of HF. Inclusion criteria were: (a) adults with a diagnosis of HF, (b) an active control group with comparable demographics (e.g., groups matched on age), (c) standardized neuropsychological/cognitive testing, and (d) data that allows for the calculation of effect size. Exclusion criteria were: (a) the HF group had other types of major organ failure (i.e., lung or liver failure), (b) the comparison was between different classes of HF (i.e., New York Heart Association (NYHA) Class II versus NYHA Class III), (c) the article was not published or translated into English, or (d) there was a risk of sample overlap with another included study. A total of 23 articles (Total HF  $n = 1,754$  and HC  $n = 5,027$ ) were included in this sub-study.

**Results:** Verbal memory domain-level differences between HF and HC subjects were all statistically significant, with the greatest difference in the Delayed Recall/Learning domain ( $g = 0.596$ ). Within this domain, CVLT (California Verbal Learning Test) Long Delayed Free Recall had the highest effect size ( $g = 1.137$ ), and RAVLT (Rey Auditory Verbal Learning Test)

Delayed Recall had among the lowest effect sizes ( $g = 0.379$ ). Sensitivity analyses identified outliers that significantly affected heterogeneity. At the domain-level, Verbal Memory-Delayed results included original ( $k = 14$ ,  $g = 0.596$ ,  $p < 0.001$ ;  $I^2 = 88.156\%$ ,  $p < 0.001$ ) and adjusted ( $k = 13$ ,  $g = 0.490$ ,  $p < 0.001$ ;  $I^2 = 72.903\%$ ,  $p < 0.001$ ) results. At the test-level, the results were (a) CVLT-Long Delayed Free Recall original ( $k = 3$ ,  $g = 1.137$ ,  $p < 0.001$ ;  $I^2 = 78.961$ ,  $p < 0.01$ ) and adjusted ( $k = 2$ ,  $g = 0.908$ ,  $p < 0.001$ ;  $I^2 = 0.000$ ,  $p = 0.356$ ) and (b) RAVLT-Delayed Recall original ( $k = 4$ ,  $g = 0.379$ ,  $p = 0.093$ ;  $I^2 = 0.000$ ,  $p = 0.737$ ).

**Conclusions:** HF verbal memory patterns suggest greater impairment in delayed recall/learning compared to immediate recall/learning and recognition. Effect sizes also varied at the test-level. Although RAVLT and CVLT have a similar general format (5 acquisition trials and 1 interference trial), RAVLT is a pure measure of verbal memory while CVLT assesses both verbal memory and executive functioning. HF also leads to impaired executive functioning, and previous research has found an association between executive dysfunction and poor CVLT performance. A possible explanation for the higher effect size of CVLT-Long Delayed Free Recall could therefore be the combined impact of impaired verbal memory and executive dysfunction on CVLT performance. Clinicians interested in a pure measure of delayed memory should consider using RAVLT instead of CVLT.

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**Keywords:** memory disorders, cardiovascular disease, vascular cognitive impairment

**A. G. O'NEAL, S. BOTTARI, C. DION, J. DEFELICE, B. HO, J. GUNSTAD, R. A. COHEN, J. WILLIAMSON. Pre-Operative Memory Performance Predicts BMI Change in Individuals with Chronic Obesity.**

**Objective:** Mounting evidence suggests that severe and chronic obesity is a risk factor for brain dysfunction, with elevated body mass index (BMI) being associated with cognitive impairment on neuropsychological testing. For the present study, we examined the predictive value of baseline cognitive performance on pre-post-bariatric surgery BMI change in individuals with chronic obesity. The objective of the study was to determine whether specific domains of cognition were predictors of successful weight loss outcomes following bariatric surgery in a diverse sample of adults with chronic obesity. Data were collected as part of a larger investigation at the University of Florida.

**Participants and Methods:** The final sample included 90 adults with obesity ( $BMI > 35\text{kg/m}^2$ ) aged 20-75 years ( $n = 48$  bariatric surgery, and  $n = 42$  community-recruited non-surgery peers). Exclusion criteria were as follows: a total score of  $< 20$  on the Montreal Cognitive Assessment (MoCA), history of neurological disorder or injury, severe psychiatric or unstable medical condition, and history of substance abuse. Participants completed neuropsychological testing at baseline and 12 weeks post-surgery, using the following measures: California Verbal Learning Test, Second Edition (CVLT-II), Paced Auditory Serial Addition Test (PASAT), Stroop, Trail Making, Verbal Fluency, Boston Naming Test (BNT), and the cognitive component of the NIH Toolbox. Neuropsychological measures were chosen based on their respective theoretical involvement in each cognitive domain of interest (Lezak, 2012). For each cognitive domain, raw scores were converted to z-scores and averaged to create composites. Four neuropsychological composites were created: executive functioning, cognitive efficiency, memory, and learning.

**Results:** Multiple linear regressions controlling for age and gender showed that greater baseline memory performance ( $\beta = 3.09$ ,  $SE = 1.30$ ,  $p < 0.001$ ) predicted greater decreases in BMI at 12 weeks ( $F[6, 76] = 4.79$ ,  $p < 0.001$ ). The observed relationship was statistically significant for the whole sample, and within the surgery participants only. Executive functioning, cognitive efficiency, and learning did not significantly predict change in BMI in either group.

**Conclusions:** Our findings suggest that in adults with obesity, memory performance at baseline explains some of the variance in BMI change at 12 weeks, such that greater memory performance is predictive of greater reduction in BMI. Memory relies on one's ability to recall and recognize provided information. Therefore, individuals who performed better on such measures may demonstrate greater ease at adhering to post-operative guidelines, on factors such as diet and exercise, that facilitate weight loss over time. Overall, these findings suggest that pre-operative assessment of memory functions may be a sensitive and useful tool in predicting weight loss outcome. Future research should investigate the role of brain integrity on weight loss outcome, as well as factors mitigating pre-operative cognitive fragility in chronic obesity samples.

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**Keywords:** treatment outcome, neuropsychological assessment, cognitive functioning

### **S. KELLEHER, F. KIRKHAM, D. E. SAUNDERS, J. KAWADLER, A. HOOD. Cerebral Infarction and Processing Speed Predict Executive Function in Patients with Sickle Cell Disease.**

**Objective:** Impairments in executive function (EF) and processing speed are found frequently in patients with sickle cell disease (SCD). Silent cerebral infarctions (SCI) are also common in patients with SCD and are associated with EF deficits, but those with normal MRI are also affected. EF and processing speed deficits in patients with SCD are related to chronic anemia and damage to the cerebral white matter. However, few data have assessed the relative importance of chronic anemia and laboratory, physiological, or imaging biomarkers (i.e., hemoglobin, oxygen saturation, and SCI) on other aspects of EF, such as task switching (e.g., cognitive flexibility) and planning. Moreover, the influence of processing speed on EF in this population is not well understood. Thus, we hypothesized that cognitive flexibility and planning in patients with SCD would be predicted by age, cerebral infarct status, lower oxygen saturation and processing speed.

**Participants and Methods:** We recruited 69 patients with SCD (HbSS genotype) aged 6-30 years from 2010-2016 from SCD clinics across the United Kingdom. During the test session, patients completed a full neuropsychological battery. Reported here are two tests of cognitive flexibility (the number and letter switching condition from the Trail Making Test and the inhibition/switching condition from the Color-Word Interference Test) and one test of planning (the total achievement score from the Tower Test) from the Delis-Kaplan Executive Function System (D-KEFS). Additionally, visual scanning condition of the Trail Making was used as our test of processing speed. We obtained SCI status from MRI scans completed within one year of neuropsychological testing and over-read by an experienced neuroradiologist. We obtained oxygen saturation on the same day of testing and steady-state hemoglobin levels from the patient's medical records taken at the closest clinical visit.

**Results:** Initial tests indicated that age and oxygen saturation were not significant predictors of EF, so they were not included in subsequent analyses. We ran 3 hierarchical linear regressions with the predictors of hemoglobin, infarct status and processing speed. For both tests of cognitive

flexibility, SCI status, but not hemoglobin, predicted EF performance. Moreover, there were interactions between SCI status and processing speed, such that patients without SCI who had faster processing speed performed better on both Trail Making ( $p = .006$ ,  $n^2 = .21$ ) and Color-Word Interference ( $p = .02$ ,  $n^2 = .15$ ) tests. The interaction between SCI status and processing speed did not reach statistical significance for the Tower Test ( $p = .11$ ,  $n^2 = .08$ ), but the medium effect suggests that the result is clinically meaningful.

**Conclusions:** Our findings indicate that when interpreting EF deficits in patients with SCD, it is important to account for the relationship between SCI status and processing speed as we found a large benefit for children without SCI who had faster processing speed. More research is needed to elucidate the mechanisms that underlie these differences, but assessing whether infarction in the visual pathway specifically affects visual processing would appear to be a plausible next step. Correspondence: *Stephanie Kelleher, University College London, London, England, WC1E6BT, United Kingdom. Email: stephkells123@gmail.com*

**Keywords:** sickle cell disease, executive functions, pediatric neuropsychology

**S. M. SZYMKOWICZ, P. E. MAY, J. W. WEEKS, D. O'CONNELL, A. NELSON SHEESE. Optimal Cut-Off Score of the Montreal Cognitive Assessment (MoCA) in Assessing Cognitive Dysfunction in Inpatient Liver Transplant Candidates: A Retrospective Chart Review.**

**Objective:** Hepatic encephalopathy (HE) is a consequence of liver disease and is often diagnosed, particularly at the milder stages, via psychometric testing. While a comprehensive neuropsychological assessment may be indicated, this is not always feasible when patients are inpatient status. At the University of Nebraska Medical Center, the Montreal Cognitive Assessment (MoCA) is often used as a part of the cognitive screening process for inpatient liver transplant candidates. However, the MoCA was developed for use in mild cognitive impairment and dementia populations and its psychometric properties in inpatients with liver disease have not been determined.

**Participants and Methods:** A retrospective chart review from 1/2014 to 2/2020 identified inpatient liver transplant candidates who were administered a MoCA as part of their neuropsychological screening. Included participants had either no cognitive diagnosis or a diagnosis of HE (of varying severity) made by the neuropsychologist. The final sample included 57 individuals (mean age =  $48.84 \pm 12.55$ , 49% female, mean education =  $12.54 \pm 2.35$ ). Psychometric analyses (internal consistency, correlations with Trails A and B, receiver operator characteristic [ROC] curve) were conducted, as well as a linear regression to determine the predictive value of demographic, disease, psychiatric, and current admission variables on total MoCA scores in this sample.

**Results:** The internal consistency of the MoCA domain scores ( $\alpha = 0.80$ ) was acceptable. Correlations with Trails A and B were negative and moderate-to-strong in nature ( $r$ 's =  $-0.43$  and  $-0.71$ , respectively;  $p$ 's  $< 0.05$ ). Area under the curve for the MoCA was  $0.77$  ( $p < 0.05$ ). ROC curve revealed a cut-off score of  $\leq 25$  had the best sensitivity ( $0.72$ ) and specificity ( $0.77$ ) for identifying those with a diagnosis of HE from those without a diagnosis. The strongest predictors of total MoCA scores were age and presence of altered mental status / confusion noted during their hospitalization ( $p$ 's  $< 0.05$ ).

**Conclusions:** The MoCA may be an appropriate cognitive screener to use in inpatients with liver disease who are transplant candidates. A cut-off score of 25 may be appropriate to detect

cognitive dysfunction in this group. In addition to the clinical interview and other neuropsychological tests, low scores on MoCA can help determine the presence of HE.

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**Keywords:** cognitive screening, liver disease, psychometrics

**M. L. TURMAN, H. A. BENDER, J. SPAT-LEMUS. Toward a Standardized Pre-Organ Transplant Neuropsychological Assessment Battery: Cognitive, Adaptive, and Emotional Functioning Insights from a Presurgical Cardiothoracic Transplant Evaluation Case..**

**Objective:** In recent years, neuropsychological assessment has become more commonly employed within standard organ transplant-related medical testing. There is clinical utility in monitoring of neuropsychological profiles in this population, especially for transplants that may carry a risk for potential cerebral neuropathology (e.g., cardiothoracic transplants). The transplantation process has been associated with frequent cognitive deficits that may impact an individual's adherence to treatment, their emotional functioning, and their overall quality of life, through impairments in executive function, verbal and visual memory, language comprehension and fluency, visuospatial perception, and intellectual functioning. Neuropsychological evaluation can provide comprehensive data on the status of these various functions and how they may impact critical post-transplant treatment concerns, such as medication-adherence, psychosocial adjustment, and adaptive functioning. Neuropsychological data (e.g., information processing, cognitive flexibility) has been shown to directly account for variance in measures assessing activities of daily living in transplant populations, arguing for the utility of concurrent assessment of these domains. A standardized set of assessment guidelines may ensure information pertinent to an individual's post-transplant care, especially vis-à-vis their cognitive, adaptive, and emotional functioning. To illustrate pertinent domains, a comprehensive pre-operative neuropsychological assessment of a cardiothoracic transplant case is discussed in detail with focused discussion on cognitive, adaptive, and emotional functioning data. The authors call for a standardized neuropsychological battery containing critical core elements for appropriate evaluation of transplant patients.

**Participants and Methods:** The authors performed a clinical interview, electronic medical record review, and a comprehensive neuropsychological assessment of a 40-year-old male with a history of end-stage heart failure, nonischemic cardiomyopathy, left ventricular assistance device implantation, and multiple cerebral ischemic events. The assessment battery employed core measures of premorbid/intellectual functioning, a repeatable neuropsychological screening tool, a functional living scale, and emotional functioning measures, which were critical in augmenting the clinical picture and informing predictive post-transplant treatment adherence.

**Results:** The patient evinced diffuse, multifocal neuropathology involving frontal, temporal, parietal, and posterior cortices with unique preservation of left interior temporal functioning, several notable adaptive functioning concerns, and clinically-significant anxiety symptomatology. Select elements of this battery are presented, along with the obtained neuropsychological profile, including neuropsychological, adaptive, and emotional functioning measures. Links among these domains and post-treatment implications are discussed.

**Conclusions:** Neuropsychological evaluation is critical in organ transplant cases and can yield essential insight into post-treatment functional and emotional concerns and trajectories. The authors argue for a shift toward a neuropsychological battery that utilizes common, standardized elements in organ transplant settings containing, at minimum: a standardized clinical interview

specific to organ transplant populations, a premorbid functioning measure, a neuropsychological screening measure, an adaptive functioning measure, and an emotional functioning measure. Such measures should be culturally-informed, and, whenever possible, clinicians should utilize measures developed and standardized in the patient's culture and language, to ensure accuracy of the diagnostic picture and the post-treatment trajectory. The authors call for such measures to be integrated into a standardized battery and for future research to validate the clinical utility of such a battery vis-à-vis post-transplant outcomes, treatment adherence, and quality of life.

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**Keywords:** adaptive functioning, vascular cognitive impairment, neuropsychological assessment

**E. HAVLIK, H. MURPHY, N. IBARRA, L. UMFLEET, J. JANECEK, K. A. MAU, J. R. BINDER, M. RAGHAVAN, S. SWANSON. WAIS-IV Prorated Verbal Comprehension Index Composite Scores in an Epilepsy Sample.**

**Objective:** When it is not possible to obtain all necessary subtest scaled scores to derive a composite score, the sum of scaled scores can be prorated to account for a missing subtest. Wechsler (2008) explains that proration should only be used as a last resort means of obtaining a composite score as it violates standard test administration and may introduce additional measurement error. However, in practical settings, proration is utilized frequently and serves as an efficient way to obtain a gross composite measure. The objective of the current study was to examine whether prorated Verbal Comprehension Index (VCI) composites are significantly different from the VCI composite and to explore the clinical relevance of the difference in a large epilepsy sample. Further, the relationship between prorated VCI scores and the VCI composite are explored.

**Participants and Methods:** A sample of 128 patients with epilepsy were administered WAIS-IV core VCI subtests; Similarities (SI), Information (IN), and Vocabulary (VC). Means for age, education, and FSIQ were 38.51 ( $SD = 13.35$ ), 13.04 ( $SD = 2.045$ ), and 84.68 ( $SD = 16.18$ ), respectively. The VCI composite score and all possible subtest combinations yielding a prorated composite score (SI+IN, SI+VC, VC+IN) were obtained. Absolute difference scores from the VCI were calculated for each prorated VCI. One-Sample t-tests were conducted to determine if the absolute difference scores were significantly different from zero. Descriptive frequency analysis was conducted to explore individual level differences. Bivariate correlations, followed by the Levy (1967) part-whole correction to account for inflated values due to collinearity, were conducted to explore the relationship between prorated VCI scores and the VCI score.

**Results:** Each prorated combination VCI composite score (i.e. SI+IN, SI+VC, VC+IN) was significantly different from the VCI composite [i.e.  $t(127) = 11.98, p = < .001, r = 0.728$ ;  $t(127) = 12.76, p = < .001, r = 0.749$ ;  $t(127) = 12.77, p = < .001, r = 0.765$ ; respectively]. Absolute mean differences ranged from 2.7 to 3.1 standard score points. Of the 384 total observed prorated scores, 22 differed from the VCI by  $\geq 8$  (0.057%) standard score points and 1 differed by  $\geq 15$  (0.002%). Correlations between Prorated VCIs and the VCI are reported in a Table.

Correlation Between Prorated VCIs and VCI		
	Pearson r	Corrected r
SI + IN	0.97	0.83
SI + VC	0.98	0.84
VC + IN	0.97	0.85

**Conclusions:** Although prorated VCI composite scores were statistically different from the VCI composite in this epilepsy sample, it may not be clinically relevant as the mean difference of three standard score points is unlikely to impact diagnostic decisions. However, on an individual level, the prorated composite can be grossly inaccurate – differing from the VCI composite up to a full standard deviation.

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**Keywords:** neuropsychological assessment, verbal abilities, epilepsy / seizure disorders

**T. W. RHOADS, K. BASURTO, J. R. SOBLE. Racial/Ethnic Differences in Chronic Pain Experience: Implications for Assessment and Intervention Among Presurgical Spinal Cord Stimulator Candidates.**

**Objective:** Considerable evidence has established the presence of racial/ethnic disparities in prevalence, treatment, and progression across pain-related conditions. However, racial/ethnic differences in pain experience have not yet been examined in patients with chronic pain undergoing neuropsychological evaluation for spinal cord stimulator (SCS) placement. This study elucidated relationships between race and pain experience characteristics in a demographically diverse sample of patients with chronic pain.

**Participants and Methods:** This cross-sectional study included 95 patients referred for neuropsychological evaluation to assess for cognitive/psychological contraindications as part of SCS presurgical workup. The sample was 60% female/40% male and 42% White/39% Black/19% Hispanic or Latinx, with mean age of 49.6 ( $SD=10.4$ ), and mean education of 12.9 ( $SD=2.6$ ). Primary outcome measures included the Beck Depression Inventory, Second Edition (BDI-II), Pittsburgh Sleep Quality Inventory (PSQI), and the West Haven-Yale Multidisciplinary Pain Inventory (WHYMPI).

**Results:** Multivariate analysis of variance with racial/ethnic group (White, Black, Hispanic/Latinx) as a fixed factor and WHYMPI subscales as outcome variables was significant,  $V=0.41$ ,  $F(24, 164)=1.77$ ,  $p=.02$ . Separate univariate ANOVAs examining the outcome variables revealed significant group effects for Pain Severity ( $p=.018$ ,  $\eta^2=.084$ ), Solicitous Responses ( $p=.001$ ,  $\eta^2=.15$ ), and Distracting Responses ( $p=.009$ ,  $\eta^2=.098$ ). Post-hoc analyses showed that Blacks reported significantly higher levels of Pain Severity than Whites and that Blacks and Hispanic/Latinx reported higher levels of Solicitous Responses and Distracting Responses than Whites. Regression analyses were conducted to examine the amount of variance accounted for in depressive symptoms and sleep quality by WHYMPI variables of interest. Pain Severity ( $p=.03$ ) and Distracting Responses ( $p=.04$ ) were significant predictors of depressive symptoms, but only for Black patients. Furthermore, Pain Severity, but not Distracting Responses, was a significant predictor of sleep quality ( $p=.04$ ) for Black patients. No such significant relationships were found for White or Hispanic/Latinx patients.

**Conclusions:** Patients of different racial and ethnic groups appear to experience pain in different ways. White patients may have a more individualistic experience of chronic pain, with generally lower pain severity, but also a more self-reliant and individualistic mentality. In contrast, whereas Black and Hispanic/Latinx patients reported greater pain severity compared to their White counterparts, individuals from these groups also experience pain in the context of greater social support with family or significant others providing more assistance with daily activities and greater distraction from pain. Taken together, implications of these findings suggest that Black patients may be particularly vulnerable to higher pain ratings being associated with

increased depression and worsened sleep. Furthermore, reduced distracting behaviors from family/friends (e.g., encouraging work on a hobby, reading or talking to the patient to take their mind off their pain) may be related to a disproportionate increase in depressive symptoms for Black patients with chronic pain.

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**Keywords:** chronic pain, cross-cultural issues, neuromodulation

**B. FUSCO-GESSICK, J. STIVER, E. M. MCCONATHEY, M. E. WATSON, M. ZIMMERMAN. Night-to-Night Variation in Sleep Quality and Quantity Is Not Associated With Executive Functioning in Healthy Young Adults.**

**Objective:** Night-to-night variation in sleep quality and quantity is commonplace among young adults. Despite this, surprisingly little is known about the relationship between variability in sleep habits and cognitive functioning. A growing body of research suggests a detrimental effect of highly variable sleep quality on learning and memory, but the relationship between variability in sleep and executive functioning (EF) among healthy adults remains uncertain. The majority of extant research examining sleep and cognitive functioning uses a single night of sleep in a laboratory setting or measurements of actigraphic-estimated sleep averaged over a given time span. In either case, the additional impact of night-to-night fluctuations (or conversely, the mitigating effect of sleep regularity) is often not fully considered. The purpose of this study was to evaluate the impact of variability in sleep quantity and quality above and beyond respective means of these factors on tasks of EF, including measures of working memory, fluency, and cognitive control.

**Participants and Methods:** University students from the Bronx, NY ( $N=78$ ; mean age=20.7, Female=69.1%) wore an actigraphic device (Actiwatch Spectrum PRO; Philips Respironics Inc.) for an average of 13.9 days (range 9.0–21.0) to measure objective sleep behavior. Actigraphy data included average minutes spent sleeping, minutes spent awake after sleep onset, sleep efficiency, and onset latency, as well as the root mean square of successive differences (RMSSD) for these sleep parameters to quantify night-to-night variation in sleep. RMSSDs were used in favor of standard deviations as an index of variability in order to incorporate the sequencing of changes across the period of measurement. Participants returned to the laboratory and were administered neuropsychological tests of EF (NIH-EXAMINER battery) and estimated level of intellectual functioning (Wechsler Test of Adult Reading), as well as mood measures.

**Results:** A series of regression models were calculated to evaluate the effect of night-to-night variability in sleep on EF. After controlling intellectual functioning, depression and anxiety, relevant demographic covariates, and their respective averages, variability in sleep did not predict composite scores for global executive function, working memory, fluency, or cognitive control in any model (Standardized  $\beta$ 's = .033-.098, all  $p$ 's > .05). The interaction between mean total sleep time and variability in sleep time was not significant, Standardized  $\beta = -.519, p > .05$ .

**Conclusions:** Across a wide range of objective sleep parameters and executive functioning abilities, variability in sleep quality and quantity appeared unrelated to performance on tests of EF. Furthermore, night-to-night variability in sleep quantity and average sleep quantity did not have an interactive effect on EF. These results suggest that variability in sleep may not impact executive functioning in the way it has been shown elsewhere to impact learning and memory. Alternatively, it is possible that healthy young adults are resistant to any detrimental effects of night-to-night variation in sleep habits. Future studies may examine the impact of variability in

sleep on EF and other cognitive domains among older adults, as well as experimentally manipulating the extent and nature of sleep variability in laboratory settings.

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**Keywords:** sleep, executive functions

**B. A. CHAPIN, K. PISANUWONGRAK, K. HEILMAN. Vertical Pseudoneglect: Attentional Versus Action-Intentional .**

**Objective:** Healthy participants demonstrate an upward bias on the vertical line bisection test (vertical pseudoneglect). One explanation is that this is due to increased activation of the ventral visual allocentric association areas that mediate upward attention. Alternatively, this may be due to an upward motor-action-intention bias. Thus, we wanted to learn whether direction of action has an effect on vertical pseudoneglect.

**Participants and Methods:** Twenty-four healthy, right-handed adults aged 21-85 years were tested on an apparatus consisting of a vertical board with pulleys at each end and a string threaded through each pulley. An arrow was attached to the string and a paper with a 24 cm vertical line was placed behind the front string. Participants attempted to move the arrow to the middle of the line, starting either from above or below. The arrow was moved with the participant's hand on the front string (congruent) or the back string, where the hand's movement was in the opposite direction of the arrow movement (incongruent).

**Results:** Upward deviation from the midline was significant in all four conditions at  $p < 0.001$ . A 2-way repeated measures ANOVA was performed to examine the effects of congruence and direction of arrow movement. Direction of arrow movement did not have a significant main effect ( $F(1,23) = 0.37, p=0.55$ ). However, hand movement congruence did ( $F(1,23) = 37.01, p < 0.001$ ) with upward deviation greater in the incongruent than congruent conditions. There was a significant interaction effect ( $F(1,23) = 10.29, p = 0.004$ ) and this was driven by the greater difference between congruent and incongruent hand movements when the arrow started above the midline.

**Conclusions:** These results suggest that vertical pseudoneglect is primarily influenced by the allocation of allocentric attention, rather than motor action. However, action-perceptual spatial incongruence increased this deviation. Perhaps the incongruent condition requires greater allocation of attention, but further exploration is needed.

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**Keywords:** visuospatial functions, visuospatial neglect, asymmetry

**L. CHILDERS, L. J. BENNETT-LELEUX, T. L. GLOVER, E. V. FLORES, A. N. HAYGOOD, K. K. MOLLENKOPF, A. M. COLDIRON, J. M. MOORE, M. D. BARNETT. Visual Working Memory and Learning and Recall of a Meal Preparation Task in Virtual Reality.**

Working memory has been linked with recall memory, including recall memory in virtual reality. In this research, working memory is often assessed verbally; however, virtual reality involves rich visual stimuli potentially assisting in memory formation, recall, and focus. While much of this work has utilized traditional neuropsychological tests, some work has suggested that visual working memory may be particularly relevant to episodic memory in virtual reality.

**Objective:** The purpose of this study was to assess the relationship between visual working

memory and learning and recall in a virtual reality environment. **Participants and Methods:** Young adults ( $N = 40$ ; age 18 – 25,  $M = 18.68$ ,  $SD = 1.10$ ) were administered the WMS-IV Symbol Span subtest and completed the Virtual Kitchen Protocol (VPK), a virtual reality-based measure of episodic memory for meal preparation tasks. **Results:** Visual working memory was not associated with performance on the learning trials but was associated with better immediate recall ( $r = .37$ ,  $p = 0.02$ ) and delayed recall ( $r = .37$ ,  $p = 0.02$ ) of meal preparation tasks in virtual reality. **Conclusion:** On the learning trials, individuals may have relied on rehearsal of verbal instructions of the cooking steps. For recall trials, participants may have relied more on visual imagery.

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**Keywords:** working memory, visual imagery, visuospatial functions

**D. C. LEE, A. N. HAYGOOD, E. V. FLORES, A. J. FLAIR, N. TRAN, L. CHILDERS, M. A. VASQUEZ, J. M. MOORE, M. D. BARNETT. Differences by Age Cohort and Gender on a Meal Preparation Task in Virtual Reality.**

**Objective:** Neuropsychologists have pointed out that we know almost nothing about how the brain organizes simple everyday activities such as cooking; indeed, some have called for function-led assessments of everyday abilities (Burgess, 2006). Likewise, some have noted a greater emphasis on simple everyday activities should be placed on intact samples to assess the degree of functional difficulty participants experience (Spooner & Pachana, 2006).

**Methods and Participants:** In this study, we investigated differences by age cohort and gender on the Virtual Kitchen Protocol, a virtual reality-based meal preparation task. Young adults (age 18-30),  $M = 59.55$ ,  $SD = 6.36$ ) and older adults (age 55 +,  $M = 38.41$ ,  $SD = 18.37$ ) completed the VKP; we analyzed differences by the immediate recall and delayed recall of the meal preparation tasks.

**Results:** A two-way (age cohort x gender) between-subjects MANOVA found significant multivariate effects for both age and gender. Univariate analyses found that young adults had higher levels of immediate and delayed recall than older adults. On immediate recall, there was a significant age cohort x gender interaction; among young adults, men and women performed at similar levels (with men performing slightly higher), but among older adults, women significantly outperformed men. This interaction was not significant on delayed recall.

**Conclusion:** The age effects may be explained by young adults' generally higher episodic memory, but it is also possible that they were more comfortable with the technology (Kosowicz & MacPherson, 2017). Older adult women may have more experience with cooking tasks (Kolpashnikova, 2018) than older adult men; this may have helped them with encoding the information and thus helped on immediate recall. However, these differences may have dissipated at delayed recall.

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**Keywords:** everyday functioning, memory: prospective, aging (normal)

**Paper Session 02: Aging, Physical Activity and Lifestyle Factors**

**9:00 AM - 10:00 AM**

**A. MENDEZ COLMENARES, M. VOSS, J. FANNING, E. A. SALERNO, N. P. GOTHE, M. L. THOMAS, E. MCAULEY, A. F. KRAMER, A. Z. BURZYNSKA. Aerobic exercise increases T1w/T2w in the aging white matter.**

**Objective:** White matter (WM) deterioration is an important mechanism of cognitive decline in healthy aging and dementia. Engaging in aerobic exercise to improve cardiorespiratory fitness (CRF) is one of the most promising ways to improve cognitive and brain health in healthy older adults. Yet, few randomized controlled trials have reported benefits of aerobic exercise interventions on WM microstructure when using diffusion tensor imaging, the gold standard for WM neuroimaging. Therefore, our aim was to study the effects of a 6-month exercise intervention on WM using a novel index of WM integrity, the ratio of the standardized T1 and T2-weighted images (T1w/T2w).

**Participants and Methods:** Our sample included 180 cognitively healthy older adults (60–79 years) from a 6-month randomized controlled trial (NCT01472744). Participants were randomized to one of four groups including a low intensity activity with complex cognitive demands (Dance), Walking, Walking + nutritional supplement or an active control. Cognitive assessment included the Virginia Cognitive Aging battery (Salthouse, 2009) and two additional experimental executive function tasks (task switching and spatial working memory).

**Results:** Results showed that a 6-month aerobic walking and dance intervention produced positive changes in the T1w/T2w with significant time-by-group interactions in the total WM, the genu and splenium of the corpus callosum, forceps minor and cingulum, relative to an active control condition. In contrast, we observed a decline in T1w/T2w in the majority of WM regions in the active control group. Lastly, a positive change in the T1w/T2w correlated with a positive change in episodic memory in the Walking, but not in the active control, when controlling for age, sex and education.

**Conclusions:** Our results provide the first evidence for the standardized T1w/T2w as a promising WM metric capable of detecting short-term within-person changes in the WM and intervention-induced WM plasticity in the adult human brain.

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**Keywords:** aging (normal), cognitive neuroscience, neuroimaging: structural

**M. MEMEL, A. BUCHMANN, D. BENNETT, K. B. CASALETTO. Resistance versus Resilience – Effects of objectively measured physical activity on neuropathology and cognitive outcomes in older adults.**

**Objective:** Physical activity is associated with positive effects on cognition, brain structure, and psychological well-being during aging. However, it remains unclear whether physical activity is directly associated with the accumulation of disease-related brain pathology (“resistance”) or confers beneficial effects indirectly to cognition by moderating adverse effects of pathology (“resilience”). Additionally, clarification of the pathology-specificity of these activity effects will help support precision-medicine interventions. We tested the direct and moderating relationships between objective physical actigraphy, individual postmortem protein and cerebrovascular pathologies, and cognition. **Participants and Methods:** Five hundred older adults in the Rush Memory and Aging Project (MAP; 85 years-old, range = 62-100y, 72% female, baseline MMSE= 27 (3.50)) completed longitudinal actigraphy monitoring and cognitive testing (average

no. visits=3), and went to autopsy with neuropathological examination. Participants wore an actigraph for 24 hours/day for up to 10 days (non-dominant wrist). Global cognition was obtained by averaging performances across 19 cognitive measures. Pathological markers included a global measure of Alzheimer's Disease (AD) pathology burden, and presence/severity of Lewy body disease (LBD), TDP-43, cerebrovascular disease (macroinfarcts, microinfarcts, arteriosclerosis, atherosclerosis), cerebral amyloid angiopathy (CAA), and hippocampal sclerosis. The direct effect of physical activity on pathology was examined in a model that tested the relationship between average daily actigraphy across all visits and all pathological markers entered simultaneously, along with age at death, sex, and education as covariates; to adjust for disease-related motor changes, we further covaried for a global measure of 10 motor performance tests. We then examined the moderating effect of physical activity on the relationship between pathology and cognition using separate longitudinal linear mixed effects models for each pathology marker. Actigraphy was decomposed into between-person (average) and within-person (change) effects. We examined the interaction between within-person changes in actigraphy and pathology on global cognition over time, adjusting for covariates and between-person actigraphy levels. **Results:** Greater daily actigraphy was directly associated with less LBD ( $B = -.10$ ,  $p=.018$ ) and fewer macroinfarcts ( $B=-.25$ ,  $p=.016$ ). Unexpectedly, greater daily actigraphy was associated with *greater* AD pathology ( $B= .54$ ,  $p=.001$ ), and this effect was driven by women. Testing moderation models, longitudinal increases in daily actigraphy significantly interacted with global AD pathology, CAA, TDP-43, and atherosclerosis ( $Bs > .05$ ,  $ps<.045$ ), but not LBD, macroinfarcts, microinfarcts, arteriosclerosis, or hippocampal sclerosis on global cognition. Adults with increasing physical activity over time demonstrated a significantly weaker adverse relationship between pathology and cognitive trajectories.

**Conclusions:** Direct effects suggest that physical activity may provide “resistance” against LBD and cerebrovascular disease accumulation, but contribute “cognitive resilience” against AD and other neurodegenerative disease pathologies during aging. These findings suggest that the protective effects of physical activity on individual brain pathologies occur through different pathways. However, results are observational in nature and future interventions are needed to address the possibility of reverse causality.

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**Keywords:** aging disorders, cognitive functioning, brain damage

**E. E. SMITH , L. H. LACRITZ, L. S. HYNAN, M. LAMAR, E. N. SMERNOFF, A. VALVANO, H. ROSSETTI. Lifestyle Factors Predicting Cognition in Elderly Adults With and Without Cognitive Impairment.**

**Objective:** Lifestyle behaviors have been associated with reduced risk of dementia and/or slower rate of cognitive decline, and only recently have studies looked at combined effects of multiple lifestyle factors on cognition. We examined 10 lifestyle factors (five healthy and five risk factors) together to determine significant predictors of cognition in community dwelling older adults.

**Participants and Methods:** Participants ( $n=467$ ,  $M_{age}=83.4[7.1]$ ,  $M_{edu}=15.0[2.7]$ , 95% White, 73% female) from the Rush Alzheimer's Disease Center's Memory and Aging Project completed 19 cognitive tests and additional measures of healthy lifestyle behaviors (diet adherence, physical activity, sleep fragmentation, social activities, perceived stress). Data were also collected on cognitive risk factors (alcohol use, smoking, body mass index [BMI], APOE  $\epsilon 4$ ,

depression) and demographics (age, education, sex, early life socioeconomic status [SES], clinical diagnosis). Diagnoses consisted of no cognitive impairment (NCI), mild cognitive impairment (MCI), or Alzheimer's disease (AD). All 10 lifestyle factors were entered into separate stepwise multiple linear regression analyses predicting cognitive composite z-scores for global cognition, verbal memory, processing speed, and working memory.

**Results:** Younger age, higher education, female sex, and an NCI diagnosis were associated with higher verbal memory ( $F[4, 461]= 105.46$ ;  $p< 0.001$ ). These variables in addition to more social activities were associated with higher global cognition ( $F[5, 461]=109.15$ ;  $p< 0.001$ ). With the addition of less depressive symptoms, the previously listed participant characteristics were also significantly associated with faster processing speed ( $F[6, 452]= 38.56$ ;  $p<0.001$ ). Higher levels of education, early life SES, and healthy diet adherence, as well as an NCI diagnosis, were associated with higher working memory ( $F[4, 457]= 24.75$ ;  $p< 0.001$ ). When divided into NCI ( $n=361$ ) and cognitively impaired (MCI and AD;  $n= 106$ ) groups, younger age, higher education, female sex, higher early life SES, and more social activities were significantly associated with higher global cognition in the NCI group ( $F[5, 351]=30.84$ ;  $p<0.001$ ), similar to the total sample. In contrast, higher education, higher BMI, better diet adherence, and more physical activity was significantly associated with higher global cognition in the cognitively impaired group ( $F[4, 92]=9.82$ ;  $p<0.001$ ).

**Conclusions:** While demographic factors and diagnosis were consistently associated with cognition in this sample, differential lifestyle factors contributed to select cognitive domains. Specifically, higher social activity was associated with higher global cognition and faster processing speed, while better diet adherence was associated with higher working memory performance, and lower depression scores were associated with faster processing speed. When considering clinical diagnoses, demographic factors, including early life SES, and only one lifestyle factor (social activities) was associated with global cognition in the NCI group, whereas lifestyle behaviors of better diet adherence and more physical activity were associated with higher global cognition for individuals with MCI or AD. Healthy lifestyle factors were associated with cognition to a greater extent than risk factors in this sample, especially for individuals who already had cognitive impairment. Future longitudinal studies of the effect of multiple healthy behaviors, or "lifestyle reserve," on cognitive outcomes in aging and Alzheimer's disease are warranted.

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**Keywords:** mild cognitive impairment, dementia - Alzheimer's disease

**A. F. SOLDAN, C. PETTIGREW, K. KUTTON, M. BILGEL, X. F. HOU, H. LU, M. ALBERT. Lifestyle activity engagement and resting-state functional connectivity among older adults.**

**Objective:** Prior work suggests that greater engagement in lifestyle activities that are cognitively, socially, or physically stimulating is associated with a reduced risk of dementia and cognitive decline. However, the neurobiological mechanisms underlying the beneficial effect of lifestyle activity engagement on cognitive and clinical outcomes are poorly understood. This study investigated whether lifestyle activity engagement among cognitively normal middle aged and older adults is associated with connectivity in large-scale functional brain networks, measured by resting-state functional magnetic resonance imaging (rs-fMRI), and whether there is

a modifying role of APOE  $\epsilon$ 4 status and cortical amyloid burden as measured by Positron Emission Tomography (PET).

**Participants and Methods:** During their annual study visits,  $N = 133$  cognitively normal participants ( $M$  age = 69 years, range=34-89) from the BIOCARD Study completed the CHAMPS activity questionnaire to quantify their frequency of engagement in cognitive, physical, and social activities. Additionally, total number of activities performed was assessed by summing the number of activities reported, independent of frequency of engagement. Participants completed both a rsfMRI scan and a PET scan using Pittsburgh Compound B ( $^{11}\text{C}$ -PiB), within 30 days of the lifestyle activity assessment. Functional connectivity was assessed in 7 non-overlapping networks using the Yeo et al. (2011) pipeline. For the amyloid PET scans, Distribution Volume Ratios (DVR) were computed using cerebellar gray matter as the reference tissue. Mean cortical amyloid burden was calculated by averaging cortical DVRs. Amyloid positivity ( $n=42$ , 32%) was defined as a mean cortical DVR threshold of 1.06, derived from Gaussian mixture modeling. Model covariates included age, sex, and years of education, and an FDR correction for multiple comparisons was applied.

**Results:** Using regression analyses, we found that frequency of engagement in physical activities was most robustly associated with greater connectivity in the default mode network ( $p=0.002$ ), somatomotor network ( $p=0.003$ ), and global connectivity (i.e., average across all 7 networks,  $p=0.0005$ ). Cognitive activity engagement was associated with greater connectivity in the dorsal attention network ( $p=0.0024$ ), whereas total number of activities was associated with greater global connectivity ( $p=0.04$ ). In contrast, social activity was not associated with rsfMRI connectivity. Additionally, more frequent cognitive and physical activity engagement were related to greater network modularity (both  $p\leq 0.019$ ), suggesting greater functional specialization. Cortical amyloid burden and APOE4 status did not modify these associations. Consistent with prior studies, older age was associated with decreased connectivity within these networks, as well as decreased global connectivity and modularity.

**Conclusions:** These findings suggest that greater engagement in cognitive and physical activities is associated with both increased functional connectivity in specific networks as well as greater network modularity, and that these relationships are independent of cerebral amyloid burden and APOE  $\epsilon$ 4 status. In light of the age-related decrease in network connectivity and network modularity, these findings raise the possibility that greater engagement in cognitive and physical activities may reduce these age-related functional network declines, thereby supporting better cognitive functioning with increasing age. Longitudinal follow-up will be able to examine this possibility.

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**Keywords:** brain function, cognitive reserve, neuroimaging: functional connectivity

### **I. SIBLE, B. YEW, S. DUTT, K. J. BANGEN, Y. LI, D. A. NATION. Visit-To-Visit Blood Pressure Variability Predicts Cerebral Perfusion Decline in Older Adults.**

**Objective:** Both elevated blood pressure and reduced cerebral blood flow are related to Alzheimer's disease pathophysiology and are predictive of cognitive decline with progression to Alzheimer's disease dementia. Recent studies link visit-to-visit blood pressure variability to dementia risk, including Alzheimer's disease and vascular dementia, independent of average blood pressure levels. Although potential mechanisms linking elevated blood pressure variability to Alzheimer's disease remain understudied, it has been hypothesized that elevated blood

pressure variability may challenge cerebral autoregulation and risk hypoperfusion injury. Alternatively, neurodegeneration of cortical autonomic centers may increase blood pressure variability, accounting for an association between blood pressure variability and dementia risk. To address these possibilities, we studied older adults over a one year period to determine whether blood pressure variability predicts decline in cerebral perfusion, independent of baseline cerebral metabolism.

**Participants and Methods:** Alzheimer's Disease Neuroimaging Initiative participants (n=57) free of dementia or stroke underwent repeated blood pressure measurement and arterial spin-labeling MRI over the same one year period. Fluorodeoxyglucose-PET determined cerebral metabolism at baseline. A subset underwent baseline lumbar puncture to determine cerebral spinal fluid amyloid-beta (n=17) and phosphorylated tau (n=20) abnormalities. Visit-to-visit blood pressure variability (variability independent of mean) and change in cerebral perfusion were both calculated over 12 months. Multiple linear regression examined blood pressure variability and change in regional perfusion after controlling for age, sex, average blood pressure, cerebral metabolism and use of antihypertensive medications. Analyses were repeated in subsets with abnormal cerebral spinal fluid amyloid-beta and phosphorylated tau after controlling for age and sex.

**Results:** Elevated blood pressure variability predicted perfusion decline in medial orbitofrontal cortex ( $B = -12.10$ ;  $p = .003$ ), hippocampus ( $B = -10.57$ ;  $p = .005$ ), entorhinal cortex ( $B = -12.12$ ;  $p < .001$ ), precuneus ( $B = -6.74$ ;  $p = .02$ ), inferior parietal cortex ( $B = -8.82$ ;  $p = .004$ ), inferior temporal cortex ( $B = -11.48$ ;  $p = .004$ ) and posterior cingulate ( $B = -6.12$ ;  $p = .047$ ). Elevated blood pressure variability predicted similar decline in regional cerebral perfusion in participant subsets with abnormal cerebral spinal fluid amyloid-beta and phosphorylated tau.

**Conclusions:** Elevated visit-to-visit blood pressure variability predicts cerebral perfusion decline in brain regions prone to Alzheimer's disease. Similar predictive value is observed in older adults with Alzheimer's disease biomarker abnormalities. Blood pressure variability relates to decline in regional cerebral perfusion independent of cerebral metabolism, indicating observed changes in perfusion are related to vascular, rather than neural, mechanisms.

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**Keywords:** cerebral blood flow, dementia - Alzheimer's disease, vascular cognitive impairment

### **S. KYTOMAA, P. JOSHI, J. YUAN, Y. LIN, R. AU. Carotid Artery Atherosclerosis, Coronary Heart Disease Risk, and Cognitive Impairment: The Framingham Heart Study.**

**Objective:** Several risk factors for coronary heart disease (CHD) have been associated with increased risk of cognitive impairment. Although multiple mechanisms have been proposed, the specific pathophysiology involved in the association is still unclear. Our objective was to estimate the extent to which the association between CHD risk factors and cognitive function is due to underlying atherosclerosis.

**Participants and Methods:** We included 1924 participants (mean age=56.54±8.94) of the Framingham Heart Study Offspring cohort who completed health exams, neuropsychological (NP) testing and carotid ultrasound studies between 1999-2014. To estimate the proportion of the association between CHD risk and cognitive function mediated by atherosclerosis, we used multivariable regression models relating a validated CHD risk score to cognitive function and compared risk ratios adjusted and unadjusted for atherosclerosis markers. We calculated the Framingham risk score, which predicts 10-year CHD risk using a previously defined validated

algorithm which combines age, gender, blood pressure, diabetes mellitus, smoking status and cholesterol level. The composite scores for executive function, memory, as well as a global cognitive score were taken from domain specific NP tests, converted into z-scores and added together. Markers of atherosclerosis were measured using ultrasound of the carotid artery, and included degree of stenosis defined by peak-systolic velocity (no stenosis, 1-24%, 25-49%, and  $\geq 50\%$ ), and the mean intimal-media thickness. Models were also adjusted for education. The percentage mediation was estimated by using the equation:  $100\%(\text{RR}-\text{RRc}/(\text{RR}-1))$  where RR is the risk ratio after adjustment for atherosclerosis and RRc is the unadjusted risk ratio. We used bootstrapping to calculate p-values for the estimated mediation effects.

**Results:** The CHD risk score was inversely associated with the composite scores of memory (OR=0.49,  $p<0.001$ ) executive function (OR=0.94,  $p<0.001$ ), and the global cognitive score (OR=0.40,  $p<0.001$ ). Mediation analysis showed that mean intimal-media thickness of both left and right common carotid bulb mediated 36% ( $p<0.001$ ), 42% ( $p<0.001$ ) and 36% ( $p<0.001$ ) of the association between CHD risk and the composite scores of memory, executive function, and the global cognitive score, respectively. Similar results were observed for mean intimal-thickness of distal internal carotid artery (ICA) (estimated mediation for memory=25%  $p<0.001$ , executive function=23%  $p=0.002$ , global cognitive score=24%  $p<0.001$ ) as well as both left and right ICA stenosis (estimated mediation for memory=26%  $p<0.001$ , and 21%  $p<0.001$ , global cognitive score=23%  $p<0.001$  and 21%  $p<0.001$ , respectively). Left and right ICA stenosis were not associated with executive function ( $p=0.46$  and  $0.08$ , respectively), thus did not contribute to the association between CHD risk and executive function.

**Conclusions:** The inverse association between the Framingham risk score for CHD and the cognitive performance was mediated by the intimal-media thickness and stenosis of the carotid artery as measured by ultrasound. These results provide valuable pathophysiological insights and suggest that the observed association between CHD risk and cognitive function is in part driven by a common atherosclerotic process.

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**Keywords:** cognitive functioning, cardiovascular disease

### **Program Chair Welcome & Plenary A: Presidential Address: Memory for News Events: What Will We Remember from 2020?**

**Presenter: Margaret O'Connor**

**9:45 AM - 10:55 AM**

#### **M. O'CONNOR. Presidential Address: Memory for News Events: What Will We Remember from 2020?**

As part of a cognitive evaluation, clinicians frequently probe recall of news items to determine extent of memory loss. People may be asked about noteworthy sports or political events. Critical factors influencing recall are rarely considered, and it is often not known whether a person has forgotten an event or whether they never learned it to begin with. The evaluation of memory for news events is a complicated enterprise as recall of remote events is influenced by both 'person-centered' and 'item-centered' factors. Person-centered factors include memory capacity, level of

interest in popular culture, pattern of news consumption (including the platform for news delivery and frequency of exposure), and personal biases regarding the importance of specific events. Item-centered factors that influence event retention include the age of the event (i.e., how long ago it was prominent in the news), intensity and frequency of news coverage, event distinctiveness (both in terms of the content of an event and its temporal proximity to events of a similar nature), and emotional salience. In this talk Dr. O'Connor discusses how information for news events is forgotten over time in the context of normal age related forgetting as well as accelerated forgetting due to neurological dysfunction such as epilepsy and neurodegenerative disease. She considers the "staying power" of events that transpired in the year 2020.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe models of memory consolidation 2) Analyze issues that affect memory for news events 3) Compare assessment methods used in the evaluation of remote memory.

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## **Invited Symposia 1: Strategies for Staving off Dementia - A Dynamic Conversation**

**Chair: Vonetta Dotson**

**Presenters: Glenn Smith, Sarah Garcia**

**11:00 AM - 11:55 AM**

### **V. DOTSON. Exercise for Cognitive Enhancement and Dementia Prevention.**

Physical activity is associated with better brain health in both epidemiological studies and in clinical trials. Long-term exercise can cause beneficial changes in brain structure and function, improve cognitive functioning, and preserve cognitive functioning over time in older adults. There is also evidence that physical activity can reduce the risk for dementia and slow the onset and progression of decline in dementia, though findings from clinical trials are not consistent. The latest research on the impact of exercise on overall brain health and on cognitive and pathological changes in dementia will be discussed. The interrelationships between the brain health benefits of exercise and late-life depression will be briefly reviewed.

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### **G. SMITH. Cognitive Strategies to Delay Dementia.**

Cognitive strategies to delay dementia in at risk people can broadly take the form of restitution or compensation approaches. In programmatic work my collaborators and I have explored each of these approaches. In older adults thought to be aging normally we have examined computerized cognitive training designed to improve processing speed and work memory. In persons with mild cognitive impairments we have examined this approach in comparison to and in combination with memory support training (i.e., systematic training in calendaring and notetaking). I will briefly present some of this work and discuss what other research and meta-analyses suggest is the current state of cognitive approaches for delaying dementia.

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**S. GARCIA. Sleep and Diet: A Pathway to Positive Cognitive Aging.**

Modification of daily activities have been shown to reduce the impact of cognitive aging and potentially prevent neurodegenerative conditions. Sleep and dietary changes are just two such activities. Poor or disrupted sleep has been linked to increased risk for dementia, likely due to amyloid accumulation. Relatedly, intake of high nutrient foods is associated with healthy aging, though which specific diets or dietary patterns work best is still to be decided. Discussion of these approaches in clinical contexts, as well as their underlying mechanisms will be explored.

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**Paper Session 03: Pediatric Traumatic Brain Injury****11:00 AM - 12:00 PM****A. URUSOV, B. D. DIPLOCK, M. E. DESROCHER. A Systematic Review of Psychological Interventions for Child and Adolescent Aggression Following Traumatic Brain Injury.**

**Objective:** To conduct a systematic review of the available evidence on psychological interventions broadly targeting behavioral and externalizing difficulties following traumatic brain injury (TBI) in children and adolescents.

**Participants and Methods:** Five electronic databases (i.e., MEDLINE, PsycINFO, PubMed, EMBASE and ERIC) were systematically searched, with publication dates ranging from 1946 to April 2020. Original research articles only were included, with study designs falling into one of the following categories: randomized controlled trials, quasi-experimental designs, single-group, or case-control studies. Study articles selected met the following criteria: a) focused on patients with TBI primarily, rather than TBI being comorbid with other neurological conditions (e.g., a study examining acquired brain injury and / or other neuropsychological disorders, wherein some participants were noted to have had a TBI, would be excluded based on this criterion); b) patients suffered a TBI between 5 to 18 years of age; c) directly assessed aggression-related outcomes of patients (e.g., behavioural difficulties, impulse control problems, conduct disorder, oppositional defiant disorder, anti-social behaviours, self-regulation, externalizing symptoms); d) considered efficacy or effectiveness of psychological interventions for aggression; and e) were not trauma-related TBIs (i.e., sexual, physical, emotional, child abuse). Two authors independently screened resulting articles to assess interrater reliability of selection criteria and concordance with the goals of the review.

**Results:** Comparison of screening results yielded an unweighted kappa (reliability coefficient) of 0.88 (CI: 0.85–0.91), indicating consistent rating between authors and excellent inter-rater reliability (Fleiss, 1981). Of 3383 studies identified in the initial search, 28 were included using the established criteria. Fourteen (50%) of these studies were randomized control trials, seven (25%) were case-control, four (14%) were quasi-experimental, and three (11%) were single-group studies. Nineteen intervention studies specifically targeted adolescents, and nine studies focused on children. Intervention settings included in-person (e.g., schools, healthcare settings, home) and online. Studies categorized TBI severity as severe (8), mild-to-severe TBI (8), and moderate-to-severe TBI (12). Thirteen unique interventions were identified overall, of which three interventions (i.e., Family Problem-Solving Therapy (F-PST), Teen Online Problem Solving, Counselor Assisted Problem Solving (CAPS)) were implemented by multiple studies

(four to seven studies each). 68% of these studies were evaluating the feasibility, efficacy, and/or effectiveness of online interventions (or comparing to in-person). Many studies tended to use similar scales to measure behavioural difficulties (i.e., Child Behavior Checklist; Behaviour Rating Inventory of Executive Function; behavioural frequency and intensity). All interventions – except for face-to-face F-PST and CAPS (for younger adolescents) – reported improvements in behavioural functioning.

**Conclusions:** Overall, there is relatively robust evidence regarding the efficacy of online – but not face-to-face – interventions targeting the behavioural difficulties of adolescents with TBIs (i.e., F-PST, CAPS and TOPS). While promising findings, it is essential that future replication studies be conducted by unique research teams, due to the current homogeneity of the research teams associated with these interventions. Future intervention studies of high rigor and methodology should also investigate the treatment of behavioural difficulties for children with TBI, and distinguish effectiveness for specific TBI severity.

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**Keywords:** traumatic brain injury, child brain injury, aggression

**M. G. MARBIL, A. L. WARE, N. M. MINICH, A. D. HERSHEY, S. L. ORR, D. M. DEFTA, H. TAYLOR, E. D. BIGLER, D. M. COHEN, L. K. MIHALOV, A. BACEVICE, B. A. BANGERT, K. YEATES. Posttraumatic Headache After Pediatric Mild Traumatic Brain Injury: Incidence and Classification Rates.**

**Objective:** Mild traumatic brain injury (mTBI) is a global health concern that affects millions of children annually. Children who sustain mTBI often experience post-concussive symptoms, the most common of which is posttraumatic headache. However, the phenotypes of and risk factors for posttraumatic headache remain poorly understood. This study aimed to examine the incidence and classification of premorbid and posttraumatic headache in a cohort of children with mTBI relative to orthopedic injury (OI).

**Participants and Methods:** Children ( $N = 315$ ) ages 8 to 16.99 years at injury ( $M = 12.46$ ,  $SD = 2.43$ ) were recruited during emergency department (ED) visits at two children's hospitals in Ohio within 24 hours of sustaining either mTBI or mild OI. Children returned for a post-acute assessment at 10 days post-injury. Of the children who returned, 211 (mTBI,  $n = 138$ ; OI,  $n = 73$ ) had valid headache data at both assessments. Parents completed a standardized headache questionnaire that was used to assess headache characteristics such as frequency, duration, and severity, and to classify premorbid headache and acute posttraumatic headache into definite/probable migraine, definite/probable tension type headache (TTH), or not otherwise classified, according to the International Headache Society International Classification of Headache Disorders (ICHD-3). Multinomial linear regression was used to compare the groups on premorbid and posttraumatic headache onset and type, controlling for age and sex.

**Results:** Premorbid headache was more common among children with mTBI (62.3% total; 28.3% definite/probable migraine, 23.2% definite/probable TTH) than those with OI (47.9% total; 16.4% definite/probable migraine, 27.4% definite/probable TTH). Group and premorbid headache history interacted to predict posttraumatic headache. Among children with mTBI, 89.5% with premorbid headache also had posttraumatic headache (50.0% definite/probable migraine, 38.4% definite/probable TTH) and 82.7% of those without premorbid headache had new-onset posttraumatic headache (38.5% definite/probable migraine, 38.5% definite/probable TTH). Conversely, in children with OI, 40.0% with premorbid headache had posttraumatic

headache (20.0% definite/probable migraine, 20.0% definite/probable TTH) and only 2.6% had new-onset posttraumatic headache (probable TTH). Among children with both premorbid and posttraumatic headache, 64.9% of children in the mTBI group and 50.0% of children in the OI group experienced worse posttraumatic headache relative to premorbid headache, defined as an increase in frequency. In children with worsening headaches ( $n = 57$ ; mTBI,  $n = 50$ ; OI,  $n = 7$ ), the most common headache types were probable migraine after mTBI (46.0%), and TTH after OI (42.9%).

**Conclusions:** Children with mTBI, regardless of headache history, were more likely to experience posttraumatic headache than children with OI, who mostly reported posttraumatic headache in association with premorbid headache. This suggests that posttraumatic headache may be an outcome specific to mTBI relative to OI, and that headache history is not a significant predictor of posttraumatic headache following mTBI. However, injury in general seems to worsen premorbid headaches. Probable migraine was the most common type of headache experienced before and after mTBI. Future research could examine whether posttraumatic headache is related to other outcomes of mTBI, such as cognitive functioning and other post-concussive symptoms.

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**Keywords:** mild traumatic brain injury, concussion, child brain injury

**S. GUO, A. L. WARE, W. CRAIG, R. ZEMEK, M. BEAUCHAMP, Q. DOAN, B. L. BROOKS, K. YEATES. Cognitive Functioning Following Pediatric Mild Traumatic Brain Injury: An A-CAP Study .**

**Objective:** Cognitive functioning can be acutely impaired in children and adolescents following mild traumatic brain injury (TBI), but longer-term cognitive outcomes are less clear. The current prospective study examined longitudinal performance changes in three core cognitive domains in children with mild TBI versus children with orthopedic injury (OI).

**Participants and Methods:** Data were drawn from the Advancing Concussion Assessment in Pediatrics (A-CAP) study, which involved a prospective, concurrent cohort design with longitudinal follow-up. Children with mild TBI or OI (total  $N=967$ ) between the ages of 8 and 16.99 years were recruited and evaluated within 24h of injury in the Emergency Departments (ED) of five children's hospitals across Canada, and returned for assessments about 2-weeks, 3-months, and 6-months post-injury. Of the total consented, 950 children completed at least one assessment (mild TBI:  $n=622$ ; OI:  $n=328$ ). Participants completed three subtests from the computerized Central Nervous System Vital Signs (CNS-VS) test battery in the ED and at each subsequent assessment. Linear mixed effects modeling was used to investigate the association of group, sex, and time (days post-injury), with participant and site included as nested, random effects, on standardized CNS-VS domain scores for Reaction Time, Cognitive Flexibility, and Visual Memory.

**Results:** The mild TBI and OI groups did not differ in age at time of injury, sex, or Full-Scale IQ ( $p>.096$ ). On Reaction Time, the interaction of group, sex, and time was significant,  $t=-2.58$ ,  $p=.012$ . The mild TBI group performed worse than the OI group at the ED, post-acute, and 3-month assessments, with declining effects that were small-to-medium in boys (Cohen's  $d=.43$ ,  $.42$ , and  $.34$ , respectively) and medium-to-large in girls (Cohen's  $d=.71$ ,  $.68$ , and  $.38$ , respectively). At 6-months, the difference remained small among boys ( $d=.24$ ) but was

negligible in girls ( $d=.04$ ), with neither being statistically significant. On Cognitive Flexibility, the interaction of group and time was significant,  $t=1.94$ ,  $p=.050$ . The mild TBI group performed significantly worse than the OI group at the ED, post-acute, and 3-month assessments, with declining small effect sizes (Cohen's  $d=.25$ ,  $.24$ , and  $.14$ , respectively). At 6-months, the group difference was not significant (Cohen's  $d=.06$ ). On Visual Memory, the group main effect was significant,  $t=-2.41$ ,  $p=.041$ , with the mild TBI group consistently performing worse than the OI group, with small effect sizes (Cohen's  $d=.33$ ,  $.32$ ,  $.26$ , and  $.19$ , at ED, 2-weeks, 3-months, and 6-months, respectively).

**Conclusions:** Consistent with previous research, mild TBI was associated with worse cognitive performance than OI in children, with differences being most pronounced acutely and becoming smaller over time. Overall, differences between groups over the first 3-months post-injury tended to be small-to-medium in magnitude, and were most pronounced in reaction time, especially in girls. Group differences generally resolved by 6-months post-injury. The one exception was visual memory, where the mild TBI group showed small but persistent differences over time. Taken together, the findings suggest that cognitive impairments may be present in children with mild TBI as long as 3-months post-injury.

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**Keywords:** mild traumatic brain injury, pediatric neuropsychology, cognitive functioning

## **L. CHADWICK, M. J. SHARMA, S. MADIGAN, B. L. CALLAHAN, K. YEATES. Classification Criteria and Rates of Persistent Post-Concussive Symptoms in Children: A Systematic Review and Meta-Analysis .**

**Objective:** This study sought to examine the proportion of children identified as demonstrating persistent post-concussive symptoms (PPCS) after a mild traumatic brain injury (TBI) as a function of the definition of PPCS used. Several definitions of PPCS are used in research and clinical practice; for example, 'simple change' methods examine number of symptoms at a given time post-injury, while 'standardized change' methods involve standardizing symptom change against a comparison group, such as reliable change indices. No diagnostic criteria or definition are universally accepted.

**Participants and Methods:** The meta-analysis protocol was registered with the International Prospective Register of Systematic Reviews (No. CRD42020161500). Medline, EMBASE, PsycINFO, SCOPUS, and CENTRAL databases were each searched using relevant search terms. Other articles of interest were identified by searching the reference lists of relevant articles. 10,976 studies were identified for title/abstract review to determine if they met the following inclusion criteria: (1) assessed PPCS at least four weeks post-injury; (2) children were 0-18 years with mild TBI; (3) proportions and sample sizes were provided; (4) study available in English. Event-rate meta-analyses were conducted to examine proportion of PPCS based on definition used. Age, sex, and study publication year were included as moderators in analyses. The Newcastle-Ottawa Scale was used to assess the quality of studies included in analyses.

**Results:** Sixteen studies (with 5645 participants) were included in the systematic review. Of these, 15 used simple change definitions (4 based on time, 11 based on symptom counts) and 1 used a standardized change definition. The proportion of children identified as experiencing PPCS based on symptom count definitions was 33.3% (weighted average, CI [23.1%, 45.3%]) compared to 40.9% (weighted average, CI [26.9%, 56.6%]) for time-based definitions. Age, sex, and publication year were significant predictors of PPCS for symptom count

definitions, such that there were higher rates of PPCS for older children, girls, and more recent publication years (average time post-injury = 7.63 weeks). Age, sex, and publication year were not significant predictors of PPCS for time-based definitions (average time post-injury = 6.0 weeks). Standardized change definitions were not included in the analyses because only one relevant study was available for comparison.

**Conclusions:** Existing research suggests that different proportions of children are identified as demonstrating PPCS depending on the definition used. Simple change definitions are more commonly used, but they may overestimate the proportion of children experiencing PPCS, given the large number of children in comparison groups who meet the definition of PPCS. Standardized change definitions may provide a more accurate characterization of PPCS in children yet are not used frequently. Age, sex, and publication year may also be important predictors of PPCS. Without a standard definition or diagnostic criteria for PPCS, estimating its true prevalence is a significant challenge with implications for research and clinical work, such as high rates of misdiagnosis, inability to identify patients who would benefit from interventions, and a barrier to harmonization and synthesis of mild TBI research. Future research should examine barriers to implementing standardized change definitions in both research and clinical practice.

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**Keywords:** mild traumatic brain injury

**A. M. SVINGOS, S. J. SUSKAUER, M. E. ELLIS-STOCKLEY, H. CHEN, B. S. SLOMINE. What's Happening to our Healthy Controls? A Preliminary Study of the Effect of the COVID19 Pandemic on Depressive Symptomatology in Youth Recently Recovered from Concussion and Healthy Controls.**

**Objective:** Depression is a long-term outcome of interest following concussion in youth and is the focus of many current research investigations. Because mood symptoms can arise from a range of etiologies, study designs in youth concussion often incorporate control groups for comparison and exclude children with premorbid histories of mood concerns that could confound study results. In the context of the COVID19 pandemic, youth with and without history of concussion may be at increased risk for mood concerns. Increased depressive symptoms in clinical and control groups during the COVID19 pandemic could have important implications for data analysis/interpretation. The present study examined depressive symptomatology in a sample of youth recently recovered from concussion and healthy controls in order to explore differences in report of mood concerns before and after onset of the COVID19 pandemic.

**Participants and Methods:** Participants included 70 youth ages 10-18 (Mean age =13.65, SD=2.34; 53.3% female) with history of sport-related concussion s/p medical clearance (n=23) and never-injured controls (n=47). Exclusionary criteria included history of diagnosed or suspected learning, neurodevelopmental, or mental health conditions. Study visits were coded as occurring either prior to or following the onset of the COVID19 pandemic based on the first day of school closure within the state of Maryland (3/13/2020). Depressive symptoms (anxious depression, depressive withdrawal, internalizing) were assessed using the Child Behavior Checklist- Parent Report. Mann-Whitney U tests were used to separately assess differences between healthy controls and recovered concussion participants whose visits occurred prior to (n=47; concussion, n=29; controls, n=18) and following (n=22; concussion, n=19; controls, n=4)

onset of the COVID19 pandemic. T-tests and chi-square tests were also used to assess group differences in demographic variables of interest (i.e., age, sex).

**Results:** Healthy control participants demonstrated significantly greater parent-reported depressive withdrawal symptoms for visits occurring after COVID19 onset,  $U=355.0$ ,  $z=2.22$ ,  $p=.026$ ,  $r=.32$ , which remained the case after excluding for extreme values,  $U=326.5$ ,  $z=1.97$ ,  $p=.049$ ,  $r=.29$ . Although age was not correlated with any outcomes of interest, the pre and post COVID group varied significantly by age such that control participants seen after the pandemic onset ( $M=14.47$ ,  $SD=2.01$ ) were older on average than those seen before its onset ( $M=12.42$ ,  $SD=1.87$ ),  $t(45)=-3.55$ ,  $p=.001$ . There were no significant differences observed pre- to post-COVID19 onset for the recovered concussion group in terms of depressive withdrawal or demographic factors. Neither group demonstrated pre- to post- COVID19 onset differences in parent-reported anxious depression or internalizing symptoms

**Conclusions:** Study findings provide evidence that healthy youth may be experiencing increased depressive withdrawal in the context of COVID19 pandemic. This is particularly noteworthy given that our sample included participants who underwent screening to exclude for preexisting mood concerns. Investigators should be mindful of pandemic related factors that could be skewing data and introducing bias in healthy controls pre and post COVID19. Additionally, given the very small sample of children with a history of concussion who were evaluated post COVID19, more data is needed to better understand differences in mood symptoms pre and post COVID19 in this group.

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**Keywords:** depression, concussion, infectious disease

**G. REMPE, C. PETRANOVICH, M. NARAD, K. YEATES, H. TAYLOR, T. STANCIN, S. WADE. Trajectories of Executive Functions After Early Childhood Traumatic Brain Injury (TBI): Comparing Teacher and Parent Ratings in the Initial 82 Months Post-Injury.**

**Objective:** To compare teacher and parent-rated latent trajectories of executive functioning (EF) after early childhood TBI and to **identify injury-related and family factors that influence growth trajectories using latent class growth modeling (LCGM).**

**Participants and Methods:** Participants included 176 children with both teacher and parent ratings of executive functions (EF) and a history of complicated mild, moderate, or severe TBI ( $n = 75$ ) or orthopedic injury (OI;  $n = 101$ ). They were 3-7 years old at the time of injury. Assessments were completed at baseline and at an average of 8, 14, 20, 41, and 82 months post-injury. At each time point, parents completed the Behavior Rating Inventory of Executive Function (BRIEF), Family Assessment Device, and the Parenting Practices Questionnaire. The child's current teacher also completed the BRIEF. Two separate latent class growth models were developed, one for each rater, to compare heterogeneity in EF recovery as measured by the BRIEF General Executive Composite (GEC). Baseline EF was omitted from the teacher model as a predictor of class-membership due to missingness. The two LCGA models were otherwise specified identically (e.g., covariates, assumptions, start-points, etc.). Sensitivity analyses were conducted with several teacher models to evaluate how missingness affected class membership and trajectories.

**Results:** Four trajectories were identified using parent BRIEF GEC: Normative (36.47%), At Risk-Increasing (32.94%), Minimal Problems (20%), and Elevated Problems-Decreasing (10.59%). Injury type (TBI or OI) and baseline BRIEF GEC, which is a retrospective rating of

pre-injury functioning in the parent model, were significant predictors of class membership. Children with TBI were more likely to belong to the At Risk-Increasing class. OI was a weak predictor of membership in the Elevated Problems-Decreasing class ( $p = .06$ ). Within-class longitudinal effects indicated that the At Risk-Increasing trajectory was related to higher family dysfunction. The Elevated Problems-Decreasing trajectory was associated with higher permissive parenting. The Normative trajectory was positively related to higher family dysfunction and permissive parenting, and the Minimal Problems trajectory was positively associated with increased endorsement of all three parenting types.

Analysis of teacher BRIEF GEC yielded three trajectories: Normative Female (40.12%), Normative Male (22%), and At Risk-Increasing (37.79%). Per the class-membership model, male sex predicted the Normative Male and At Risk-Increasing classes. The At Risk-Increasing class was also negatively associated with family census track income. TBI was a weak predictor in the At Risk-Increasing class ( $p = .08$ ). Within-class longitudinal effects associated the Normative Male trajectory with increased family dysfunction and endorsement of all parenting types. The At Risk-Increasing trajectory was related positively to authoritarian parenting and negatively to authoritative.

**Conclusions:** EF trajectories of children with TBI differ from those of children with OI using parent ratings, and, to a lesser extent, teacher ratings. These findings may be explained by environmental differences between school and home settings (e.g., increased structure, academic supports, etc.). Considering these findings, increased structure and implementation of academic supports may make EF difficulties less prominent in the school setting. Consistent with the results of previous studies, family factors were associated with the trajectories derived from both teachers and parents.

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**Keywords:** traumatic brain injury, executive abilities - abnormal, pediatric neuropsychology

## Poster Session 2: Aging & MCI

11:00 AM - 12:00 PM

### M. GERAU, Y. SUCHY. Sex Differences in Self-Appraisal During Instrumental Activities of Daily Living in Community-Dwelling Older Adults.

**Objective:** Ample research has demonstrated the negative impact of low awareness of deficits on daily functioning in individuals suffering from neurodegenerative disease (Consentino, Metcalfe, Cary, De Leon, & Karlawish, 2011; Cotrell & Wild, 1999; Steward, Kennedy, Erus, Nasrallah, & Wadley, 2019); however, this topic has not been studied in healthy, non-demented older adults, a population in which awareness of basic abilities and of changes in these abilities is thought to be integral to prolonged functionality and independence (Suchy, Kraybill, & Franchow, 2011). Additionally, past research has demonstrated sex differences in self-appraisal accuracy during various cognitive tasks (Ariel, Lembeck, Moffat, & Hertzog, 2018; Lundeberg, Fox, & Punóchar, 1994; Pallier, 2003; Ring, Neyse, David-Barett, & Schmidt, 2016), but these studies have not included older adults nor functional tasks relevant to this population. Accordingly, the aims of this study were to assess self-appraisal of performance on instrumental

activities of daily living (IADLs) in healthy older adults and to determine whether self-appraisal judgments differ by sex in this population.

**Participants and Methods:** 150 community-dwelling older adults ( $M$  age = 71.1; 50% female) without signs of cognitive decline at screening using the Dementia Rating Scale (DRS) completed a series of five laboratory-simulated IADLs, after each of which they self-rated perceived speed relative to others of similar age and perceived difficulty relative to their own past capacity.

**Results:** As a whole, participants judged themselves to be faster than others of similar age ( $t(149) = 8.35, p < .001$ ); however, a significant interaction emerged between sex and objective and estimated speed ( $F(1,148) = 5.57, p = .020$ ) in a 2x2 mixed model ANOVA such that men judged their speeds more favorably than women did despite women having completed the tasks faster than men. Similarly, on the whole, participants perceived the tasks to be more difficult for them than they were earlier in their lives ( $t(149) = , p < .001$ ). However, there was again a significant interaction between sex and objective performance and estimated difficulty ( $F(1,148) = 4.77, p = .031$ ) in a 2x2 mixed model ANOVA such that women reported relative greater difficulty than men did despite women having better overall performance than men.

**Conclusions:** Taken together, results suggest that men tend to overestimate their abilities more than women, while exhibiting poorer performance than women. Additional research is needed to investigate how these self-appraisal differences may affect daily functioning over time in healthy community-dwelling older adults.

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**Keywords:** activities of daily living, aging (normal), awareness

### **L. M. MEISTER, L. B. ZAHODNE. Prospective Associations Between Social Network Components and Cognitive Domains in Older Adults.**

**Objective:** Previous research suggests that social network structure and quality are associated with cognitive outcomes later in life. However, few studies include multiple cognitive domains or disaggregate the social network by relationship type (i.e., spouse, family, children, friends).

**Participants and Methods:** Using data from 3,346 participants aged 65 or older in the Harmonized Cognitive Aging Project (HCAP) of the Health and Retirement Study, this longitudinal study examined prospective relationships between social network structure (i.e., size, contact frequency) and quality (i.e., support, strain) across relationships and five cognitive domains (i.e., episodic memory, executive function, visuoconstruction, language, and processing speed) two to four years later. Separate linear regressions were conducted for each cognitive outcome, which were factor scores obtained from a confirmatory factor analysis of the HCAP neuropsychological battery. All models controlled for age, sex/gender, marital status, number of years in school, wealth, income, race, year of social network assessment, and previous cognitive functioning as assessed by an abbreviated battery.

**Results:** When averaging across relationship types, network size was not associated with any domain. Contact frequency was positively associated with all domains except episodic memory. Both social network support and strain were negatively associated with all five cognitive domains. When considering individual relationship types, larger friend networks were positively associated with visuoconstruction, and greater contact frequency with friends was positively associated with all five cognitive domains. Larger family networks were associated with worse executive function, visuoconstruction, and speed. Strain from friends had a negative relationship

with every domain except for episodic memory, and spousal strain was negatively associated with executive function and visuoconstruction. Support from family was negatively associated with episodic memory executive function, and language.

**Conclusions:** These results showed that both social network structure and quality may be consequential for cognitive functioning and that links between social relations and cognition differ across domains and as a function of relationship type. In particular, these results add to a growing body of literature pointing to unique benefits of friendships for late-life cognitive functioning. Having a greater level of specificity in our understanding of how multidimensional social networks interact with cognitive aging could facilitate more targeted interventions.

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**Keywords:** aging (normal), cognitive functioning, social processes

**M. GOGNIAT, T. L. ROBINSON, K. JEAN, L. MILLER. Physical Activity Moderates the Association Between Functional Connectivity and Executive Function in Older Adults.**

**Objective:** New evidence suggests that physical activity may influence the functional connectivity (FC) of the aging brain. The purpose of this study was to examine the influence of physical activity on the association between executive function (EF) and FC in older adults.

**Participants and Methods:** Participants were 47 older adults ( $M = 73$  years;  $SD = 5.92$ ) enrolled in a study where they participated in neuropsychological testing, physical activity and fitness measurements, and magnetic resonance imaging (MRI). Physical activity was calculated as average number of steps in one week using an accelerometer. EF was measured using a composite of scaled scores from the Delis-Kaplan Executive Function System (DKEFS). Seed-to-voxel analyses was conducted in the CONN toolbox using the default mode network (DMN) and dorsal attention network (DAN) as seeds. The interaction between average steps and EF on the functional connectivity of the DMN and DAN was analyzed.

**Results:** EF was not significantly associated with DMN FC, but it was significantly related to DAN FC in this sample (Inferior Frontal Gyrus, Pars Triangularis (L),  $p\text{-FDR} = .045$ ). Steps was significantly positively associated with DMN FC (Posterior Cingulate Gyrus,  $p\text{-FDR} = .005$ ; Frontal Pole (L),  $p\text{-FDR} = .005$ ; Posterior Cingulate Gyrus,  $p\text{-FDR} = .006$ ; Superior Frontal Gyrus (L),  $p\text{-FDR} = .016$ ) and DAN FC (Inferior Frontal Gyrus Pars Opercularis (R),  $p\text{-FDR} = .044$ ). The interaction between EF and steps was significantly associated with DMN FC. When this significant interaction was probed, the association between steps and DMN FC differed between levels of high and low EF such that the association was only significant at levels of high EF. The interaction between EF and steps was not significantly associated with DAN FC.

**Conclusions:** Results suggest that greater physical activity in later life is associated with greater functional connectivity of the DMN and DAN. Importantly, physical activity and EF interact such that the positive association between physical activity and DMN FC is significant at high levels of EF. This indicate that older adults see the greatest benefit of physical activity on brain function in the DMN if they are already functioning at high levels of EF. This provides evidence for the importance of physical activity in cognitively healthy older adults.

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**Keywords:** executive functions, aging (normal), neuroimaging: functional connectivity

**S. RUSHIA, J. N. MOTTER, G. H. PELTON, J. R. PETRELLA, J. R. SNEED, P. M. DORAISWAMY, D. P. DEVANAND. The Relationship Between Cortical Thickness and Cognition in Older Adults with Comorbid Depression and Cognitive Impairment.**

**Objective:** Older adults with depression (DEP) and cognitive impairment (CI) appear to have an increased risk of conversion to dementia. Potential contributing factors include neuroanatomical changes, as lower cortical thickness is associated with increased risk of cognitive decline. Thus, our aim was to examine the relationship between cortical thickness and cognition in DEP-CI.

**Participants and Methods:** Fifty-five patients with comorbid DEP-CI underwent brain magnetic resonance imaging and completed a comprehensive neuropsychological battery.

**Results:** Worse performance on the Alzheimer's Disease Assessment Scale-Cognitive Subscale was associated with thinner left hemisphere (LH) superior frontal ( $p = .001$ ), precentral ( $p = .005$ ), and rostral middle frontal gyri ( $p = .042$ ), and right hemisphere (RH) precentral ( $p < .001$ ) and postcentral gyri ( $p = .043$ ). Worse performance on the Selective Reminding Test delayed recall was associated with thinner RH superior frontal gyrus ( $p = .015$ ). Worse performance on Trail Making Test – Trail A was associated with thinner RH postcentral ( $p < .001$ ), supramarginal ( $p = .015$ ), inferior parietal ( $p = .046$ ), and rostral middle frontal gyri ( $p = .046$ ). Worse performance on Trail Making Test – Trail B was associated with thinner RH postcentral gyrus ( $p = .040$ ).

**Conclusions:** These results suggest that DEP-CI patients exhibit widespread cortical thinning corresponding with specific cognitive impairment, which may contribute to increased risk of conversion to dementia.

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**Keywords:** aging disorders, neuroimaging: structural, cognitive functioning

**K. B. CASALETTO, H. ZETTERBERG, K. BLENNOW, A. BRINKMALM, W. HONER, D. BENNETT, J. SCHNEIDER, N. DJUKIC, S. WEINER-LIGHT, M. YOU, C. FONSECA, B. MILLER, J. KRAMER. Synaptic Markers Moderate the Adverse Effects of Alzheimer's Disease Proteinopathy in Older Adults.**

**Objective.** Synaptic failure is a prominent feature of Alzheimer's disease (AD), yet its role in the AD cascade is not understood in humans. We evaluated the association of *in-vivo* and postmortem synaptic markers with AD proteinopathy indicators in older adults. We aimed to determine whether synaptic proteins affect fundamental relationships between pathologic markers of amyloid, tau, and neurodegeneration (MRI brain volume).

**Participants and Methods.** We leveraged two independent observational, cross-sectional cohorts. 68 clinically normal adults from the UCSF Memory and Aging Center (MAC) completed lumbar puncture and brain MRI (age  $M=71$ ; 43% female; MMSE  $M=29$ ; CDR=0). Cerebrospinal fluid (CSF) was analyzed for synaptic proteins (synaptotagmin-1, SNAP-25, neurogranin, and GAP-43),  $A\beta_{42/40}$ , and ptau<sub>181</sub>. To test generalizability, we also examined 633 deceased adults from the Rush Memory and Aging Project (MAP)(age at death  $M=89$ , 68% female; MMSE  $M=23$ ). Brain tissue was analyzed for presynaptic proteins (complexin-I, complexin-II, VAMP, and the SNARE protein-protein complex), amyloid (neuritic plaque count and total  $A\beta$  fraction), and neurofibrillary tangles (NFT). Regression interaction models tested moderating effects of synaptic proteins on the relationships between AD proteins on each other and on brain volumes.

**Results.** CSF synaptic proteins demonstrated positive, linear relationships with ptau<sub>181</sub>. Curvilinear (inverse-U) relationships were observed between some CSF synaptic proteins and A $\beta$ <sub>42/40</sub>. Each CSF synaptic protein moderated the relationship between A $\beta$ <sub>42/40</sub> and ptau<sub>181</sub>, such that the two AD proteins only adversely related to each other in adults with high CSF synaptic protein (more abnormal). Effects were specific to A $\beta$ <sub>1-42</sub> versus A $\beta$ <sub>1-40</sub>. CSF synaptic proteins also moderated the relationship between ptau<sub>181</sub> and gray matter volume. Ptau<sub>181</sub> negatively related to gray matter volume in those with high CSF synaptic protein (more abnormal), an effect that reversed directionality in adults with low CSF synaptic protein (more normal). Postmortem analyses recapitulated CSF models. Higher presynaptic complexin-I, VAMP, and SNARE complex attenuated the adverse relationship between neuritic plaques and NFTs. Effects were specific to neuritic plaques versus total A $\beta$ , and remained in adults without cognitive impairment.

**Conclusions.** Pathogenic relationships of A $\beta$  and tau may depend on synaptic state. *In-vivo* synaptic quantification may be needed to capture early risk for AD. Synapses may be a target to support resilience to AD neuropathology.

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**Keywords:** aging disorders, cognitive reserve, dementia - Alzheimer's disease

**A. HALPIN, A. BOEVE, S. MICHAUD, M. FAGAN, R. K. MACAULAY. Are Adverse Childhood Experiences Associated with Worse Cognitive Function in Older Adults?.**

**Objective:** Adverse childhood experiences have been associated with increased risk for dementia. However, prior research is mixed regarding the relationship between early life adversity and cognition, and remains understudied in older adult populations. Therefore, the current study aimed to characterize associations among early life adversity with relevant risk factors and cognitive performance in a group of socioeconomically diverse older adults.

**Participants and Methods:** Participants included 121 community-dwelling older adults (74% female, Mage=70.7) without diagnosis of moderate to severe psychiatric, cognitive, or neurological disorders. A comprehensive neuropsychological battery was used to assess estimated verbal/non-verbal intelligence, visual/verbal memory, working memory, executive function, processing speed, and attention. The Adverse Childhood Experiences (ACE) questionnaire measured childhood experiences of sexual and physical abuse, neglect, and household dysfunction. ACE groups were formed based upon the number of adverse events endorsed.

**Results:** Over 56% of older adults reported an adverse childhood event. ACE scores were positively associated with lower socioeconomic status (lower education and income). There were no significant differences in estimated intelligence or neuropsychological performance between low and high ACE groups; however, the latter group reported significantly less self-efficacy and higher levels of depression and subjective cognitive concerns.

**Conclusions:** Early life abuse and neglect did not have a direct association with cognitive function but did associate with psychological factors associated with risk and resiliency for dementia. Given the high prevalence of abuse, future research should place emphasis on addressing these modifiable risk factors in efforts to attenuate risk for future cognitive decline.

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**Keywords:** childhood maltreatment, neuropsychological outcome, aging (normal)

**L. C. OBERMEIT, E. PAOLILLO, A. M. HOLLIS, M. O'CONNOR. Exploring the impact of sex, cognition, and age on driving safety.**

**Objective:** Even though dementia occurs more frequently in females, we have observed that older males are more frequently referred for driving evaluations. To date, little is known about whether sex-based differences in cognition differentially impact skills important for driving - especially as individuals age. The current study explored the effects of sex, age, and cognitive functioning on driving performance.

**Participants and Methods:** 457 individuals were evaluated through the Drivewise® program, which includes clinical and on-road driving evaluations.

**Results:** Age and cognitive status were significantly associated with road test outcome. Sex-based cognitive differences were detected in terms of processing speed but not in other aspects of cognition. There was a significant interaction between sex, visual speed and driving competence such that the negative relationship between visual speed and driving performance was stronger for males than females.

**Conclusions:** Consistent with prior work, we found that age and cognitive health robustly predicted road test performance. Findings also suggested that, compared to woman, males' driving competence may be more affected by visual speed difficulties. This highlights the clinical importance of utilizing visual speed assessments when evaluating driving abilities.

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**Keywords:** driving, activities of daily living, everyday functioning

**J. S. DIXON, K. DUFF, R. READY. Practice Effects Associated with Sociodemographic and Health Factors in a Multiracial Sample of Midlife Women.**

**Objective:** Practice effects are observed when scores from a second administration of a neuropsychological test are greater than the first administration and may be due in part to familiarity with test content or procedures. Reliable change scores (RCS) are a statistical method to control for practice effects, but RCS could prove useful in identifying risk for cognitive decline in midlife. Since little is known about RCS at midlife, this study sought to examine sociodemographic and health correlates of RCS on tests of episodic memory, processing speed, and working memory in a multiracial sample of midlife women. It was hypothesized that women with lower RCS will have poorer physical and mental health and more sociodemographic disadvantage than women with stable or greater RCS.

**Participants and Methods:** Participants were African American ( $n = 516$ ), European American ( $n = 1,000$ ), and Asian American ( $n = 437$ ) women in midlife from the Study of Women's Health Across the Nation. Practice effects were calculated using a standardized regression-based formula which creates a z-score-based RCS from the first to the second administration of tests of episodic memory (East Boston Memory Test-delayed recall [EBMT]), processing speed (Symbol Digit Modalities Test [SDMT]), and working memory (WAIS-IV Digit Span Backward [DSB]). For each cognitive outcome, participants were trichotomized into three groups: "decline" (z-scores less than -1.645), "stable" (z-scores -1.645 to +1.645), and "improved" (z-scores greater than +1.645). Age, income, education, race, and smoking were collected at baseline. Depressive symptoms measured by the Center for Epidemiological Studies-Depression Scale, hypertension, and diabetes metrics were collected prior to first cognitive assessment. One-way ANOVA,

independent sample t-test, and chi-square analyses compared dependent variables between the RCS groups.

**Results:** Due to small percentage of persons in the “improved” group, comparisons were made between “decline” and “stable” groups for EBMT only. EBMT and SDMT - but not DSB - RCS were significantly correlated. EBMT and SDMT “decline” participants ( $n = 184$  and  $95$ , respectively) had significantly ( $p < 0.05$ ) higher depressive symptoms, higher hypertension, more smokers, more African Americans, lower income, and lower education compared to the “stable” groups ( $n = 1,571$  and  $1,577$ , respectively), as well as the “improved” group ( $n = 53$ ) for SDMT. The SDMT “decline” group had higher diabetes than the “stable” group. The DSB “decline” group ( $n = 79$ ) had higher education and higher diabetes compared to the DSB “stable” group ( $n = 1,543$ ) and improved group ( $n = 84$ ), as well as higher hypertension than the “stable” group. **Conclusions:** Lower RCS in these midlife women, especially on tests of episodic memory and processing speed, were linked to a greater prevalence of cardiovascular risk factors and depressive symptoms, as well as more women identifying as African American and lower socioeconomic status than women with “stable” or “improved” RCS. Since RCS tend to be linked to these negative cardiovascular and depressive conditions, they may be informative in identifying midlife women at risk for cognitive decline.

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**Keywords:** ethnicity, cardiovascular disease, depression

### **K. JEAN, L. MILLER. The Effect of Bilingualism on Executive Functions in Older Adults: A Systematic Review and Meta-Analysis.**

**Objective:** Bilingual individuals are thought to consistently recruit executive control systems into their everyday linguistic processing, thus enhancing the executive control system of bilinguals. A bilingual advantage on tasks of executive functions has been proposed, however, study findings are mixed. Given age-related changes in executive function abilities, this meta-analysis was conducted to quantitatively synthesize the literature regarding whether a bilingual advantage on tasks of executive function exists in older adults and determine what factors moderate this effect.

**Participants and Methods:** EBSCOhost, Embase, and ProQuest Dissertations and Theses online databases were searched to determine eligible studies examining executive function abilities in a sample of bilingual older adults compared to monolingual older adults. After inclusionary and exclusionary criteria were applied, 198 effect sizes from 52 studies were included.

**Results:** Random-effects model indicated a small, non-significant overall effect size (Hedges'  $g = 0.0228$ ,  $p = .4841$ , 95% CI  $[-0.0411, -0.0867]$ ). However, multi-level model analysis, which accounted for nested effects, suggested a small, significant overall effect (Hedges'  $g = 0.1071$ ,  $p = .0410$ , 95% CI  $[.0044, .2097]$ ). Education level, executive function domain, and task type (i.e., nonverbal vs verbal tasks) were significant moderators of the overall effect size, although significant unaccounted variance of the effect size remained when accounting for these moderators. Notably, sensitivity analyses were run to determine if exclusion of outliers would have a considerable impact on the conclusions from the meta-analysis. Sensitivity analyses suggested an overall non-significant effect and also accounted for the heterogeneity of the effects; this finding was consistent when conducted in multi-level model analysis.

**Conclusions:** Results from this meta-analysis revealed that studies examining bilingualism's possible effect on executive function in older adults are heterogeneous, with significant outliers tending to be those that reported a bilingual advantage. The results from this meta-analysis do not support coherent and sufficient evidence showing a clear bilingual advantage in executive function abilities in older adults.

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**Keywords:** bilingualism, executive functions

**N. SLAVAT, T. A. GIRARD, R. LACHMAN, E. EARLE, A. GOVEIA. Using Virtual Reality to Examine memory and the Active Navigation Effect in Younger and Older Adults.**

**Objective:** Spatial memory allows a person to store and retrieve information about the environment as well as create mental images of and navigate our environment from one place to another. This is a skill useful across the lifespan. Aging, however, is associated with a decline in a number of cognitive abilities, including spatial memory. Studies using virtual reality (VR) have shown better memory of environments when explored using active compared to passive encoding when navigating for younger adults (YA), but the results are mixed for older adults (OA). Here we assess the extent to which active navigation in an immersive VR apartment may benefit memory in OAs.

**Participants and Methods:** Twenty two YA and eight OA both actively and passively explored a four-room virtual apartment twice. Subsequently, they performed a surprise recognition test for objects and scenes from the VR apartment, where scene recognition required memory of where objects had been located. The current thesis builds on prior work by examining how the navigation condition at encoding and age influence spatial memory while increasing ecological validity with immersive VR and high-quality graphics.

**Results:** Results showed that there was an active navigation effect for OA when considering hits and false alarms, particularly for scene memory, but this was not present for YA. In addition, when considering confidence ratings for old items in the object recognition task, confidence ratings were higher for objects in the passive condition whereas they were higher for scene recognition in the active condition.

**Conclusions:** Overall, we observed an active navigation effect for spatial memory among OA, but not YA in this study. These results support that active engagement within a small-scale VR environment can improve memory among OA, although the effect appears to be stronger for scene memory. This study provides a unique contribution to the literature, such that we used an immersive VR set-up to increase realism and immersivity, and used a mean confidence rating scale for more nuanced assessment of memory. This work sets the stage for further investigation into the active navigation effect in aging. Ultimately, this work might be harnessed to inform protocols to promote memory function and that are in line with current government initiatives that encourage longer independence and home living for seniors.

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**Keywords:** aging (normal), visuospatial functions, memory training

**S. A. EVANS, E. R. PAITEL, T. A. GREGG, C. B. OTTEMAN, Z. B. BALLARD, K. A. NIELSON. Vascular Risk Factors and Sex Alter the Relationship Between Objective**

**Memory and Subjective Memory Complaint Endorsement in Cognitively Intact Older Adults.**

**Objective:** Subjective memory complaints (SMCs) may be one of the earliest indicators of future cognitive decline and are currently used as a criterion in the diagnosis of mild cognitive impairment (MCI), a transitional diagnosis between normal aging and Alzheimer's disease (AD). The literature, however, is mixed regarding the predictive utility of SMCs. Importantly, recent research has shown a link between SMCs, vascular risk factors, and increased risk of AD. While vascular risk factors may increase the likelihood of SMCs and developing AD, little is known as to whether the relationship between SMCs and objective memory performance changes as a function of vascular risk. This study examined the relationship between SMCs and objective memory performance and the effects vascular risk have on this relationship in generally healthy, cognitively intact, older adults.

**Participants and Methods:** Forty-six older adults (Mage=77.52, range=70-86) screened for intact overall cognitive functioning completed the Memory Functioning Questionnaire (MFQ) Frequency of Forgetting subscale (FoF) to measure SMCs and the Rey Auditory Verbal Learning Test (RAVLT) to measure memory. Each participant's Body Mass Index (BMI) was calculated and blood pressure (BP) taken; principal components analysis (PCA; equimax rotation) was used to reduce these to a single vascular risk factor (VASCRISK). We examined whether combined vascular risk moderated the relationship between SMCs (MFQ FoF) and RAVLT delayed recall (DR) performance (age, depression covaried), and whether the moderating effect of vascular risk was dependent on sex (dichotomous, female/male; PROCESS 3.0; model 3).

**Results:** The model was significant ( $R^2=0.50$ ;  $p=0.002$ ), with the VASCRISK X SEX interaction ( $\beta=-61.44$ ,  $t(46)=-3.20$ ;  $p=.003$ ) and the RAVLT DR X VASCRISK X SEX interaction ( $\beta=7.22$ ,  $t(46)=2.54$ ;  $p=.02$ ) significantly predicting MFQ FoF score. Results indicate that RAVLT DR predicted MFQ FoF score, but when objective delayed memory was poorer, females with elevated vascular risk endorsed more SMCs than those with lower vascular risk. In males, vascular risk did not alter the prediction between objective memory performance and SMCs, even when delayed memory performance was low.

**Conclusions:** Amongst females with higher combined vascular risk, those with poorer objective delayed memory performance endorsed greater SMCs. These findings underscore the need to assess for vascular risk factors, particularly in healthy, cognitively intact older adults so as to facilitate early detection of cognitive decline and intervention. Formal assessment may be necessary when individuals present with SMCs and vascular risk factors. Moreover, while SMCs remain a part of the diagnostic criteria for MCI, these findings suggest that males with vascular risk factors may be less likely to be accurately diagnosed as they have less accurate self-appraisal of memory than females. Informant corroboration of memory concerns may be particularly necessary when individuals present with vascular risk factors.

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**Keywords:** memory complaints, cognitive, vascular cognitive impairment

**Z. B. BALLARD, E. R. PAITEL, S. A. EVANS, T. A. GREGG, C. B. OTTEMAN, K. A. NIELSON. Emotional Suppression Interacts with Apolipoprotein-E  $\epsilon 4$ , Reducing Executive Speed and Memory Performance in Cognitively Intact Older Adults.**

**Objective:** Individual differences in emotion regulation (ER) in response to emotional challenge tend to vary with age. Any of several ER strategies might be utilized, including cognitive

reappraisal and expressive suppression. Reappraisal reduces emotional impact early in emotional responding and involves reinterpreting an emotive stimulus. Suppression occurs later and focuses on inhibiting expression of feelings. No one strategy produces more positive outcomes across all situations, but suppression is associated with higher arousal and amygdala activation, less reduction in negative affect, and poorer cognition (memory and executive function), as compared to reappraisal in emotive contexts. Memory and executive function (EF) performance also decreases with age, which could particularly impact elders and, among them, particularly those with greater genetic risk for developing Alzheimer's Disease (e.g., those carrying the Apolipoprotein-E  $\epsilon 4$ /APOE4 allele). However, relatively few studies have investigated whether suppression (S) might have cognitive effects.

**Participants and Methods:** In the current study, a sample of 80 cognitively intact older adults (age 48-86, mean = 69.0, SD = 10.6; 28 males) completed a battery of neuropsychological tests and a measure of S, forming four groups: Low-S/ $\epsilon 4$ - (individuals lower in suppression and without the APOE4 allele; n=29), high-S/ $\epsilon 4$ + (n=15), low-S/ $\epsilon 4$ + (n=24), high-S/ $\epsilon 4$ - (n=12).

**Results:** Covarying age and gender, high-S individuals showed overall slower digit copy speed, and high-S/ $\epsilon 4$ + had slower symbol-digit modality performance and poorer overall performance across measures of memory.

**Conclusion:** These results suggest the need for further research to characterize the impact of suppression on cognitive health in aging and implications of genetic risk for dementia.

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**Keywords:** apolipoprotein E, emotional processes, executive functions

## **B. KIM, S. CHOI, S. LEE. Development and validation of mobile based neuropsychological cognitive tests.**

**Objective:** This study tried to examine the validity of the mobile based neuropsychological tests we developed. Android Application based neuropsychological tests include a Trail Making Test(TMT), Continuous Performance Test(CPT), Go No go Association Test(GNAT), Signpost Memory Test. A mobile based neuropsychological cognitive test could be a useful strategy to evaluate cognition in older driver with and without cognitive decline. This study aimed to assess Executive Function, Working Memory, Visual Memory, Sustained Attention, Response Inhibition using a mobile based neuropsychological tests that compared the results to those from standardized neuropsychological cognitive tests for older driver.

**Participants and Methods:** This study included 150 participants from a hospital. a sample of 150 adults aged between 65 and 75 completed a four neuropsychological tests(TMT, CPT, GNAT, Signpost Memory Test) with paper, web-based tests and the mobile based tests.

**Results:** The result of the analysis for the TMT, CPT, GNAT, Signpost Memory Test showed significant correlations between the test scores, especially in standard deviations of RT, accuracy, and false alarm.

**Conclusions:** In conclusion, the present findings suggest that mobile based neuropsychological cognitive test can serve as a new and expanded platform for the administration of psychological assessments. It is concluded that mobile based neuropsychological cognitive tests can be useful and valid.

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**Keywords:** neuropsychological assessment, executive abilities - normal, test validity

**M. A. CORNWELL, B. CICERO, I. GRUNWALD, S. HALL, W. KRAUSE, T. MYERS, L. H. PICK, K. FINLEY, K. R. SAVAGE, J. M. SCHMIDT, J. TWAITE, V. NANCY, J. C. BOROD. Integrating Affect Perception Tasks from the New York Emotion Battery into a Comprehensive Measure of Neuropsychological Change across the Lifespan.**

**Objective:** Affect perception (AP) is vital for social competency, impacting personal and professional relationships (e.g., Côté & Miners, 2006). Relatedly, social engagement may be protective against dementia (Sommerlad, 2019). Thus, mixed research findings of reduced AP in aging (Ruffman et al., 2008; Slessor et al., 2005) are especially salient for adults now retiring later and living longer than in previous generations (Silverstein, 2008). The current study examined AP as a function of age in a diverse sample, while also controlling for the potential confound of cohort effects, long identified as a shortcoming in cross-sectional research on aging (e.g., Costa & McCrae, 1982).

**Participants and Methods:** Identification tasks from the New York Emotion Battery (NYEB; Borod, Welkowitz, & Obler, 1992) were given to a diverse sample across the adult lifespan (ages 21-88,  $N=124$ ), measuring affect-labeling accuracy (i.e., happiness, interest/excitement, pleasant surprise, sadness, anger, fear, disgust, and unpleasant surprise) in three communication channels (i.e., facial, prosodic [vocal tone], and lexical [words and sentences, as separate stimuli conditions]). The sample was stratified by age in terms of decade (e.g., ages 60 to 69 were in the 60s age-group). Distributions of characteristics in terms of gender, education, socioeconomic status, race (i.e., White or non-White), and language background (i.e., monolingual or bilingual+) were not significantly different across the seven decade age-groups. NYEB data were collected from 1993 to 2015, affording the opportunity to disentangle age-effects from cohort-effects among the oldest participants (i.e., ages 60 to 88,  $n = 51$ ) by dividing them into two groups according to their birth-year proximity to the Great Depression (i.e., proximal cohort, [b. 1924 – 1933] or distal cohort [b. 1913-1923 and b.1934-1950]). All data were collected at the Mount Sinai School of Medicine or at Queens College, City University of New York, with approval from the Institutional Review Boards of both institutions.

**Results:** General linear models (GLM) extended by general estimating equations (GEE) were used for the analyses as GEE accommodates heteroscedasticity and a broad range of distribution-types. Findings revealed statistically significant downward linear trends for overall AP ( $p<.01$ ) and for AP in each of the four task-conditions of the three communication channels ( $p<.001$ ), such that accuracy for labeling affect decreased as age increased. Moreover, there were no statistically significant differences in AP ( $p > .05$ ). between the two birth-cohort groups of the oldest participants (ages 60-88).

**Conclusions:** Findings revealed that, in a diverse sample, age is associated with declines in AP for all three channels evaluated, particularly for prosodic affect. Lexical AP was relatively less impacted than other channels. This study extends prior findings of age-related AP decline by increasing generalizability with a diverse sample, reinforcing the validity of age-effects by controlling for cohort-effects among older participants, and by increasing ecological validity with evaluation across three distinct channels, directly relevant to present-day communication modes (e.g., email or video conferencing). In terms of future directions, continuing work with these data will contribute sociohistorical context by evaluating how early childhood events predict AP biases in older adulthood.

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**Keywords:** emotional processes, diversity, aging (normal)

**B. ROHL, J. BOISSONEAULT, S. DEKOSKY, J. WILLIAMSON, E. S. PORGES. Effects of nonpharmacological sleep interventions on cognitive performance in older adults: A systematic PRISMA review.**

**Objective:** Subjective impairment in daily functioning is a requisite criterion for a clinical diagnosis of chronic insomnia, and accumulating evidence demonstrates the deleterious consequences of poor sleep on cognitive performance. The risk of both cognitive decline and disordered sleep increases with advanced age, raising the question of whether improvements in sleep could mitigate changes in cognitive performance. The current study aims to systematically survey and characterize existing literature on the possible effects of non-pharmacological sleep treatments on cognitive performance in older adults.

**Methods:** PubMed, PsycInfo, and Google Scholar were searched for papers up until June 1st, 2020. We selected articles reporting any objectively measured cognitive outcome in trials of non-pharmacologic interventions to improve sleep in older adults. Case studies, meta-analyses, and studies whose participants' mean age was below 60 years were excluded.

**Results:** Seven hundred and sixty-eight abstracts were screened, and 12 studies were included in the final review. Interventions included sleep hygiene education, cognitive interventions with and without behavioral components, behavioral-only interventions (such as sleep restriction and stimulus control), and multimodal lifestyle interventions including the use of bright light and body temperature manipulation therapies. Sleep measurements spanned objective (actigraphy, polysomnography) and self-report methods (sleep diaries, symptom questionnaires). Executive functioning and declarative memory were the most often-reported cognitive domains to show improvement associated with participation in a non-pharmacologic intervention for sleep symptoms. One study found that at baseline, insomnia patients were able to transiently mask differences from controls on a simple vigilance task, but not on a more complex task requiring the inhibition of responses in a random sequence, and this normalized following treatment. This may reflect that if improvements in cognitive performance result from improved sleep, it may be in domains often omitted from traditional neurocognitive assessments (e.g. sustained attention) or are too subtle to be captured by performance on traditional clinical testing. Cognitive impairment was a frequent exclusion criteria, perhaps leading to ceiling effects. Further, medical and psychological factors known to impact cognitive performance (i.e. comorbidities, chronic pain, alcohol use) were not consistently reported.

**Conclusions:** There is insufficient evidence to conclude that participation in a non-pharmacologic sleep intervention improves cognitive performance in older adults. Limited evidence suggests that executive functioning and memory domains may be most susceptible to improvement. In several studies, cognitive change was not a primary outcome measure and therefore assessed with relatively insensitive measures and limited batteries. The available evidence reviewed here suggests that an effect may be revealed if the complex constructs of sleep and cognition are carefully and consistently measured. Previous studies have demonstrated that insomnia patients are capable of masking deficits with effort. Further, there is a demonstrated gap between subjective and objective sleep disruption in older adults, which appears to resolve over the course of treatment. Therefore, in addition to more rigorous assessment

of cognitive function, including the use of assessment methods capable of overcoming possible effects of effort ‘masking’ weaknesses, future studies would be well-served by employing both objective and subjective sleep measurement tools, and a comprehensive accounting for medical and psychological comorbidity.

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**Keywords:** sleep, sleep disorders, treatment outcome

**K. MCVEIGH, M. R. MEHL, A. A. WANK, A. J. POLSINELLI, S. A. MOSELEY, E. L. GLISKY, M. GRILLI. Loneliness and aging: Manifestations of loneliness in everyday conversations among older adults.**

**Objective:** Loneliness is a perceived lack of social and emotional support and is related to many adverse health and cognitive outcomes. Losing a partner to death, deteriorating health, and decreasing network size may make older adults particularly susceptible to loneliness, which is further associated with risk for Alzheimer’s disease, cardiovascular disease, and mortality. It is unclear how loneliness is related to everyday social interactions, despite knowing the importance of social interaction to cognitive function and overall well-being in older adults. One important function of social interaction is memory sharing. Autobiographical memory sharing (i.e., memory for personal events) in particular facilitates meaningful connections with others and is susceptible to age-related changes, but also has not yet been studied in the context of loneliness. Due to the valuable role of memory sharing in social interactions, it seems important to study the relationship between daily social interactions and loneliness also from the perspective of conversational autobiographical memory sharing. To begin to address these gaps in knowledge, we investigated whether lonelier older adults have different real-world conversations, social engagement, and autobiographical memory sharing than less lonely older adults.

**Participants and Methods:** Participants included 106 healthy, cognitively unimpaired older adults (age range = 65-90,  $M = 76.12$ ,  $SD = 6.00$ ). We used the Electronically Activated Recorder (EAR) as an unobtrusive, observational method to capture sound files of real-life, everyday instances of social interaction and conversational memory sharing over the course of four days. Sound files containing conversations were identified and scored for conversation type and memory sharing using established protocols. We measured self-reported loneliness with the loneliness scale from the National Institutes of Health (NIH) Toolbox. We examined the relationship between loneliness and different conversation types (small talk, gossip, practical conversation, substantive conversation, or personal/emotional disclosure), number of episodic and non-episodic autobiographical memories, and number of details included in episodic memories.

**Results:** Higher loneliness was significantly related to more time spent alone ( $r = .40$ ,  $p = .0002$ ). Higher loneliness was also significantly related to less small talk ( $r = -.24$ ,  $p = .016$ ) and less gossip ( $r = -.24$ ,  $p = .016$ ) in conversations. However, loneliness was not significantly related to autobiographical memory sharing ( $r = 0.04$ ,  $p = .73$ ), number of episodic autobiographical memories ( $r = 0.004$ ,  $p = .965$ ), number of non-episodic autobiographical memories ( $r = .07$ ,  $p = .516$ ), or number of details included in autobiographical memories ( $r = .038$ ,  $p = .708$ ).

**Conclusions:** Results showed that lonelier older adults spent more time alone and were less likely to engage in small talk and gossip, independent of how many conversations they had.

However, loneliness was not significantly related to autobiographical memory sharing, indicating that among older adults, higher loneliness may not lead to fewer or greater attempts to connect through autobiographical memory sharing.

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**Keywords:** aging (normal), everyday functioning, social processes

**V. RANGER, M. BEDARD, V. TALER. Social Support, Cognition, and Post-Traumatic Stress Disorder: Findings from the Canadian Longitudinal Study on Aging.**

**Objective:** Considerably less research has investigated neurocognitive changes in older adults than in younger adults suffering from post-traumatic stress disorder (PTSD). As the aging population increases, it is important to understand how aging interacts with different psychological conditions and its impact on cognition. Interestingly, previous research has demonstrated that some lifestyle factors can help mitigate the clinical representation of cognitive deficits by recruiting differential brain networks or using alternative cognitive strategies when confronted with pathology. Numerous studies have recognized the crucial role of social support in the development of PTSD, however, there is a need for more studies investigating the impact of social support on cognition in those suffering from PTSD. The current study aims to evaluate the cognitive performance of older adults with symptoms of PTSD and assess if preserved social support can act as a cognitive reserve factor by mitigating cognitive deficits in both control and PTSD groups.

**Participants and Method:** The study was conducted using baseline data derived from the Canadian Longitudinal Study on Aging, a nationwide study on health and aging. The study included 1,100 participants that exhibited symptoms of PTSD and 22,200 cognitively healthy older adults all between the ages of 45-85. Symptoms of PTSD were assessed using an adapted version of the Primary Care PTSD Screen Test. Furthermore, participants completed the MOS Social Support Survey as well as neurocognitive tests in the domains of executive functioning, declarative and prospective memory.

**Results:** People with PTSD scored lower on domains of executive functioning as well as domains of declarative and prospective memory. Furthermore, in examining global cognitive impairments, people with PTSD demonstrated greater impairment rates than controls on two or more tests. Moderation analyses revealed that greater social support was associated with greater executive functioning for controls, although this was not found to be true for people with PTSD.

**Conclusion:** People with PTSD experienced greater cognitive deficits when compared to controls, however, social support did not appear to moderate this relationship for PTSD sufferers as it did for controls.

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**Keywords:** post-traumatic stress disorder, cognitive functioning, cognitive reserve

**C. E. ESCHER, B. M. ASKEN, M. YOU, C. FONSECA, J. KRAMER, K. B. CASALETTO. The Roles of Physical Activity and Diet for Cognitive Aging: Is More Better?.**

**Objective:** Single modifiable lifestyle factors, such as exercise and nutrition, are associated with slowed age-related cognitive decline. Combining lifestyle factors in a multimodal approach may have synergistic benefits for cognition compared to a single lifestyle factor alone. This study

examined whether the interactive effects of nutrition, specifically adherence to the Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND) diet, and physical activity associates with better cognition compared to either factor alone in a cross-sectional normal aging cohort.

**Participants and Methods:** 132 adults (52-91 years old) were sampled from the UCSF Longitudinal Brain Aging Project. Participants were excluded if they had a diagnosis of MCI or dementia. Subjects completed a 15-item MIND diet food frequency questionnaire and a 11-item self-report weekly physical activity measure [Physical Activity Scale (PASE)]. Additionally, participants underwent neuropsychological testing, as well as neuroimaging. Cognitive outcomes included executive functioning, episodic memory, and language. Neuroimaging outcomes consisted of total grey matter volume and total white matter volume, adjusted for total intracranial volumes. All regression interaction models adjusted for age, sex, education, and a composite vascular burden score.

**Results:** There was a significant interaction between PASE and MIND on episodic memory ( $b = -1.15$ ,  $p = .03$ ) and executive functioning ( $b = -1.21$ ,  $p = .02$ ). The positive effect of PASE and MIND were not synergetic; the beneficial effect of PASE on cognition attenuated in those with highest MIND diet adherence. For language, the interaction between PASE and MIND showed the same directionality, but did not reach statistical significance ( $b = -.91$ ,  $p = .10$ ). There was also a statistically significant interaction between PASE and MIND on total grey matter volume ( $b = -1.20$ ,  $p = .04$ ) consistent with the pattern observed in the cognitive models. Specifically, the beneficial effects of PASE on grey matter volume attenuated in participants with highest MIND diet adherence. There was no statistically significant relationship observed for total white matter volume ( $b = -.28$ ,  $p = .60$ ).

**Conclusions:** Higher levels of physical activity were associated with better executive functioning, verbal episodic memory, and gray matter volume, particularly when diet is poor. However, higher levels of exercise and healthier diet together did not necessarily lead to disproportionately better cognitive and brain volume outcomes.

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**Keywords:** aging (normal), neuropsychological outcome, neuroimaging: structural

**C. DION, E. M. FORMANSKI, A. DAVOUDI, K. RODRIGUEZ, S. AMINI, J. J. TANNER, K. HEILMAN, D. LIBON, C. PRICE. Quantifying Clock Drawing Number Placement Accuracy in Participants with Mild Cognitive Impairment.**

**Objective:** Assessing how well numbers are drawn within a clock face is part of many traditional pencil and paper clock scoring criteria; however, the mean to actually quantify this behavior has until now been constrained to subjective visual inspection (Libon, 1993; Sunderland, 1989; and Rouleau, 1992). Our team recently developed a digital Clock Drawing Test (dCDT) variable that objectively quantifies number placement accuracy; and is hypothesized to provide a measure of mental planning. Using traditional clock scoring methods, prior research has shown that patients with Alzheimer's disease (AD) generally improve from the command to copy test conditions (Libon et al., 1996). To determine whether a similar phenomenon is present in non-dementia disease states, the current investigation examined number placement accuracy from command to copy in older adults with mild cognitive impairment (MCI) compared to non-MCI peers. We hypothesized that 1) individuals with MCI

would display worse number placement compared to the non-MCI peers in the command test condition, but 2) show improvement from command to copy compared to non-MCI peers.

**Participants and Methods:** MCI classification was defined using the comprehensive criteria suggested by Jak and colleagues (Jak et al., 2009) using age-adjusted normative data. The final prospectively recruited IRB-consented participant sample included 137 non-demented older adults (110 cognitively well and 27 with MCI) who completed the digital clock drawing test along with a comprehensive neuropsychological protocol. Quantification of number misplacement was generated by calculating each digit's degree of absolute deviation from ideal placement around the clock face.

**Results:** Groups did not differ in sex or age; however, the MCI group was slightly less educated (education years MCI= 14.20(0.58); non-MCI= 16.02(0.24)). Controlling for education, a repeated measures analysis of covariance (ANCOVA) showed significant main effects of Group [ $F(1,135)= 24.84, p<.001, \eta^2= .155$ ; MCI > non-MCI], test Condition [ $F(1,135)= 4.88, p=.029, \eta^2= .035$ ; Command > Copy], and Group x Condition interaction [ $F(1,135)= 6.30, p=.013, \eta^2= .045$ ] such that only the MCI group significantly improved from command to copy.

**Conclusions:** Individuals with MCI produced drawings with measurable difficulty in number placement within the clock face relative to non-MCI along with significant improvement from the command to copy conditions. These results are consistent with literature describing command to copy improvement in individuals with AD suggesting a similar phenomenon may typify putative prodromal neurodegenerative illness. Overall, these findings suggest that digitally-acquired number placement accuracy may be a sensitive and useful tool in early disease identification.

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**Keywords:** neuropsychological assessment, mild cognitive impairment

**C. M. MEWBORN, M. C. ADLER, K. M. MONTRY, B. L. ROPER, T. J. ARENTSEN, J. L. JACOBSON. Differential Predictors of Caregiver Burden in Caregivers of Veterans with Newly Diagnosed vs. Established Neurocognitive Disorders.**

**Objective:** It is well-established that caregiver burden is higher for caregivers of patients who have greater cognitive and functional impairment, more severe neuropsychiatric symptoms, and greater medical multimorbidity. Previous research has also demonstrated that these factors differentially predict caregiver burden based on various patient (e.g., severity/etiology of cognitive impairment) and caregiver factors (e.g., ethnicity, sex, relationship to patient). However, there has been little examination of whether these factors differentially predict burden based on caregiving length, including time since diagnosis. Thus, the current study sought to examine potentially unique predictors of burden in caregivers of veterans with newly diagnosed vs. established neurocognitive disorders.

**Participants and Methods:** Participants were 194 patients (98.5% male) aged 63-101 years ( $M=80.7, SD=7.5$ ) and their caregivers who received comprehensive neuropsychological evaluation in a VA medical center transdisciplinary memory clinic from 2010-2020. All participants received a diagnosis of Mild ( $N=41$ ) or Major Neurocognitive Disorder ( $N=153$ ) post-evaluation. 60.3% of diagnoses were new, whereas 39.7% were confirmations of an established diagnosis. Predictors of caregiver burden (measured by the 22-item Zarit Burden Inventory [ZBI] total score) included diagnosis severity (mild vs. major), MMSE total score,

number of neuropsychiatric symptoms endorsed on the Neuropsychiatric Inventory Questionnaire (NPI-Q), clinician-rated 16-item I/ADL dependency measure, and number of medical comorbidities. Diagnosis recency (new vs. established) was employed as a moderator in the prediction of ZBI scores. Hierarchical regression analyses were conducted to determine the association between predictor and ZBI scores, as well as the potential moderating effect of diagnosis recency on observed associations. Significant moderating effects were further investigated with simple slopes analysis at each level of the moderator.

**Results:** ZBI scores were higher for caregivers of patients with established vs. new diagnoses ( $t=3.528$ ,  $p=0.001$ ,  $d=.51$ ). Across both groups, major neurocognitive disorder severity ( $F=11.483$ ,  $R^2=0.056$ ,  $p=0.001$ ), higher number of NPI-Q symptoms ( $F=118.37$ ,  $R^2=0.381$ ,  $p<0.001$ ), and greater I/ADL dependency ( $F=9.882$ ,  $R^2=0.049$ ,  $p=0.002$ ) were independently associated with higher ZBI scores. Number of comorbidities did not independently predict ZBI scores ( $F=0.064$ ,  $R^2=0.00$ ,  $p=0.80$ ). However, diagnosis recency was a significant moderator, such that higher number of comorbidities predicted ZBI scores for caregivers of patients with new ( $F=4.448$ ,  $R^2=0.037$ ,  $p=0.037$ ) but not established diagnoses ( $F=2.153$ ,  $R^2=0.028$ ,  $p=0.146$ ). MMSE scores were not significantly associated with the ZBI, and there were no other significant moderator effects.

**Conclusions:** More severe diagnosis (major vs. mild neurocognitive disorder), higher number of neuropsychiatric symptoms, and greater I/ADL dependency was associated with higher caregiver burden, consistent with previous research. Neuropsychiatric symptoms alone accounted for 38% of the variance in caregiver burden, pointing to a promising area for intervention. Unique to this study is the finding that greater medical multimorbidity was associated with higher burden for caregivers of newly diagnosed patients only; thus, interventions to help new caregivers understand and manage medical comorbidities may reduce burden in this group. Additionally, caregivers of patients with established diagnoses reported higher burden than caregivers of patients with new diagnoses, suggesting that additional factors (e.g., depression, burnout, limited resources or social support) may contribute to burden as dementia chronicity increases.

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**Keywords:** caregiver burden, activities of daily living, medical disorders/illness

**E. M. BOUTZOUKAS, A. O'SHEA, A. ALBIZU, N. D. EVANGELISTA, H. K. HAUSMAN, J. N. KRAFT, E. J. VAN ETEN, P. K. BHARADWAJ, S. G. SMITH, H. SONG, E. S. PORGES, G. A. HISHAW, S. DEKOSKY, S. WU, M. MARSISKE, G. E. ALEXANDER, R. A. COHEN, A. J. WOODS.** Effects of frontal white matter hyperintensities on executive function tasks in older adults.

**Objective:** Frontal lobe structures decline faster than most other brain regions in older adults. Age-related decline in frontal lobe structures have been associated with poorer executive function (e.g. working memory, switching/set-shifting, and inhibitory control). The effects and presence of frontal lobe white matter hyperintensities (WMH) on executive functioning in normal aging is relatively unknown. The current study assessed relationships between region-specific frontal WMH volumes and cognitive performance in healthy older adults using three executive functioning tasks from the NIH Toolbox (NIHTB) Cognition Battery.

**Participants and Methods:** A cohort of 276 healthy older adults ages 65-88 completed the NIHTB and 3T T1-weighted and FLAIR MRI. Lesion Segmentation Toolbox was used for WMH volume quantification (in mL) and generating lesion probability maps. Individual

participant lesion maps were registered to the Desikan-Killiany atlas in FreeSurfer 6.0 to define regions of interest (ROI). Region-specific analyses used multiple independent linear regressions to assess the relationship between NIHTB executive functioning performance and WMH volume in frontal lobe ROIs. All models included age, sex, education, estimated total intracranial volume, multi-site scanner differences, and cardiovascular disease risk dichotomized for low-and-high-risk using Framingham criteria as covariates.

**Results:** Poorer set-shifting performance was associated with greater WMH volume in 8 of 10 frontal ROIs including bilateral caudal middle frontal (left  $\beta=-0.13$ ,  $p=0.03$ ; right  $\beta=-0.13$ ,  $p=0.04$ ), medial orbitofrontal (left  $\beta=-0.12$ ,  $p=0.05$ ; right  $\beta=-0.16$ ,  $p<0.01$ ), superior frontal (left  $\beta=-0.18$ ,  $p<0.01$ ; right  $\beta=-0.24$ ,  $p<0.001$ ), left rostral middle frontal ( $\beta=-0.14$ ,  $p=0.02$ ), right lateral orbitofrontal ( $\beta=-0.13$ ,  $p=0.03$ ). Poorer inhibitory performance was associated with higher WMH volume in 3 of 10 frontal ROIs including bilateral superior frontal (left  $\beta=-0.17$ ,  $p<0.01$ ; right  $\beta=-0.21$ ,  $p<0.001$ ), right medial orbitofrontal ( $\beta=-0.12$ ,  $p=0.05$ ). There were no significant associations between working memory performance and WMH in the 10 frontal ROIs.

**Conclusions:** Our study demonstrates that the location and pattern of frontal WMH may be important to assess when examining age-related differences in cognitive functions involving switching/set-shifting and inhibition tasks. On the other hand, working memory performance was not related to presence of frontal WMH in this sample. These data suggest that WMH may contribute selectively to age-related declines in executive functioning. These findings emerged above and beyond predictors known to be associated with WMH presence, including age and cardiovascular disease. The location of WMH within the frontal lobes may play an important role in the neuropsychological profile of cognitive aging. Further research should explore whether early intervention on modifiable vascular factors or specific cognitive interventions targeted for executive abilities may help mitigate the effect of frontal WMH on executive functioning.

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**Keywords:** executive functions, aging (normal), neuroimaging: structural

**H. K. HAUSMAN, A. O'SHEA, V. DOMINGUEZ, M. FILLINGIM, K. CALFEE, S. PERRYMAN, D. CARBALLO, C. HERNANDEZ, J. N. KRAFT, E. S. PORGES, S. WU, M. MARSISKE, R. A. COHEN, A. J. WOODS. COVID-19 Concerns in Older Adults and Mental Health Outcomes During the Pandemic.**

**Objective:** In an attempt to mitigate the rapid spread of the coronavirus (COVID-19), officials worldwide have implemented socialization restrictions (e.g., the closure of public places, stay-at-home orders, and social distancing). Older adults are at a greater risk for experiencing severe illness from COVID-19 that can result in hospitalization, intensive care, or even death. As such, older adults are being encouraged to remain in their homes for an uncertain amount of time. The consequences of systematic isolation and COVID-19 on mental health and well-being in this population are currently unknown. This study investigated the relationship between older adults' concerns regarding COVID-19 and changes in depression and anxiety during the outbreak.

**Participants and Methods:** Participants were recruited from an ongoing clinical trial with baseline data collected prior to the issuance of stay-at-home orders across Florida. During the initial spreading of COVID-19 cases statewide, 107 healthy older adults completed measures remotely via REDCap, including the Beck Depression Inventory (BDI), State-Trait Anxiety Inventory (STAI), and a COVID-19 questionnaire. On the COVID-19 questionnaire, participants

rated their level of concern for the potential impact of COVID-19 on items regarding getting sick, access to healthcare services, work/financial capabilities, and social isolation. Participants were divided into two groups based on the total of their ratings via median-split: lower concern and higher concern. Mixed-design ANOVAs were conducted to analyze whether change in BDI and STAI scores measured before and during the pandemic differed between lower and higher COVID-19 concern groups. We ran three models with concern group, occasion, and their interaction as predictors for each outcome: depression, state anxiety, and trait anxiety. For secondary analyses, change scores were created for BDI, STAI state anxiety, and STAI trait anxiety (post-pre). We ran three univariate ANOVAs with the COVID-19 concern items as predictors for each change score. The number of days between participants' assessments was included as a covariate in all models.

**Results:** There were significant COVID-19 concern group by occasion interactions across all three models. Post-hoc analyses using Bonferroni correction revealed that scores on the BDI and STAI did not differ between groups prior to COVID-19. However, those in the higher concern group had significantly greater levels of depression, state anxiety, and trait anxiety during COVID-19 ( $p$ -values  $< .001$ ). Secondary analyses revealed that concerns related to one's own social isolation ( $p=.007$ ) and an at-risk family member getting sick ( $p=.001$ ) predicted greater BDI change scores. Whereas concerns related to one's own social isolation (state  $p=.002$ ; trait  $p=.003$ ), access to healthcare for chronic conditions (state  $p=.04$ ; trait  $p=.008$ ), and ability to work (state  $p=.04$ ) predicted greater STAI change scores.

**Conclusions:** Older adults with higher concerns about COVID-19 report greater levels of depression and anxiety during the pandemic. Identifying specific concerns that affect mental health in this population during COVID-19 (social isolation, family's health, access to healthcare services, ability to work) can aid in the development of intervention strategies to preserve well-being. Importantly, these results begin to uncover the mental health ramifications of COVID-19 and the public's response to the pandemic.

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**Keywords:** aging (normal), anxiety, depression

### **C. CAUGHIE, H. HEPPNER, P. BEAN, S. HALL. Worried Well or Rightfully Worried? A Coming of Old Age Story..**

**Objective:** Recent research suggests dementia worry is related to decreases in cognitive performance in healthy older adults. However, whether dementia worry is a psychological phenomenon or a precursor to later cognitive impairment is difficult to determine. Disentangling this complex question is imperative for the effective assessment of older adults in neuropsychological practice. The current study thus investigates whether dementia worry is more prevalent in younger or older; otherwise healthy, older adults in order to better clarify the nature of its cause.

**Participants and Methods:** Participants ( $n=49$ ) aged 65-85 were screened for depression and cognitive impairment using the Patient Health Questionnaire-8 and the Telephone Interview for Cognitive Status. All included participants were asked to complete the Dementia Worry Scale (DWS), a self-report measure assessing the level of dementia worry individuals experience in daily life.

**Results:** A main effect of age on dementia worry was supported. Specifically, young-old adults (between the ages of 65-75) reported experiencing a higher level of dementia worry than old adults (76-85 years in age) ( $\chi^2(1, N=40) = 4.912, p = .027$ ).

**Conclusions:** Dementia worry may present more frequently in healthy older adults who are in earlier stages of aging. Implications of these findings are discussed.

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**Keywords:** aging (normal), anxiety, cognitive functioning

**S. G. SMITH, P. K. BHARADWAJ, G. A. HISHAW, T. P. TROUARD, G. E. ALEXANDER. Age-Related Regional Network Covariance Pattern of Gray to White Matter Contrast in Healthy Middle-Aged to Older Adults.**

**Objective:** Reductions in gray to white matter contrast (GWC) in magnetic resonance imaging (MRI) have been shown to be an important factor related to aging. These age-related contrast differences are thought to be primarily due to changes in white matter signal intensity and have been shown to differ in those experiencing healthy versus pathological aging. Previous studies have focused on univariate analyses to evaluate GWC differences. How MRI GWC regionally covaries on a region of interest (ROI) basis in relation to age, in cognitively unimpaired older adults, has yet to be investigated.

**Participants and Methods:** We applied a multivariate network analysis technique, the scaled subprofile model (SSM; Alexander & Moeller, 1994), to identify a GWC covariance pattern related to age in a sample of healthy older adults ( $N = 175$ ; mean $\pm$ sd Age =  $69.4 \pm 10.2$  years, range = 50 - 89 years; Sex (F/M) = 87/88; mean $\pm$ sd Education =  $16.7 \pm 2.8$  years; mean $\pm$ sd MMSE =  $29.02 \pm 1.21$ ). GWC was computed for each participant from 3T volumetric MRI scans for 68 ROIs using Freesurfer (v5.3) with a depth of 30% of the cortical ribbon from the GWC boundary to the gray matter-cerebrospinal fluid boundary (Kong et al., 2015). SSM network covariance analysis was performed on the GWC ROIs using Akaike Information Criteria with 10,000 bootstrap iterations to identify a linear combination of GWC patterns associated with age.

**Results:** A linear combination of SSM components was associated with increasing age ( $R^2 = .526, p \leq 2.80e-22$ ). The combined age-related SSM pattern was characterized by decreases in bilateral middle temporal, left (L) pars orbitalis, bilateral superior frontal, bilateral supramarginal, right (R) inferior parietal, R superior parietal, and R frontal pole areas, with relative increases in bilateral caudal anterior cingulate, L cuneus, bilateral isthmus cingulate, L lingual, L pericalcarine, bilateral posterior cingulate, bilateral transverse temporal, and R temporal pole areas. After controlling for age, sex, and years of education, greater expression of the SSM age-related GWC pattern was associated with lower Wechsler Adult Intelligence Scale-IV Working Memory Index scores ( $R^2$  change = .014,  $p = .023$ ).

**Conclusions:** The results indicate a regional pattern of GWC in healthy middle-aged to older adults characterized by decreases in selective frontal and parietal brain regions as well as relative increases in distinct frontal, occipital, and temporal areas with increasing age. Given that degradation of myelin can affect differences in MRI gray-white boundary signal intensities, the observed regional differences in GWC may reflect a pattern of age-related demyelination that was also associated with poorer working memory performance. Together, our findings suggest that SSM network analyses of MRI GWC may provide an important neuroimaging biomarker, with potential applications for the evaluation of interventions for brain aging.

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**Objective:** While related to one's chronological age, prior literature suggests that structural brain changes in aging may relate to health factors including comorbidities, body mass index (BMI), chronic pain, substance use, sleep habits, and physical activity. Recently, machine learning methods have been developed to predict an individual's "brain age" based on structural, T1-weighted images. The discrepancy between predicted brain age and chronological age has been proposed as a strong predictor of brain health. In a sample of healthy older adults, the present study aimed to understand what contributes to the differences observed between brain age and chronological age in healthy older adults.

**Participants and Methods:** Community-dwelling older adults without cognitive impairment were recruited for a randomized clinical trial. Brain age was derived with *brainageR* using baseline T1-weighted structural images. To correct for age bias, age was regressed onto predicted brain age. The intercept was subtracted from predicted brain age which was then divided by the slope. Chronological age was subtracted from corrected brain age to create a predicted age difference (PAD) score that was uncorrelated with age. Composite scores were calculated for self-reported medical history and self-reported experiences of chronic pain by summing indications of lifetime medical comorbidities and number of body areas with chronic pain ongoing for at least six months. Walk speed (m/sec) was calculated using the average time to walk 10 meters on two trials. To control for height, height was regressed onto walk speed and residual values were used. The Pittsburgh Sleep Quality Index global score, Alcohol Use Disorders Identification Test (AUDIT)-10 total, sex, handedness, BMI, and years of education were also assessed. All continuous variables were standardized for interpretation. A lasso regression was performed to select relevant predictors for the model. Linear regression was used to test the selected predictors, with PAD as the outcome and use of assistive walking device as a covariate.

**Results:** Variables selected for inclusion in the linear regression predicting PAD included: chronic pain composite, AUDIT-10 total, sex, education, and meters/second walked. Larger PAD was significantly predicted by more areas of self-reported chronic pain ( $b=.253, p=.004$ ), male sex ( $b=-.486, p=.002$ ), and slower walk speed ( $b=.218, p=.012$ ). This model explained 14% of the variance in PAD [ $F(6, 143)=3.872, p=.001, R-sq=.1397$ ].

**Conclusions:** Self-reported experiences of chronic pain in a greater number of body parts positively predicted PAD. This supports prior findings showing reductions in grey matter volumes associated with chronic pain. Male sex also was predictive of larger PAD. Further research will be needed to understand the directionality of walk speed in the present results which suggest faster walking is associated with larger PAD. The current findings suggest that chronic pain, sex, and walk speed predict differences in structural brain health in healthy older adults. Future work to understand the mechanisms of these sources of heterogeneity is important

both for deeper understanding of brain aging and interventions to prevent or delay age-related functional decline.

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**Keywords:** aging (normal), brain structure

### **S. SANZ SIMON, S. LEE, Y. GU, Y. STERN. Leisure Activity Engagement Predicts Cognitive Trajectories over 5 Years: Evidence Across Adulthood.**

**Objective:** Leisure Activity Engagement (LAE) has been associated with better cognitive performance and reduced risk of Alzheimer disease. Nevertheless, the association between LAE and age-related cognitive decline remains controversial and there is limited evidence from longitudinal data in healthy population across adulthood. The aim of this study was two-fold: (1) examine longitudinal associations between self-reported LAE and cognitive trajectories over 5-years across the adult lifespan, and (2) examine if LAE subdomains are associated with specific cognitive changes.

**Participants and Methods:** 236 healthy participants across the adult lifespan (21-80 years) completed an 18-item LAE questionnaire and neuropsychological measures comprising four cognitive domains: reasoning, vocabulary, episodic memory, and processing speed. Latent change score analysis was applied to generate latent variables estimating the change in cognitive domains from baseline to follow-up, taking into consideration the duration between the visits. Each cognitive domain included six measures (total of 24 measures). Participants reported Total-LAE frequency in each activity using a 3-point scale: never, sometimes, or often (coded as 0, 1 and 2). An aggregate score was calculated as the sum of all 18 items (19.71, range 8.42 - 32). The associations between baseline LAE (as the predictor) and cognitive change over 5-years (as the outcome) were investigated through regression models adjusted by age, sex, education, socio economic status (SES - family income), and baseline cognitive performance. In a separated model, we investigated whether these associations were moderated by age (age was used as a continuous or dichotomous variable in separated models). For secondary analysis, similar models were run using LAE subdomains as separate predictors, such as Social-LAE, Cognitive-LAE, and Physical-LAE.

**Results:** The mean age of the overall sample was 63.8 years (SD=16.4, range 21 to 80 years), and the mean years of education was 16.3 years (SD=2.3). More than half of participants were female (56.4%), 62.6% White, 24.7% African American, 3.8 % Asian, and 11.9% Hispanic. The regression models showed that higher baseline LAE was significantly associated with increased improvement on vocabulary ( $\beta=.14$ ,  $p=.02$ ) and slower rates of cognitive decline for reasoning ( $\beta=.18$ ,  $p=.003$ ), speed ( $\beta=.18$ ,  $p=.005$ ), and marginally, for memory ( $\beta=.12$ ,  $p=.06$ ). Age did not moderate any of these associations. Our analysis revealed that Social-LAE predicted better improvement in vocabulary ( $\beta=.12$ ,  $p=.05$ ) and slower rate of cognitive decline in reasoning ( $\beta=.14$ ,  $p=.02$ ) and speed ( $\beta=.14$ ,  $p=.03$ ); Cognitive-LAE predicted slower decline of memory ( $\beta=.13$ ,  $p=.04$ ); and Physical-LAE was not associated with cognitive change.

**Conclusion:** We demonstrated that higher baseline LAE predicts cognitive trajectories over 5-year above and beyond several demographics. The findings suggest that LAE may be a proxy of cognitive reserve and buffer against age-related cognitive decline across adulthood. Additionally, LAE may serve as target for future intervention. Our results should be considered with caution due to the relatively modest sample size and the sample characteristics, and should be replicated in a more diverse population.

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**Keywords:** aging (normal), cognitive reserve, neuropsychological outcome

**S. RODMAN, S. SAKMAR, L. J. NEOKRATIS , N. D. RIEDLER, K. A. LOGAR, T. GREZMAK, C. A. HUSTON, A. POREH. Impact of Depression on Cognitive Decline Across Lifespan using non-linear Models.**

**Objective:** In this presentation we applied the mechanistic curve fitting method to examine cognitive decline across the life span. This model allowed us to describe the asymptote (base rate), threshold (age of onset), and rate of decline. This model also allows us to assess the impact of psychiatric conditions on these three factors. In this study we examined the impact of depression on cognitive decline using a sample adopted from the National Alzheimer's Coordinating Center's database. We focused on commonly used neuropsychological measures that were not impacted by ceiling or floor effects.

**Participants and Methods:** The mean scores of 98,230 subjects of which 58.31% were female were examined. The data was extracted from the National Alzheimer's Coordinating Center's database. The Semantic Fluency Test (Animal Naming) and Trail Making Tests were included in the analyses. Scores on the Geriatric Depression Scale were transformed into two categories Non-Depressed ( $GDI < 5$ ) and Depressed ( $6 < GDI$ ).

**Results:** The mechanistic model produced high coefficients of determination for both tests ( $r^2 = .97-.98$ ). When we examined the verbal fluency data we noted that the asymptote for depressed patients was 16.85, which was notably less than the asymptote of 20.60 in non-depressed patients,  $t(363) = 8.36$ ,  $p < .00001$ . Age threshold of initial decline was first observed at age 63 in depressed and 68 non-depressed patients. Non-depressed patients had a higher rate of decline while depressed patients reached a floor score of around a raw score of 14. Around age 82, the difference in scores was less notable. Similar findings were observed on the Trail Making Tests (TMT- A & B). Asymptotes for the depressed patients on Trail Making A were 40.70 for depressed patients and 30.86 for non-depressed patients,  $t(330) = -5.91$ ,  $p < .00001$ . The age of threshold of initial decline for depressed patients was 63, and the age threshold for non-depressed patients was 68. Decline rates were almost identical. The asymptote for depressed patients on the Trail Making Test B was 116.18, which was significantly higher than the score of 89.02 for non-depressed patients,  $t(343) = -5.14$ ,  $p < .00001$ . Age of threshold of initial decline of depressed patients was 63, and the age of threshold for non-depressed patients was 68. The rate of decline was nearly linear for depressed patients and exponential for non-depressed patients.

**Conclusions:** This study suggests that depression generated a decreased baseline in performance for the Semantic Fluency Test (Animals) and Trail Making Test (TMT- A & B). Onset of cognitive decline in depressed patients preceded non-depressed patients by five years. The Trail Making tests demonstrated mixed rates of decline after onset. The Semantic Fluency test demonstrated a lower rate of decline in depressed patients when compared to non-depressed patients until the age of 82. Rates of decline after 82 were similar. Patients with geriatric depression can be expected to experience cognitive decline sooner than non-depressed geriatric patients, and in cases of semantic fluency, to encounter floor effects on tests sooner depending on score sorting methods.

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**Keywords:** cognitive functioning, geriatric depression

**K. RODRIGUEZ, E. M. FORMANSKI, C. DION, A. DAVOUDI, R. AU, D. LIBON, C. C. PRICE, K. HEILMAN. Pseudoneglect in Clock Drawing: Changes in Digit Placement with Increased Age.**

**Objective:** To examine the role of pseudoneglect in healthy older adults when placing digits on the digital clock drawing test (dCDT). Pseudoneglect, or a leftward hemispacial attentional bias, is a well-established phenomenon in young adults that has been attributed to right hemisphere dominance in mediating spatial attention (Bowers and Heilman, 1980). During the aging process, however, hemispheric asymmetry is reduced, and there is a reduction of this left bias (Mańkowska et al., 2020). Given that leftward bias reduces with aging, the current study aims to assess whether digits placed on the left side of the clock by healthy *older* adults will be further away from the clock face edge than digits placed on the left side of the clock by healthy *younger* adults.

**Participants and Methods:** Data were acquired from well classified samples of older adults with average or higher cognition across multiple domains aged  $\geq 55$  years who completed the dCDT (command & copy conditions). The sample was divided into two age groups, older ( $n=210$ ) and younger ( $n=195$ ) adults. Clocks in the command condition were divided into left and right halves. Digits 12 and 6 were omitted due to their midline placement on the clock face. Distance from the clock face edge were averaged for digits in each half (L: 1-5, R: 7-11). The outcome measure was calculated using a difference score subtracting the left half's average from the right half's average, such that a positive value indicates the digits drawn in the right half were further away from the clock face edge than those in the left half. A difference score was used due to its ability to detect leftward bias based on how individuals placed their digits on the right half of the clock. Analyses were completed with an analysis of covariance (ANCOVA), controlling for clock face area.

**Results:** Participants (Younger age= $62.77 \pm 2.79$ , 62.1% female, education= $16.51 \pm 3.01$ . Older: age= $73.57 \pm 4.84$ , 55.2% female, education= $16.44 \pm 3.16$ ). ANCOVA revealed that individuals in the younger group had a larger mean difference score than individuals in the older group (Mean difference score =  $0.78 \pm 1.58$  and  $0.45 \pm 1.44$ , respectively); [ $F(1,400)=5.80$ ,  $p=.016$ ,  $\eta^2=.014$ ].

**Conclusions:** Our findings reveal that younger older participants (aged 55-66) show a larger mean difference score than older participants (aged 68-92), such that older participants are more homogenous in their difference score (closer to zero). These results are consistent with the right-hemi aging model as well as the hemispheric asymmetry reduction in older adults (HAROLD) model, in which leftward bias is reduced in older adults due to age-related reduction in lateralization of brain activity (Cabeza, 2002). Future studies examining spatial biases in clock drawing in aging adults with neurodegenerative disorders may provide valuable information about these disorders.

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**Keywords:** aging (normal)

**M. B. TASSONI, S. M. SIMONE, T. GIOVANNETTI. Contextual Factors Influencing Self-Reported Prospective Memory Performance.**

**Objective:** Prospective memory (PM), or remembering to perform a task in the future, is a complex cognitive process that involves multiple brain regions. Consequently, PM failures on performance tasks are sensitive to even mild cognitive changes associated with aging. However, past studies have shown that self-reported PM failures do not differ between older adults (OA) and younger adults (YA; Smith et al. 2000). Whether and how environmental demands might explain or differentially affect PM performance in OA compared to YA remains unclear. We hypothesized that OA and YA would report a similar number of PM failures, despite differences in contextual factors (e.g., daily busyness and COVID-19). We also evaluated relations between PM failures and environmental contexts in both OA and YA.

**Participants and Methods:** 173 participants (age range=18-96) completed a modified version of the Prospective Retrospective Memory Questionnaire (PRMQ; Smith et al., 2000) and a subset of the Environmental Demands Questionnaire (MPED; Martin & Park, 2003) that measures the daily task demands (max score=35). Both were rated based on the last month, with higher scores reflecting more memory failures and a busier daily schedule. After the PRMQ, participants rated how much they thought the context of COVID-19 affected the frequency of PM failures in the last month, ranging from “not at all” to “significantly.” Participants were grouped according to age (OA = 50+years, n=43, mean age=76, SD=10.49; YA = <50years, n=130, mean age=23, SD=5.94).

**Results:** As expected, between-group t-tests demonstrated no difference in self-reported PM abilities between OA and YA ( $p>.05$ ). T-tests also showed that YA were significantly busier than OA (OA MPED mean=16.36; YA MPED mean=20.10;  $p<.001$ ). There was no significant difference in how OA versus YA self-reported the effect of COVID-19 on PM failures, with both groups reporting a minimal impact of COVID-19 on PM failures. Pearson correlations revealed significant, positive correlations between PM failures and both busyness (OA  $r=.45$ ,  $p<.01$ ; YA  $r=.19$ ,  $p<.05$ ) and impact of COVID-19 (OA  $r=.64$ ,  $p<.001$ ; YA  $r=.33$ ,  $p<.001$ ), suggesting that for both age groups, an increase of PM failures was associated with busier daily lives and a greater influence of COVID-19. Effect sizes indicated a stronger relationship between self-reported PM failures and contextual factors in OA compared to YA.

**Conclusions:** Although older and younger adults did not report differences in PM failures, younger adults reported significantly greater daily demands, suggesting that if daily demands for older adults were greater, they might report more PM failures. In fact, older adults' PM abilities were more susceptible to both personal (e.g., daily demands) and global (e.g., stressors resulting from a pandemic) environmental demands. PM abilities in YA were less influenced and constrained by contextual stressors. These findings suggest that self-reported cognitive abilities, particularly PM abilities, must be considered in the context of the reporter's daily task demands and stressors. Adjustments for daily task demands to self-reported cognitive abilities, similar to adjustments to cognitive scores for demographic variables, will provide more accurate assessments of self-reported abilities.

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**Keywords:** aging (normal), self-report

### **A. C. MOLL, J. L. WOODARD. Measures of Obesity Predict Executive Function Performance in Older Adults.**

**Objective:** Obesity, hypertension, and diabetes are metabolic risk factors, especially prevalent in older adults, that have been inconsistently associated with worse cognition. Additionally, the

relationship between obesity and cognitive function in older adults is unclear given the various measurements of obesity available. Body mass index (BMI) has yielded inconsistent findings, but waist-to-hip ratio (WHR) and waist circumference (WC) may be better markers of obesity-related factors that may affect cognition than BMI. This study investigated the relationship between varying measures of obesity, hypertension, and diabetes with cognition in older adults.

**Participants and Methods:** Participants included 5,580 1957 high school graduates ( $M_{age}=71.2$  years,  $SD=0.9$  years) from the Wisconsin Longitudinal Study, a publicly available database that includes high school graduates who were followed longitudinally until 2011. Cognitive, demographic, and health variables from the 2011 wave were used. Cognitive assessment included Letter Fluency, Category Fluency, Digit Ordering, Similarities, and Immediate and eight-minute Delayed Recall of a 10-word list. Bayesian regressions examined the cross-sectional effect of obesity measures (WHR, WC, BMI) on cognition scores, adjusted for sex and education. Because they are commonly associated with cognitive outcomes and are comorbidities of obesity, cognition scores were also corrected for the presence or absence of self-reported hypertension and diabetes.

**Results:** The Bayesian regression null model included sex, education, and presence of self-reported hypertension and diabetes. Compared to the null model, when WHR was added, the strongest evidence in favor of the alternate hypothesis was associated with addition of WHR to the null model ( $BF_{10}=58.7$ ,  $\Delta R^2=0.2\%$ ) when predicting Letter Fluency. Each 0.1 unit increase in WHR was associated with 0.325 word decrease in Letter Fluency performance. In like manner, the addition of BMI to the null model provided strong evidence in favor of the alternate hypothesis when predicting Letter Fluency ( $BF_{10}=16.8$ ,  $\Delta R^2=0.2\%$ ) and more modest evidence when predicting Digit Ordering ( $BF_{10}=3.0$ ,  $\Delta R^2=0.2\%$ ). Higher BMI was associated with worse Letter Fluency performance and slightly better Digit Ordering performance. Addition of WC to the null model also provided modest evidence in favor of the alternate hypothesis when predicting Letter Fluency ( $BF_{10}=9.2$ ,  $\Delta R^2=0.2\%$ ). None of the obesity measures predicted Similarities or Immediate or Delayed Recall beyond the null model. Male sex, lower education, and the presence of diabetes were associated with worse Immediate and Delayed Recall in all models. The presence of hypertension was associated with worse Immediate Recall and slightly better Delayed Recall in all models. The null model that included sex, education, and presence of self-reported hypertension and diabetes accounted for approximately 4% to 15% of the variance across all models.

**Conclusions:** After adjusting for sex, education, and the presence of self-reported hypertension and diabetes, worse Letter Fluency was predicted by higher WHR, WC, and BMI, and worse Digit Ordering was predicted by lower BMI, although effect sizes were generally quite small. Obesity measures did not predict memory performance beyond sex, education, and the presence of self-reported hypertension and diabetes. Our findings suggest obesity measures may provide some insights into executive functioning performance in older adults.

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**Keywords:** cognitive functioning, aging (normal), diabetes

**K. HACKETT, S. KATTA, J. M. JARCHO, D. S. FARERI, T. GIOVANNETTI, D. V. SMITH. Relationship Between Cognition, Social Support, and Susceptibility to Fraud Among Two Groups of Older Adults Before and During COVID-19 .**

**Objective:** Financial fraud is a growing concern among older adults facing age-related cognitive decline and increased loneliness associated with COVID-19. While changes in overall cognition place older adults at increased risk for fraud, it is unclear whether decline in specific cognitive domains are particularly detrimental, and the extent to which social support may protect against these effects.

**Participants and Methods:** Survey data was collected from two separate cohorts of 50+ year-old participants from a larger study on determinants of risk for financial fraud: N=625 residing within 20 miles of Philadelphia (collected pre-COVID), and N=375 residing in Pennsylvania (collected during-COVID). All participants used Qualtrics to complete demographic information, the Everyday Cognition scale (ECog), Multidimensional Scale of Perceived Social Support (MSPSS), and the Older Adult Financial Exploitation Measure (OAFEM), an index of susceptibility to fraud. We first compared the two cohorts on key variables to explore the potential influence of the COVID-19 pandemic. Correlation and logistic regression analyses were then applied to the entire dataset to evaluate whether self-reported cognitive functioning (total and domain-based scores from the ECog), perceived social support (MSPSS), and study cohort were associated with susceptibility to fraud (OAFEM).

**Results:** Only participants with completed data were analyzed (N=981; 58% female; 81% white; M age = 62, range: 50-91; majority completed some college education). The two study cohorts were comparable on distributions of age, sex, and race; however, the during-COVID cohort reported lower levels of education ( $p < .01$ ). Mann Whitney-U tests comparing OAFEM, ECog, and MSPSS across study cohorts revealed significant differences in ECog\_memory, ECog\_planning, and MSPSS ( $p$ 's < .05) such that the cohort studied during-COVID reported poorer cognition and less perceived social support than those studied pre-COVID. There were no cohort effects on fraud susceptibility. Within the combined sample, spearman correlations revealed weak but significant associations between OAFEM and ECog total ( $r_s = .29$ ) and subscale scores ( $r_s$ 's = .16-.29), and MSPSS ( $r_s = -.24$ ) (all  $p$ 's < .005) such that poorer cognition and less perceived social support were associated with greater fraud susceptibility. A logistic regression applied to a dichotomized OAFEM (any/no susceptibility) compared the relative predictive strength of each ECog domain, MSPSS, and study cohort. There was a significant predictive effect ( $p$ 's < .005) such that a 1-unit change in ECog\_organization and MSPSS was associated with a 1.98 and .75 elevated odds, respectively, of endorsing any degree of fraud on the OAFEM.

**Conclusion:** Poorer cognition and less social support were identified as important features related to susceptibility to financial fraud among a large cohort of older adults. Although individuals studied during-vs-pre-COVID reported lower levels of cognitive functioning and less social support, there were no differences in susceptibility to fraud. However, across the full sample poorer cognition – specifically organization abilities -- and lower perceived social support, predicted risk of fraud. Bolstering organizational strategies and social support through compensatory tools and social engagement represent two addressable avenues to protect older adults from financial fraud. Longitudinal work examining within-person changes is necessary to clarify the causal influence of the COVID-19 pandemic on fraud susceptibility, cognition and social isolation among older adults.

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**Keywords:** cognitive functioning, social processes, executive functions

**L. MINTO, R. ELLIS, K. CHERRY, R. WOOD, V. DOTSON. Interactive Effect of Age, Cardiovascular Risk, and Physical Activity on Affective Symptoms and Cognitive Functioning in a Diverse Sample of Middle Aged to Older Adults.**

**Objective:** Cardiovascular disease (CVD) is related to increased depressive symptoms and worse neurocognitive performance in adults, while physical activity (PA) is associated with decreased depressive symptoms and appears to have some protective effect on cognitive functioning. However, few studies examine these relationships in diverse samples, and it is not fully understood whether risk factors for CVD moderate the effects of physical activity on these health outcomes. We investigated the interrelationships among age, risk for CVD, and PA on affective symptoms and cognitive functioning in a predominantly Black sample of middle-aged to older adults. We hypothesized that individuals with higher CVD risk would be most vulnerable to vascular-related mood and cognitive impairment, and thus would show the greatest benefit of PA on mood and cognitive functioning

**Participants and Methods:** Participants included 62 adults age 45 and older (mean age = 65.9; 71.0% Black; 80.6% female) who completed the Forward Digit Span (FDS), Backward Digit Span (BDS), and Size Judgment Span (SJS) tasks, and completed the self-report Short Form-36 (SF-36) and CHAMPS Physical Activity Questionnaire for Older Adults. Sex, education, and race were included as covariates in a regression model in which age, the CHAMPS total energy expenditure score, CVD risk (sum of CVD risk factors), and their interactions predicted the SF-36 Mental Composite score and cognitive test scores.

**Results:** A significant three-way interaction between age, PA, and risk for CVD was observed for the SJS, such that greater self-reported PA was associated with higher SJS scores in those with lower CVD risk compared to those with higher CVD risk, particularly at older ages. Significant interactions were not observed in other measures.

**Conclusions:** The relationship between PA and working memory, as measured by the SJS, in those at low risk for CVD is consistent with previous research showing that PA is beneficial for cognitive function. Contrary to expectation, those with high risk for CVD did not show the greatest benefits of PA on health outcomes. Rather, these findings indicate that active older adults with low health risk are more likely to have better cognitive functioning. Future studies with larger samples and that include an intervention component and objective measures of PA are needed to further clarify moderators of the impact of PA on cognitive and mental health outcomes.

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**Keywords:** cardiovascular disease, mood disorders, cognitive functioning

**T. A. GREGG, E. R. PAITEL, S. A. EVANS, K. A. NIELSON. Compensatory P200 Amplitude in Cognitively Intact APOE  $\epsilon$ 4+ Older Adults on a Semantic Memory Task Discriminating Famous Names.**

**Objective:** Compensatory models of cognitive aging suggest that increased neural activation in healthy, older adults relative to younger adults is evidence of compensation for underlying neural deficits. Studies using fMRI show that neural activation is further elevated in healthy older adult carriers of the Apolipoprotein-E (APOE)  $\epsilon$ 4 allele, a genetic risk for Alzheimer's disease (AD), relative to non-carriers. However, there is very little research on  $\epsilon$ 4 carriers using event-related potentials (ERPs), despite that ERPs have some advantages over fMRI, particularly in terms of temporal specificity and affordability. The few existing studies examined simple sensory and

oddball tasks, reporting no  $\epsilon 4$  amplitude differences. Given that ERP amplitude differences between cognitively intact  $\epsilon 4$  carriers and non-carriers are likely to be subtle, more complex memory and executive functioning tasks might better tap them. The P200 component, while not yet well-understood, reflects higher-order perceptual processing modulated by selective attention and has been implicated in recognition memory. Specifically, P200 may reflect comparison of incoming stimuli with information in memory; larger amplitudes are evoked to item “matches” and smaller amplitude for “non-matches”. We hypothesized that a semantic memory task would elicit greater anterior ERP amplitude in  $\epsilon 4+$  participants than in  $\epsilon 4-$  participants despite comparable task accuracy.

**Participants and Methods:** We examined P200 amplitude at fronto-central electrodes during semantic memory in forty-three, cognitively intact older adults who were either APOE carriers ( $\epsilon 4+$ ;  $n=21$ , 85% female, mean age= $78.20(SD=4.29)$ ) or non-carriers ( $\epsilon 4-$ ;  $n=21$ , 69.6% female, mean age= $79.45(SD=4.35)$ ) using a famous name discrimination task. Participants were shown sixty pseudo-randomly ordered famous names (30 trials) and non-famous names (30 trials) and asked to indicate whether the name was famous or not by button press. Task accuracy and response time were both recorded.

**Results:** Task accuracy was very high overall in both groups ( $\epsilon 4+$   $m=94.83\%$  ( $SD= 3.54$ );  $\epsilon 4-$   $m=92.61\%$  ( $SD= 8.50$ )), but  $\epsilon 4+$  had slower response times than non-carriers ( $\epsilon 4+$   $m=1.47s$  ( $SD=0.26$ );  $\epsilon 4-$   $m=1.33s$  ( $SD= 0.25$ )). Despite comparable task accuracy between groups,  $\epsilon 4+$  had larger P200 amplitudes than  $\epsilon 4-$  at fronto-central electrodes, particularly for non-famous stimuli. This finding indicates there was less distinction between “non-match” v. “match” at the neural level in  $\epsilon 4+$ , due primarily to less effective down-regulation of response to novel stimuli in  $\epsilon 4+$  than in  $\epsilon 4-$ .

**Conclusions:** The results suggest compensatory activation helped enable task accuracy in  $\epsilon 4+$ . Elevated amplitude and slower response time in  $\epsilon 4$  carriers is indicative of early, underlying neural dysfunction that signifies risk of future cognitive decline. These findings highlight the potential value of ERPs for revealing AD risk prior to symptom onset, when prevention or intervention might be effective. Future research is therefore urgently needed to better evaluate this utility and to determine whether ERPs can detect and characterize subtle APOE-  $\epsilon 4$ -related compensatory trajectories that portend cognitive decline.

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**Keywords:** event-related potentials, apolipoprotein E, semantic processing

## **R. DIVERS, A. ROBINSON, L. MILLER, A. DEVITO, E. PUGH, M. CALAMIA. The Role of Anxiety Sensitivity, Dementia Worry, and Health Anxiety on Everyday Function in Older Adults.**

**Objective:** Subtle changes in everyday function can be observed in cognitively normal older adults. Further, these changes have been associated with future functional decline and conversion to mild cognitive decline and dementia. Given this, identifying modifiable risk-factors associated with this decline remains a high priority. While general measures of anxiety have been associated with functional decline in older adults, less is known about the relationship of specific dimensions of anxiety (e.g., dementia worry, health anxiety) and anxiety sensitivity (e.g., concerns that cognitive difficulties are a signal of illness) to subjective everyday functioning. The goal of this study was to examine whether specific dimensions of anxiety and anxiety

sensitivity are associated with subjective functioning above and beyond general measures of anxiety and depression.

**Participants and Methods:** Participants ( $N = 429$ ) who were at least 60 years old were recruited via Qualtrics panels ( $M$  age = 67.7). Everyday function was via the 39-item self-report Everyday Cognition scales (ECog). ECog total scores and subscale scores served as the outcomes of the models. These variables were regressed onto participant demographic characteristics (age, education, race, gender) and general symptoms of anxiety and depression (Geriatric Anxiety Scale, Geriatric Depression Scale, Penn State Worry Questionnaire) in the first block of a hierarchical regression with variables of interest (i.e., Anxiety Sensitivity Index-3 Cognitive Concerns Subscale [ASI-3 Cog], Dementia Worry Scale [DWS], Health Anxiety Inventory [HAI]) examined in the second block.

**Results:** The overall model accounted for a significant portion of the variance in ECog total score,  $F(10, 231) = 11.95$ ,  $p < .000$ , with an  $R^2$  of .312 and an  $R^2$  change of .103. Of our variables of interest, ASI-3 Cog was related to worse everyday functioning ( $p < .000$ ,  $\beta = .319$ ), while DWS ( $p = .35$ ,  $\beta = .07$ ) and HAI ( $p = .92$ ,  $\beta = -.01$ ) were not significant. For ECog subscales, all overall models accounted for a significant portion of the variance ( $p < .05$ ). ASI-3 Cog was related to worse everyday function in all subscale models ( $p < .05$ ). DWS was related to worse everyday function for the language, visual, and planning subscale models ( $p < .05$ ). HAI was not significant ( $p > .05$ ).

**Conclusions:** Cognitive aspects of anxiety sensitivity were consistently associated with everyday function beyond general symptoms of depression and anxiety in older adults. Dementia worry was inconsistently associated everyday function in older adults while health anxiety was not associated with everyday function in older adults. Psychological interventions and psychoeducation related to dementia may help to decrease the cognitive aspects of anxiety sensitivity and worry about dementia respectively in older adults, which may protect against functional decline

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**Keywords:** everyday functioning, aging (normal)

**J. USSUI ANZAI, C. PLUIM, J. E. MARTINEZ, D. MUNERA, A. GARZA-NAVEDA, C. VILA-CASTELAR, E. GUZMÁN-VÉLEZ, L. RAMIREZ-GOMEZ, V. L. TORRES, Y. QUIROZ. Associations Between Purpose in Life and Subjective Cognitive Decline in Ethnically Diverse Older Adults.**

**Objective:** Subjective cognitive decline (SCD), the self-reported experience of worsening memory, is associated with an increased risk of developing Alzheimer's disease (AD) dementia later in life and may serve as an early marker that precedes Mild Cognitive Impairment (MCI). Conversely, greater purpose in life (i.e., life satisfaction and a sense of meaning and purpose; PiL) has been suggested to be a potential protective factor against cognitive decline in older adults. However, the relationship between PiL and SCD is not well understood, and research with ethnically diverse populations is lacking. Here, we investigated the relationship between PiL and SCD in older Latinos and non-Latino Whites. We hypothesized that higher scores in PiL would be negatively associated with SCD.

**Participants and Methods:** A total of 618 participants (119 Latino, 499 non-Latino Whites; age 55-91) residing in the United States completed an online survey that included the Life Purpose Questionnaire and the Everyday Cognition Scale (ECog), which measures cognitive concerns in

memory, language, executive function, and divided attention. Independent samples T-tests and Chi-Square tests were used to assess group differences of SCD, PiL, and demographics (i.e., age, sex, and education). Multiple regressions were conducted to assess the relationships between ethnicity and PiL with SCD while controlling for demographic factors. We conducted a hierarchical regression with demographics (age, sex, education) as covariates entered in step 1 and predictors of interest (PiL, SCD, and PiL-SCD interaction term) in step 2, with ECog overall score entered as the criterion variable.

**Results:** Non-Latino Whites were older than Latinos (non-Latinos: mean age = 67.56, SD = 7.6 years; Latinos: mean age = 64.29, SD = 7.2 years;  $p < .001$ ). There were no group differences in education (non-Latinos: 15.17 +/- 5.33 years; Latinos: 14.76 +/- 5.33 years;  $p = .452$ ). There were more females in the Latino group (83%), compared to the non-Latinos (73%;  $\chi^2(1,617) = 5.36$ ,  $p = .021$ ). Groups did not differ in PiL (non-Latinos: 37.16 +/- 7.6; Latinos: 37.8 +/- 8.0;  $p = .419$ ), or ECog scores (non-Latinos 9.52 +/- 3.43; Latinos: 9.13 +/- 3.87;  $p = .262$ ). Regression results showed that higher PiL scores predict lower SCD in the overall sample ( $p < .001$ ), and in both groups separately (non-Latinos  $p < .001$ , Latinos  $p = .013$ ). Further, there was a significant interaction between PiL and ethnicity ( $b = .428$ ,  $p = .018$ ), which demonstrated that the association between PiL and SCD was stronger in non-Latino Whites.

**Conclusions:** Current results suggest that PiL and SCD are associated in ethnically diverse older individuals, and that PiL may play an important role in an individual's perception of cognitive decline. Although PiL scores were comparable in non-Latino Whites and Latinos, the association between PiL and SCD was stronger in non-Latino Whites, which suggests that PiL may be a better predictor of SCD in non-Latino Whites than in Latinos. Future research should examine these associations in larger and more ethnically diverse samples, including longitudinal follow up and objective cognitive measures.

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**Keywords:** memory complaints, ethnicity, self-report

**J. H. OWENS, M. MARSISKE, R. JONES. The effects of occupational complexity on late life cognition in ACTIVE: Examining the mediating and moderating effects of race.**

**Objective:** Cognitively demanding occupations are associated with better late life cognition; substantive complexity (engagement with people/data) is the most frequently observed covariate. Obstacles encountered by African American workers mean that racial disparities in occupational complexity may explain some of the apparent late life race cognitive differences. This paper evaluated three models: Model 1 examined the relationship between occupational complexity and five cognitive domains; Model 2 examined whether African American status moderated these relationships; Model 3 examined whether some of the apparent Black-White cognitive differences might be mediated by occupational complexity.

**Participants and Methods:** Participants were 2,371 ACTIVE (Advanced Cognitive Training for Independent and Vital Elderly) study volunteers who provided occupational information (mean age = 74 years; mean education = 14 years; 77% female, 25% African American). Occupations were coded using the Dictionary of Occupational Titles (DOT), and grouped into six factors of occupational complexity: substantive complexity, fine motor skills, physical demand, visual attention, color vision, and handling/reaching. A broad battery of cognitive outcomes included composite scores representing reasoning, useful field of view (UFOV), memory, digit symbol, and vocabulary. Covariates of age, sex, and years of education were included in all models.

**Results:** Whites evinced higher cognitive performance in all five cognitive domains examined. African Americans reported having occupations that were higher in *physical demand, visual attention, and handling/reaching* and lower in *substantive complexity* and *fine motor skills*. Pearson correlations showed that education was significantly ( $p < .05$ ) positively correlated with substantive complexity ( $r = 0.63$ ), visual attention ( $r = 0.05$ ), and color vision (0.04), and negatively correlated with fine motor skills ( $r = -0.11$ ), physical demands ( $r = -.32$ ), and handling/reaching ( $r = -0.43$ ).

**Model 1:** Two occupational dimensions were positively associated with cognition: *substantive complexity* with reasoning, memory, digit symbol, and vocabulary; *fine motor skills* with reasoning and vocabulary. Two dimensions were negatively associated with cognition, *physical demand* with reasoning and digit symbol; and *color vision* with reasoning, UFOV, memory, digit symbol, and vocabulary.

**Model 2:** In general, race did not moderate relationships, except for vocabulary, where fine motor skills and handling/reaching showed weaker relationships for Black than for White participants.

**Model 3:** Black-White differences in cognition were at least partially explained by three dimensions of occupational complexity. There were significant indirect effects of race through at least one of *substantive complexity, physical demands, and fine motor skills* for all cognitive domains except *UFOV*.

**Conclusions:** Multiple dimensions of occupational complexity are related to cognition, but we found few race differences in these associations. Race differences in several dimensions of occupational complexity do appear to explain at least some of the apparent race differences in older adults' cognition. Future work must also examine whether occupations also explains education effects on late life cognition. Thus, policy and social justice initiatives aimed at achieving higher levels of racial equity in occupational attainment may help to reduce some of the apparent race disparities in late life cognition.

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**Keywords:** minority issues, cognitive reserve

### A. KNIGHT, C. C. MCMANUS, C. X. GUAN, J. YUAN, R. AU. Cognitive Function is Associated with Activities of Daily Living in Older Adults.

**Objective:** It is often presumed that cognition and activities of daily living represent separate behavioral symptoms of neurodegenerative disorders, including Alzheimer's disease. We contend that function is dependent on cognition and hypothesize there will be a significant association between performance on neuropsychological tests, particularly for measures of executive function, and activities of daily living.

**Participants and Methods:** Participants of the Framingham Heart Study Offspring cohort who were administered both a neuropsychological test protocol and a self-reported questionnaire on activities of daily living comprised the study sample. ( $N = 1828$ ). The mean age (SD) of the participants was 60.67 (9.241) years, of which 54.99% were females. 63.4% of participants achieved an education of some college or higher. All participants with a history of stroke were excluded from the analyses. Cognitive performance was assessed by tests of verbal memory (Logical Memory - Immediate and Delayed Recall), visual memory (Visual Reproductions - Immediate and Delayed Recall), visuospatial function (Hooper Visual Organization Test), abstract reasoning (Similarities), attention and executive functions (Trailmaking A and B). The

test scores were log-transformed to meet normal distribution if needed. A modified version of the Katz Activities of Daily Living (ADL) self-report questionnaire, was used to evaluate the level of dependence required to perform activities of daily living. Subjects were also divided into two groups: those reporting full functionality (ADL-full; N=1621) and those reporting one or more functional impairments (ADL-impaired; N=207). The difference in cognitive performance between the two groups was examined by ANCOVA analysis, with Bonferroni correction, for multiple comparison (with adjusted significance level = 0.0063). This analysis was also adjusted for age, education, sex, body mass index (BMI).

**Results:** After adjusting for age, education, sex, and BMI, the completion time of Trails A (F=9.62, p=0.0021) and Trails B (F=11.65, p=0.00071) was significantly longer in the ADL-impaired group. No significant difference was found in other cognitive test scores between the two groups.

**Conclusions:** Taken together, these results suggest that ADL performance is linked to cognitive tests primarily measuring attention and executive function, but does not inform the directionality of the relationship. Future research requires longitudinal follow-up to determine whether poor cognitive performance is predictive of incident ADL decline or vice versa. Further, one significant limitation of most studies of ADL is the use of self-reported questionnaires. Objective measures of ADL, such as from wearable or smart-home devices, would offset the bias of self report.

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**Keywords:** activities of daily living, neuropsychological assessment, executive functions

**A. L. CLARK, A. J. WEIGAND, K. R. THOMAS, S. SOLDERS, L. DELANO-WOOD, M. W. BONDI, R. A. BERNIER, E. E. SUNDERMANN, S. J. BANKS, K. J. BANGEN. Elevated Inflammatory Markers and Arterial Stiffening Exacerbate Tau but not Amyloid Pathology in Older Adults with MCI.**

**Objective:** Vascular dysfunction has been identified as an early marker and propagator of Alzheimer's disease (AD)-related pathology in older adults. Age-related cerebrovascular and neuroinflammatory processes have been independently identified as key mechanisms, although the interactive effects of these factors on pathological tau and amyloid accumulation have yet to be fully examined. Therefore, we sought to characterize the influence of arterial stiffening and markers of inflammation on proteins underlying neurodegeneration in older adults with and without mild cognitive impairment.

**Methods:** This study included 218 Alzheimer's Disease Neuroimaging Initiative (82 Cognitively Normal [CN], 136 Mild Cognitive Impairment [MCI]) participants who underwent lumbar puncture to obtain cerebrospinal fluid (CSF), as well as apolipoprotein E (APOE) genotyping, and cognitive testing. Pulse pressure ([PP]systolic – diastolic blood pressure) was used as an index of arterial stiffening. CSF levels of eight pro-inflammatory markers (IL-7, IL-6, IL-9, IP-10, TNFR1, TNF $\alpha$ , ICAM1, VCAM1) were quantified using multiplex immunoassays and a principal component analysis was used to create a composite measure of inflammation. CSF levels of amyloid beta 1-42 (A $\beta$ <sub>42</sub>), phosphorylated tau (p-tau), and total tau (t-tau) were quantified using Elecsys immunoassays. Demographically-adjusted scores on measures of language, memory, and executive functioning were used to assess cognitive functioning and MCI status. Multiple regression analyses controlling for for age, education, and APOE e4 genotype

were employed to examine inflammation x PP interactions on AD CSF biomarkers, as well as AD biomarker and cognitive associations within each group.

**Results:** Regressions revealed significant inflammation x PP interactions for p-tau ( $B = .84, p = .02$ ) and t-tau ( $B = .88, p = .01$ ), but not amyloid ( $B = .02, p = .95$ ) within the MCI group. Simple main effects revealed that inflammation was associated with higher levels of tau, and this association was strongest in those with higher (p-tau:  $r = .54, p < .001$ ; t-tau:  $r = .58, p < .001$ ), as opposed to lower (p-tau:  $r = .25, p = .05$ ; t-tau:  $r = .33, p = .007$ ), levels of PP. Parallel analyses within the CN group revealed a significant inflammation x PP interaction for amyloid ( $Bs = -1.0, p = .02$ ), but not p-tau or t-tau ( $Bs: .16 - .25, ps > .51$ ). Simple main effects revealed that inflammation was associated with higher levels of amyloid in those with lower ( $r = .37; p = .02$ ), but not higher ( $r = -.003; p = .98$ ) PP. Finally, higher levels of tau were associated with poorer memory performance within the MCI group only ( $ps < .05$ ).

**Conclusions:** PP and inflammation exert differential effects on AD CSF proteins in older adults that are CN relative to those with MCI. The combined effect of inflammation and PP exacerbate tau, but not amyloid, pathology in older adults with MCI. However, inflammation is associated with successful clearance of amyloid in CN older adults with lower levels of vascular risk. Results suggest that inflammation and vascular risk factors are potentially modifiable points of prevention and intervention underlying blood-brain barrier dysfunction, neurodegeneration, and cognitive decline in older adults at risk for AD.

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**Keywords:** aging disorders, cerebrovascular disease, immune disorders

**K. MULHAUSER, B. GIORDANI, C. PERSAD, B. M. HAMPSTEAD, S. SHAIR, V. KAVCIC, L. MAY, A. BHAUMIK, H. PAULSON, J. HEIDEBRINK, K. VOTRUBA.**  
**Using CogState to Differentiate Normal Aging, Mild Cognitive Impairment, and Dementia.**

**Objective:** Rapid computer-based cognitive screening is essential for efficient large-scale identification of individuals at risk for mild cognitive impairment (MCI) and dementia. The CogState Brief Battery (CBB) is one such program that has the potential to assist in screening for cognitive deficits associated with MCI and dementia. The current study evaluated the ability of the CBB to differentiate and classify participants when compared to independent diagnoses made through comprehensive clinical assessment and committee consensus through the Michigan Alzheimer's Disease Research Center.

**Participants and Methods:** Participants included 360 older volunteers (ages 52-90, 62% female) who completed the CBB and a comprehensive neuropsychological assessment. CBB subtests measuring processing speed (Detection, DET), visual attention (Identification, IDN), learning (One Card Learning, OCL), and working memory (One Back, ONB) were age- and education-adjusted in all analyses. Analysis of variance (ANOVA) was used to evaluate group differences and logistic regression was used to classify participants based on test performance. Participants were diagnosed by consensus committee as having normal cognitive functioning ( $n=165$ ), MCI ( $n=102$ ), and dementia ( $n=93$ ).

**Results:** Performance scores for CBB subtests were significantly different across consensus diagnosis groups ( $p < .001$ ) for IDN, OCL, and ONB, but not DET. Performance on OCL and ONB subtests provided the best discrimination between groups. Overall, classification accuracy, specificity, and sensitivity were all acceptable ( $\geq 0.70$ ), with classification of normal cognitive functioning and dementia being stronger than MCI.

**Conclusions:** These findings emphasize the effectiveness of CBB subscales, especially OCL and ONB, in discriminating among diagnostic groups and may offer a rapid and efficient screening tool for cognitive decline. However, classification of MCI was weakest and remains an important area for further evaluation and research. Different regression models for diagnostic classification are discussed.

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**Keywords:** computerized neuropsychological testing

**R. PATEL, Y. GU, Z. ZHENG, N. SCHUPF, S. M. BARRAL RODRIGUEZ, M. FEITOSA, S. L. ANDERSEN, P. SEBASTIANI, S. UKRAINTSEVA, K. CHRISTENSEN, J. ZMUDA, B. THYAGARAJAN, S. COSENTINO. Inflammatory Biomarkers in Long Lived Families with Exceptional Cognition.**

**Objective:** Studies of centenarians and long-lived persons have found substantial familial aggregation of healthy aging phenotypes. Recent work in the Long Life Family Study (LLFS), a family-based, multicenter, international (USA-Denmark) study assessing the genetics and familial components of healthy aging, suggested that long-lived families demonstrate exceptionality in specific non-overlapping phenotypes, such as cognition, blood pressure, and grip strength, among others. The biological mechanisms by which long-lived families attain exceptional cognition (EC) are not known. Both neuroinflammation and peripheral systemic inflammation have been associated with cognitive functioning and decline, dementia, and lower regional brain volume. More specifically, higher levels of peripheral inflammation are associated with worse executive function, spatial reasoning, and memory. The aim of the present study is to assess whether long-lived families with EC have lower baseline levels of inflammatory biomarkers, and are more stable in such levels over time, than families without EC (non-EC).

**Participants and Methods:** Whole blood samples from N=4,469 (EC = 567 + non-EC = 3902) LLFS study participants were collected to measure inflammatory biomarkers at two visits approximately 7.7 years apart, including: adiponectin, white blood cell subtype (granulocytes, lymphocytes, monocytes) and total count, and platelet count. High sensitivity C-reactive protein and interleukin-6 were only available at baseline. LLFS families were classified as EC (567 individuals from 28 families) or non-EC (3,902 individuals from 411 families) on the basis of a composite z-score representing immediate and delayed story memory. The threshold for EC was defined in the offspring generation of the LLFS cohort (mean age = 61±8.38), as performance  $\geq +1.5$  standard deviations from the age, sex, and education adjusted mean scores in the normative cohort of non-demented LLFS offspring. Families were then defined as having EC if  $\geq 2$  offspring in the family performed above this threshold. Generalized linear models (GEEs) examined cross-sectional differences in inflammatory biomarkers at baseline. In a sub-sample of LLFS participants with repeated biomarker measures (378 subjects from EC families and 2,222 subjects from non-EC families), GEEs examined differences in rate of biomarker change. GEE analyses were adjusted for family size, relatedness, age, sex, and education.

**Results:** EC families had significantly higher monocyte count at baseline compared to non-EC families ( $p = 0.001$ ). Descriptive analyses showed an increase in all biomarker profiles in both groups over time, except for lymphocyte and platelet counts, which decreased over time in both groups, consistent with normal patterns of inflammation change in aging. EC families had slower rates of decline than non-EC families in platelet count ( $p = 0.018$ ).

**Conclusions:** Monocytes are responsible for phagocytosis and production of cytokines, while platelets are involved in homeostasis. Compared with non-EC families, EC families had significantly higher monocyte count (potentially indicating active innate immune response) at baseline, and slower decline in platelet count over time. This pattern of results suggests that differences in inflammatory markers may be a pathway through which EC emerges in some long-lived families.

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**Keywords:** cognitive functioning, cognitive neuroscience

## **B. DUDA, A. ROCHETTE, L. SWEET. Frontoparietal Coherence Mediates Cerebrovascular Risk and Executive Functioning in Older Adults.**

**Objective:** Cerebral small vessel disease (CSVD) affects 70% of community dwelling older adults and is a leading cause cognitive decline and dementia. CSVD is understood by relatively cerebrovascular risk factors and changes in executive functioning. However, less well understood is the cumulative effect of cerebrovascular risk factors on cognitive and functional connectivity brain changes. The current study sought to confirm the relation between cerebrovascular risk and executive functioning performance, and examine mean frontoparietal network (FPN) coherence as a mediator of this relation, due to its role in executive functioning, sensitive to CSVD, and the “flexible hub” theory; the latter posits that the FPN that is highly flexible and engaged by a wide variety of tasks.

**Participants and Methods:** 45 community dwelling older adults were recruited from the community and cardiology clinics. Participants completed a neuropsychological battery, cardiology assessment, and one-hour MRI. Exclusion criteria included low global cognition (>1.5 SDs below the sample on the MMSE), MRI contraindications, neurological or psychiatric diagnoses. CHA<sub>2</sub>DS<sub>2</sub>-VASc index was used to quantify cumulative cerebrovascular risk. The Paced Auditory Serial Addition Test (PASAT) raw score served as a measure of executive functioning.

Whole-brain echoplanar fMRI was conducted using a Siemen’s 3T scanner. Resting state processing and analyses were performed with CONN v1.2 using four bilateral regions of interest (ROI) to characterize the FPN: left prefrontal (-43, 33, 28), left posterior parietal (-46, -58, 49), right prefrontal (41, 38, 30), and right posterior parietal (52, -52, 45) cortices. Each ROI served as a seed and target region and results were thresholded using false discovery rate corrected p-values by height and extent. Multiple linear regression and mediation analyses were performed using the PROCESS macro for SPSS.

**Results: Mean age of the sample was 66.0 (SD ± 9.50).** Bivariate correlation analyses revealed a significant relation between CHA<sub>2</sub>DS<sub>2</sub>-VASc and PASAT ( $r = -.32, p = .03$ ), but not between CHA<sub>2</sub>DS<sub>2</sub>-VASc and mean FPN coherence ( $r = -.06, p = .72$ ). Group-level connectivity analyses revealed a significant contribution of each ROI to the network, with the strongest relation between left and right parietal cortices ( $t=11.25, p < .01$ ) and the weakest between left prefrontal and right parietal cortices ( $t= 3.95, p < .01$ ). Since mean FPN coherence did not correlate with CHA<sub>2</sub>DS<sub>2</sub>-VASc nor PASAT, the proposed mediation analysis was not conducted; however, a post-hoc analysis revealed an indirect effect of FPN coherence ( $R^2 = .10, t = -2.19, p = .03$ ) on the relation between left prefrontal and right posterior parietal cortices ( $B = -.64, \text{Boot SE} = .41, 95\% \text{ CI } [-1.69, -.10]$ ).

**Conclusions:** Results confirmed our previous finding of a significant and inverse relation between cerebrovascular risk and executive functioning. In addition, the indirect effect of the left prefrontal and right parietal hubs on suggest that large-scale FPN coherence may be a particularly important neurobiological mechanism through which CSVD risk factors influence executive functioning in older adults. Future research would benefit from using a more ethnically diverse sample, multiple cognitive outcome measures, and comprehensive modeling (e.g. path analysis).

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**Keywords:** brain function, aging (normal), cerebrovascular disease

**R. P. FELLOWS, M. SCHMITTER-EDGEcombe. Cognitive and Functional Correlates of Symptom Profiles in Midlife and Older Adults.**

**Objective:** Heterogeneity in cognitive performance among midlife and older adults is multifactorial and likely influenced by psychosocial and health-related symptoms that are increasingly prevalent with advancing age. Pain, sleep problems, fatigue, depressed mood, and social isolation are common among older adults in the United States. To increase understanding of the etiology of cognitive and functional changes in later life, it is necessary to examine the complex constellation of symptomatology common in aging populations.

**Participants and Methods:** Participants were 171 community-living mid-life and older adults aged 51 to 83 years old ( $M = 67.7$ ,  $SD = 7.7$ ). Pain interference, fatigue, sleep disturbance, perceived social isolation, and depression were assessed with Patient-Reported Outcomes Measurement Information System (PROMIS) questionnaires and submitted to a cluster analysis. Functional abilities were assessed with self-and informant report questionnaires as well as a performance-based medication management task. Neuropsychological tests were administered to assess working memory, executive functioning, language, and verbal memory.

**Results:** The three groups that emerged from the cluster analysis did not significantly differ in age, sex or level of education. Mean symptom domain scores across groups were within the normal range. The group characterized by higher levels of pain, fatigue, depression, and social isolation performed significantly worse on working memory and executive functioning composite scores, but not language or verbal memory. The group with higher self-reported symptoms also performed worse on a medication management task, and both participants and their informants reported greater everyday executive dysfunction and memory difficulties. In the whole sample, pain interference and depressive symptoms were consistently associated with poorer self- and informant rated everyday functioning, but not cognition.

**Conclusions:** Quantifying commonly experienced symptoms in both research and clinical practice will be useful for delineating associations between health-related symptoms and cognitive and functional abilities.

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**Keywords:** everyday functioning, chronic pain, medical disorders/illness

**L. MILLER, R. DIVERS, M. CALAMIA. Understanding Predictors of Everyday Functional Ability in Older Adults: A Bidimensional Mental Health Approach.**

**Objective:** As the number of adults aged 65 years or older is estimated to rise to 20% of the U.S. population by 2030, it is anticipated that a higher proportion of individuals will be in need of

services to mitigate everyday issues associated with dementia. As neuropsychologists prepare to meet this challenge, a comprehensive understanding of the factors contributing to – and preventing – functional impairment is imperative. Despite promising evidence for positive mental health factors to promote important rehabilitation outcomes (i.e. healthy functioning, quality of life, longevity), neuropsychological research continues to focus disproportionately on psychopathology (e.g., depression and anxiety) in relation to disability. The current study explored the predictive value of positive mental health factors on everyday functioning.

**Participants and Methods:** The 385 older adults aged 60 to 94 included in the present survey study responded to a series of surveys via Qualtrics. Changes in the ability to perform cognitively mediated functional tasks (e.g., shopping, keeping a schedule) compared to 10 years ago was measured via the Everyday Cognition (ECOG) questionnaire. Psychological factors were measured including resilience [Washington Resilience Scale (UWRS) 8-item short form], wellness (e.g. positive perceptions of one's standing in psychological, physical, spiritual, and more aspects of life) [Perceived Wellness Survey (PWS)], life satisfaction [Satisfaction With Life Scale (SWLS)], depression [Geriatric Depression Scale (GDS)], and anxiety [Geriatric Anxiety Scale (GAS)]. A positive mental health composite score was calculated from the PWS, SWLS, and UWRS, and a negative mental health composite score was calculated from the GAS and GDS. Pearson correlations were used to examine the relationships among positive mental health, negative mental health, and functioning. Multiple linear regression was used to assess whether positive mental health had a unique association with everyday functioning.

**Results:** Positive and negative mental health were negatively correlated with one another ( $r = -0.68$ ,  $p < .01$ ). Positive mental health was associated with fewer perceived negative changes in functioning ( $r = -0.14$  to  $r = -0.35$ ,  $p < .05$ ) while negative mental health was associated with more perceived negative changes in functioning ( $r = 0.38$  to  $r = 0.57$ ,  $p < .05$ ). In multiple regression models also including age and gender as predictors, both negative mental health ( $\beta = .50$ ,  $t(274) = 7.08$ ,  $p < .01$ ) and positive mental health were significant predictors of overall changes in everyday functioning ( $F(4, 275) = 43.30$ ,  $p < .01$ ). However, in contrast to the bivariate association, the unique variance associated with positive mental health was associated with worse changes in functioning. This was also true for the specific subscales of visual spatial and perceptual abilities, organization, and planning (all  $p < .05$ ).

**Conclusions:** Evidence from this study suggests measuring positive mental health factors may be important for identifying those at-risk of – or resistant to – declines in everyday functioning. Further research is needed to explore the suppression effect that emerged when examining both positive and negative mental health together in the same model. Future research should also continue to examine the incremental validity of positive factors in predicting neuropsychological

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**Keywords:** aging (normal), everyday functioning, geriatric depression

### **C. HAYS, Z. Z. ZLATAR, M. MELOY, C. WIERENGA. Cerebral Metabolic Rate of Oxygen Consumption During Object Naming is Associated with Worse Language Performance Among APOE $\epsilon$ 4 Carriers.**

**Objective:** The  $\epsilon$ 4 allele of the apolipoprotein E (APOE) gene confers increased risk for Alzheimer's disease (AD) but the mechanistic link between the  $\epsilon$ 4 allele and AD remains poorly understood. Elucidating early APOE  $\epsilon$ 4-related alterations in neural function could improve mechanistic understanding of its role in AD. Evidence suggests that blood oxygenation level

dependent (BOLD) fMRI response in the fusiform gyrus (FG) during object naming is greater among  $\epsilon 4$  carriers even in the face of equivalent cognitive performance. However, these findings are limited by the use of BOLD fMRI, which is susceptible to age-related vascular changes. To bridge this gap, the present study used calibrated fMRI during an object naming task with hypercapnia to obtain a more direct measure of neural function - cerebral metabolic rate of oxygen consumption (CMRO<sub>2</sub>). We investigated the extent to which APOE genotype modified associations between FG  $\% \Delta$ CMRO<sub>2</sub> during object naming and objective language performance outside the scanner among a sample of older adults without dementia.

**Participants and Methods:** Multiple linear regression models were employed in R to explore the two-way interaction of  $\% \Delta$ CMRO<sub>2</sub> in the left FG and APOE status ( $\epsilon 4$  +/-) on neuropsychological performance outside the scanner (object naming, semantic fluency, lexical fluency) among a sample of 40 older adults (26  $\epsilon 4$ -, 14  $\epsilon 4$ +) between the ages of 65 and 85 (mean=73). All analyses statistically adjusted for the effects of age, sex, education, cognitive status (normal, mild cognitive impairment), and stroke risk. Results were considered significant at  $p < 0.016$  (Bonferroni corrected).

**Results:** The relationship between left FG  $\% \Delta$ CMRO<sub>2</sub> during object naming and lexical fluency performance was negative among APOE  $\epsilon 4$  carriers and positive among non-carriers. Relationships between left FG  $\% \Delta$ CMRO<sub>2</sub> and performance on other language tasks (object naming, semantic fluency) did not differ by APOE status.

**Conclusions:** Results suggest that the relationship between neural activation and cognitive performance is disrupted among APOE  $\epsilon 4$  carriers and implicate altered CMRO<sub>2</sub> response as a potential early biomarker of AD-related neural dysfunction and cognitive decline that is not confounded by vascular dysfunction. More broadly, findings support the use of quantitative fMRI techniques in AD-risk to potentially identify those who would benefit from early intervention strategies or targeted AD-prevention clinical trials.

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**Keywords:** aging disorders, memory disorders, apolipoprotein E

### **J. FINEGAN, C. HAYS, Z. Z. ZLATAR, M. MELOY, J. OSUNA, C. WIERENGA. APOE Modifies the Relationship Between Longitudinal Changes in Subjective and Objective Cognitive Decline.**

**Objective:** Possession of the apolipoprotein E (APOE)  $\epsilon 4$  allele and subjective cognitive decline (SCD), or self-reported cognitive decline despite normal neuropsychological test performance, are both associated with increased risk for objective cognitive decline and Alzheimer's disease (AD). Although available evidence suggests that a relationship between APOE  $\epsilon 4$ , SCD, and AD likely exists, a clearer understanding of these relationships has been hindered by a dearth of longitudinal outcome research. The current study aimed to bridge this gap by examining the extent to which APOE genotype modifies the relationship between longitudinal changes in SCD and memory performance among a sample of older adults who were cognitively normal at baseline.

**Participants and Methods:** 87 cognitively normal older adults (61  $\epsilon 4$ -, 26  $\epsilon 4$ +) between the ages of 65 and 89 (mean age = 73) completed baseline and follow-up assessment of SCD (i.e., Subjective Memory Rating Scale) and objective memory performance (mean time interval between baseline and follow-up = 2.5 years). Linear regression was employed in R to explore the two-way interaction of APOE  $\epsilon 4$  status (+/-) and longitudinal changes in SCD on longitudinal

changes in objective memory performance, statistically adjusting for age, sex, depressive symptoms, and the follow-up time interval.

**Results:** APOE  $\epsilon$ 4 carriers who reported greater SCD over time also demonstrated greater objective memory decline, whereas longitudinal changes in SCD were not associated with memory change among non-carriers. SCD scores did not differ by APOE  $\epsilon$ 4 status at baseline, at follow-up, or with respect to change over time.

**Conclusions:** Results suggest that the relationship between subjective and objective cognitive decline differs by genetic risk for AD. Specifically, longitudinal changes in SCD appear to be predictive of objective cognitive changes among  $\epsilon$ 4 carriers but not among non-carriers. These findings demonstrate the potential prognostic utility of measuring SCD over time in those at genetic risk for AD and generally support the notion of links between APOE  $\epsilon$ 4, SCD, and cognitive decline.

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**Keywords:** aging disorders, memory complaints, apolipoprotein E

**D. POHL, D. SEBLOVA, J. CASEY, E. R. KULICK, J. AVILA-RIEGER, R. P. MAYEUX, J. J. MANLY. The Relationship of Residential Segregation and Memory Across Race/Ethnicity.**

**Objective:** Systemic racism leads to racial/ethnic residential segregation, which in turn can result in health inequalities. However, the associations between residential segregation and cognitive decline in later-life are unclear. We aimed to examine: 1) the cross-sectional association between racial/ethnic residential segregation and later-life memory; 2) if the association differed based on a measure of segregation, and 3) how the associations differed across individual-level race/ethnicity.

**Participants and Methods:** We analyzed responses of 4616 participants in the Washington Heights-Inwood Columbia Aging Project (mean age: 75.7 years) who completed at least one baseline visit, representing 2064 Hispanics, 1406 non-Hispanic Blacks and 1146 non-Hispanic Whites. Racial/ethnic residential segregation was measured at the block group-level using three indices (dissimilarity, isolation, and interaction) derived from the American Community Survey. Each block group was categorized as low vs. high segregation for each index. Scores on immediate recall, delayed recall, and delayed recognition from the Selective Reminding Test were used to create a memory composite z-score. We used multivariate linear regression models with standard errors clustered at the block group-level to measure the association of each segregation index and later-life memory adjusting for age, sex/gender, race/ethnicity, childhood socioeconomic position, education, occupation, language of test administration, birthplace, and recruitment cohort. We included an individual-level race/ethnicity  $\times$  segregation term to test for differential associations.

**Results:** Residence in a block group with a higher proportion of Black people than in all of New York City was associated with lower memory (high isolation  $\beta$  = -0.064; 95% CI: -0.120, -0.007 and high dissimilarity  $\beta$  = -0.050; 95% CI: -0.101, 0.0002). In contrast, living in areas with higher potential contact between Hispanic and non-Hispanic Whites, either due to homogeneous composition or presence of pockets of people of the same background, was positively associated with memory (interaction  $\beta$  = 0.064; 95% CI: 0.020, 0.109). The association of residential segregation and memory varied across race/ethnicity. The negative association of living in predominantly Black areas, measured by high dissimilarity, was apparent only among Black

respondents ( $\beta=-0.237$ ; 95% CI: -0.406, -0.069). Living in highly isolated Black areas was negatively associated with memory among non-Hispanic White and Black respondents (high isolation  $\beta=-0.236$ ; 95% CI: -0.530, 0.058 &  $\beta=-0.069$ ; 95% CI: -0.137, -0.0004, respectively).

**Conclusions:** We observed associations between worse memory and racial/ethnic segregation at the block group-level across multiple measures of segregation, especially for non-Hispanic Blacks. The segregation indices partly capture downstream effects of structural racism, such as unequal distributions of wealth, resources, and opportunity. However, there were indications of positive benefits to later-life memory when living in areas with higher potential contact between non-Hispanic Whites and Hispanics (interaction index). The interaction index highlights the positive value of desegregation for later-life cognitive health.

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**Keywords:** memory disorders, diversity

**S. M. SIMONE, M. B. TASSONI, C. C. PRICE, T. F. FLOYD, T. GIOVANNETTI.**  
**Relations Between Vascular Burden and Cognition in the Context of Demographic Factors in Older Adults with Cardiovascular Disease.**

**Objective:** Cardiovascular risk factors and disease is associated with lower cognitive abilities, particularly executive functioning, as well as cognitive decline, including increased risk for incident mild cognitive impairment (MCI) and dementia. Moreover, cerebrovascular disease independently reduces the threshold of AD-specific pathologic burden that results in cognitive impairment. It remains unclear whether demographic factors (i.e., sex, race, age, and education) moderate the relation between vascular risk/disease and cognition and cognitive decline. Therefore, in an older adult cohort with cardiovascular disease, we examined relations among vascular burden score (VBS) and demographic variables, and cognition at baseline and over time.

**Participants and Methods:** 392 participants (M age=75.07, SD=6.28; 35.6%women; 12%non-White) were recruited for a parent study of post-operative cognitive change following surgical aortic valve replacement (AVR). 193 participants underwent AVR surgery and 199 were medically stable with mild-to-moderate aortic stenosis who had not undergone any surgical cardiac procedure within the past 6 weeks. Cognitive data from baseline and 1-year follow-up measures of executive functioning (Trail-Making Test Part B, TMT-B; Digit Span Backward, DSB, total score), episodic memory (Hopkins Verbal Learning Test – Long Delay Free Recall), and visual memory (Rey Complex Figure Test – Long Delay) were analyzed. VBS was calculated as the sum of an individual's vascular disease and vascular risk factors and ranged from 0 to 7 (e.g., the sum of hypertension, diabetes, hyperlipidemia, coronary artery disease, cerebrovascular disease, bleeding disorders, and peripheral vascular disease).

**Results:** Independent samples t-tests showed a significant difference in VBS for women (M=3.49, SD=1.22) compared to men (M=3.15, SD=1.13),  $t(386)$ ,  $p=.006$ , but no significant difference in VBS between Whites (M=3.23, SD=1.13) and non-Whites (M=3.57, SD=1.38),  $t(54.77)$ ,  $p=.106$ . Pearson correlations demonstrated that greater VBS was significantly associated with lower levels of education ( $r=-.16$ ,  $p=.002$ ) and older age ( $r=.10$ ,  $p=.042$ ). Pearson correlations between VBS and cognition at baseline demonstrated that VBS was significantly associated with visual memory ( $r=-.12$ ,  $p=.025$ ) and executive functioning (TMT-B time  $r=.135$ ,  $p=.010$ ; DSB total score  $r=-.14$ ,  $p=.008$ ), but not episodic memory ( $r=-.02$ ,  $p=.70$ ). The relation between VBS and baseline DSB was stronger in Whites vs. non-Whites, but there was no

evidence for interaction effects between VBS and sex, age or education on baseline cognition. Linear regressions showed no relation between VBS and change in cognition at the 1-year follow-up.

**Conclusions:** Consistent with past research, women had greater VBS compared to men, and VBS was significantly associated with age and education. VBS was modestly associated with baseline measures of executive functioning and visual episodic memory but not baseline verbal episodic memory or change in any cognitive score over the 1-year follow-up period. The baseline effect of VBS on cognition was particularly strong in White participants relative to non-White participants; otherwise demographic variables did not moderate the effect of vascular risk and disease on cognition in older adults with cardiovascular disease.

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**Keywords:** cognitive functioning, cardiovascular disease, aging disorders

**M. J. FERRARA, S. ARNOLD, M. LIVNEY, S. NEGASH, D. MECHANIC-HAMILTON.**  
**Frequency of Self-Report of Traumatic Childhood Experiences and Impact on Cognition and Mood in Older Adults.**

**Objective:** This study aims to investigate the prevalence of self-reported early childhood trauma and the relationship between these traumatic experiences and cognitive aging, subjective cognitive impairment, anxiety and depression.

**Participants & Methods:** Participants included 128 community-dwelling older adults (64% female; age=76.2±7.1, years of education=15.5±2.7; 74% Caucasian) with normal cognition who were enrolled in the Penn Resilience Study. Participants completed the Childhood Trauma Questionnaire (CTQ), Depression Anxiety and Stress Scale (DASS), Prospective and Retrospective Memory Questionnaire (PRMQ), and the Geriatric Depression Scale (GDS). The CTQ includes measures of physical, emotional and sexual abuse and neglect. A CTQ denial score was calculated to determine the rate of response bias reflecting underreporting of traumatic experiences. Cognitive evaluation included the MOCA and the CogState Battery, including the Detection, Identification, Two-Back, Groton Maze Learning (GML), International Shopping List Recall (ISLR), and the Social Emotional Cognition (SEC) tasks.

**Results:** Of 128 participants, 26% reported emotional abuse, 14% reported physical abuse, 16% reported sexual abuse, 39% reported emotional neglect, and 24% reported physical neglect. A denial score was seen in 40% of CTQ respondents. There were significant differences in DASS depression ratings for individuals who endorsed emotional abuse [ $t(43) = -2.34, p=.02$ ] and emotional neglect [ $t(79) = -2.6, p=.01$ ] compared to those who did not. One-Way ANCOVAs showed significant relationships between physical neglect and worse performance on the Two-Back [ $F(1,127)=4.49, p=.04$ ], GML [ $F(1,127)=6.01, p=.02$ ], and ISLR [ $F(1,127)=9.95, p=.002$ ] tasks, controlling for age and education.

**Conclusions:** Self-report of emotional abuse and neglect was associated with higher ratings of depression. Self-report of physical neglect showed lower performance on tasks of memory and executive functioning. Additionally, there was a high rate of endorsement on the CTQ denial scale, indicating that the prevalence of childhood trauma may be greater than reported in this group. Future work will include further examination of the relationship between childhood traumatic experiences and the influence on longitudinal cognition and mood outcomes in older adults.

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**Keywords:** childhood maltreatment, aging (normal), neuropsychological assessment

**S. EMRANI, E. MATUSZ, V. WASSERMAN, C. FRENCH, R. SWENSON, R. NAGELE, D. A. NATION, D. LIBON. ICAM-1 Moderates the Relationship Between Visual Episodic Memory and Triglycerides in both Men and Women.**

**Objective:** Cardiovascular disease (CVD) is a major risk factor underlying neurocognitive decline, particularly in domains of memory and executive functions. CVD including diabetes, hypertension, hyperlipidemia and coronary artery disease (CAD) are now well-known contributors to the development or exacerbation of dementia. An ancillary process to these disease risks is endothelial intercellular adhesion molecule-1 (ICAM-1), a protein shown to play a major role in the initiation of inflammatory processes and recruitment of immune cells during atherosclerotic plaques. Recent studies have shown that both visual episodic and working memory may be more sensitive to neurocognitive decline compared to their analog verbal modalities. While ICAM-1 has a bidirectional relationship with lipids, the relationship between lipids and cognition when moderated by ICAM-1 levels is poorly understood. In the current research, we assessed how ICAM-1 potentially moderates the relationship between lipids (plasma triglyceride) and memory. This research was undertaken using participant data from the Framingham Heart Study (FHS), a community-based epidemiological study, to assess how ICAM-1 moderates the relationship between triglycerides and visual episodic memory test conditions (i.e., immediate/delayed free recall; delayed recognition).

**Participants and Methods:** Visual episodic memory was assessed with the Wechsler Memory Scale Visual Reproduction subtest (WMS-VR). Regression-based norms were created to convert WMS-VR raw scores into z-scores and included 465 males and 628 females from FHS Gen 2, exam cycle 7. Regression analyses were employed using SPSS PROCESS, where outcome variables included immediate, delayed, and recognition WMS-VR test conditions, triglycerides as the predictor, and ICAM-1 as the moderating variable. Regression analyses were run separately for males and females.

**Results:** Regression models for males on all WMS-VR test conditions (i.e., immediate free recall, delayed free recall, and delayed recognition) were not statistically significant (immediate free recall,  $R^2 = 1.3$ ,  $p = .12$ ; delayed free recall,  $R^2 = .93$ ,  $p = .23$ ; and recognition,  $R^2 = .84$ ,  $p = .27$ ). However, ICAM-1 by triglycerides interaction was statistically significant for immediate free recall ( $p = .034$ ). Comparatively, all regression models for females on visual reproduction measures were statistically significant (immediate free recall,  $R^2 = 1.7$ ,  $p = .011$ ; delayed free recall,  $R^2 = 1.4$ ,  $p = .04$ ; and recognition  $R^2 = 1.5$ ,  $p = .03$ ). Moreover, triglycerides as a stand-alone predictor was statistically significant for both immediate ( $p = .02$ ) and delayed ( $p = .045$ ) free recall. ICAM-1 alone was also statistically significant for the recognition test condition ( $p = .03$ ). Finally, similar to males, triglycerides by ICAM-1 was statistically significant on immediate free recall ( $p = .02$ ). For both males and females, the negative relationship between visual reproduction and triglycerides was statistically significant at -1sd (males  $p = .02$ ; females  $p = .002$ ), and at the mean ( $p = .02$ ) for women.

**Conclusions:** There may be divergent mechanisms that drive neurocognitive decline between sex. Specifically, ICAM-1 and triglycerides appear to be independent predictors of neurocognitive decline amongst females. Nonetheless, the ICAM-1 by triglycerides interaction

appears to be associated with immediate recall on both sexes; and, thus a potential biological predictor of executive abilities including attention, concentration, and learning.

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**Keywords:** aging disorders, executive functions, cardiovascular disease

**J. E. MAYE, R. VAN PATTEN, T. T. NGUYEN, Z. MAHMOOD, H. KIM, D. JESTE, E. W. TWAMLEY. A Comparison of Cognition and Functional Capacity Between Independently Living Veteran and Non-Veteran Older Adults.**

**Objective:** United States military Veterans aged 65 and older comprise an estimated 43% of the 22 million living Veterans in the United States. Veterans have high rates of physical, psychiatric, and social challenges, but it is not known whether Veteran status confers additional risk for cognitive or functional impairments in later life. Thus, this investigation specifically compared older Veterans with their non-Veteran peers in cognitive functioning and performance-based functional capacity.

**Participants and Methods:** Participants (N=110; 29 Veterans and 80 non-Veterans) were part of a larger longitudinal study on biopsychosocial functioning in independently living older adult residents of a Continuing Care Senior Housing Community. Participants provided demographic and mental health information and were administered a comprehensive neuropsychological battery. Functional capacity was assessed using the UCSD Performance-Based Skills Assessment-Brief (UPSA-B), which uses financial and communication role-plays to assess everyday functioning skills. Neuropsychological scores were appropriately normed prior to analysis. Independent samples t-tests and ANCOVAs were used to examine neuropsychological and functional capacity differences, respectively, between Veterans and non-Veterans.

**Results:** Veterans did not differ from non-Veterans in educational attainment (16.4 years vs. 15.5 years,  $p=.110$ ), but they were significantly older (mean age 86.9 years  $\pm$  5.7, versus 81.74 years  $\pm$  6.53;  $p<.001$ ) and were more likely to be male ( $X^2 [1, N=110]=62.39, p<.001$ ). Thus, though neuropsychological norms already accounted for demographic differences in our participants, age and sex were controlled in the ANCOVA predicting UPSA-B score from Veteran status. Results suggested that, compared to non-Veterans, Veterans had significantly worse performance in verbal memory (Hopkins Verbal Learning Test-Revised, Total Recall;  $t=2.56, p=.012, d=0.57$ ). Veterans and non-Veterans did not significantly differ in performance on a cognitive screening test (Montreal Cognitive Assessment) or on measures of premorbid intellectual functioning (Wide Range Achievement Test-4 Reading), language (Boston Naming Test, Verbal Fluency), visual memory (Brief Visuospatial Memory Test-Revised), attention/working memory (WAIS-IV Digit Span), processing speed (WAIS-IV Digit Symbol Coding), executive function (Delis-Kaplan Executive Function System Trails and Color-Word Test), or functional capacity (UPSA-B). Because our examination of multiple outcomes might have inflated Type I error, we performed a post hoc adjustment of  $p$  values using Benjamini-Hochberg procedures and the group difference in verbal learning remained significant.

**Conclusions:** Veterans performed worse on verbal memory testing than did their non-Veteran peers, suggesting the presence of some degree of cognitive disparity for this unique population. Given that late life is a time of risk for memory decline, future research should consider additional focus on neuropsychological assessment and treatment needs for aging Veterans.

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**Keywords:** cognitive functioning, neuropsychological assessment, memory complaints

**B. F. BEECH, C. M. LUNA, S. FARIAS, M. SCHMITTER-EDGECOMBE. The Influence of Personality on Compensatory Strategy Use in Community Dwelling Older Adults.**

**Objective:** It is well established that the successful use of compensatory strategies enhances the everyday functioning of older adults along the cognitive continuum. However, little attention has been given to factors that relate to individual differences in compensatory strategy use. The present study sought to investigate how personality relates to compensation in the daily lives of older adults, age 50+.

**Participants and Methods:** Ninety-six community-dwelling older adults completed the Patient Reported Outcome Measure Information System (PROMIS) Applied Cognition items, Brief Assessment of Cognitive Symptoms (BACS), Big Five Inventory (BFI) and the Everyday Compensation Questionnaire (Ecomp). The five personality traits (i.e., Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism) from the BFI were used to predict the total score from the Ecomp and each of the six subscales (i.e., appointment management, shopping, cooking, finance management, transportation, and medication management). Demographics were not controlled for due to lack of significant correlations with predictor and outcome measures.

**Results:** Regression analyses revealed neuroticism as the most robust predictor of frequency of overall compensatory strategy use ( $p = .02$ ), followed by openness, which trended toward significance ( $p = .07$ ). With the exception of medication management and finance management, each of the compensatory strategy subscales was consistently best predicted by neuroticism ( $ps < .05$ ). Additionally, severity of symptoms of cognitive decline as measured by the BACS emerged as a significant mediator of the relationship between neuroticism and overall compensatory strategy use ( $ab = .005$ ,  $CI = .0003 - .01$ ).

**Conclusions:** Older adult's use of self-reported compensatory strategy use surrounding many complex tasks of daily living was best predicted by neuroticism in the present study. Future studies should investigate potential relationships between personality and observed compensatory strategy use on real-world tasks. By better understanding factors that may contribute to successful implementation and consistent use of compensatory strategies, intervention plans can be tailored to the individual to maximize skill uptake and subsequently enhance and preserve functional independence.

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**Keywords:** personality, everyday functioning, aging (normal)

**J. SAURMAN, K. L. VICKERS, D. LORING, F. C. GOLDSTEIN. Sensitivity and Specificity of the Montreal Cognitive Assessment - Blind Conversion Score in the Alzheimer's Disease Neuroimaging Initiative.**

**Objective:** Due to the recent COVID-19 pandemic, many clinicians have turned to completing assessments using telehealth platforms. The Montreal Cognitive Assessment Blind Version (MoCA-Blind; Nasreddine et al., 2005; Wittich et al. 2010) is easily adapted for telehealth administration as it does not include visual components (Trails, Cube, Clock, or Picture

Naming). The MoCA-Blind score can be converted to a standard MoCA score to determine whether an individual's performance falls within the normal or impaired range. However, this conversion has not been validated. Thus, the objective of the current study was to examine the sensitivity and specificity of the converted MOCA-Blind score for people who are cognitively impaired.

**Participants and Methods:** Archival data was obtained from 1,132 participants in the Alzheimer's Disease Neuroimaging Initiative (ADNI) database in three diagnostic categories: cognitively normal, mild cognitive impairment (MCI), and Alzheimer's disease (AD). The sample was primarily White (91.7%) and well-educated ( $M_{\text{years}} = 16.25$ ,  $SD=2.56$ ). All participants completed the standard MoCA. MoCA-Blind scores were calculated per standard procedures (i.e., by totaling all non-visual items) and were then translated to converted MOCA-Blind scores using the equation provided by test developers, which is  $(\text{MoCA-Blind Score} \times 30) / 22$ . A score of 18 or above on the MoCA-Blind was considered normal whereas converted MOCA-Blind score of 26 or above was considered normal. Sensitivity and specificity values for identification of cognitive impairment were then obtained.

**Results:** MoCA-Blind scores ranged from 0 to 22 ( $M = 16.18$ ,  $SD = 3.51$ ). Converted MoCA-Blind scores ranged from 0 to 30 ( $M = 22.06$ ,  $SD = 4.79$ ). The sensitivity of the unconverted MoCA-Blind was 68.3% for detecting individuals with MCI and 98% for detecting individuals with AD. Specificity for the MoCA-Blind was 68.8% for both groups. Using the converted MOCA-Blind score resulted in an increase in sensitivity for detecting individuals with MCI and AD (86.1% and 99%, respectively). In contrast, the use of converted MoCA-Blind scores resulted in reduced specificity (41.7%) for both groups.

**Conclusions:** Results of the current study suggest that converted MoCA-Blind scores demonstrate strong sensitivity for identifying individuals experiencing cognitive impairment and thus is a valuable tool for telehealth evaluations. However, clinicians should be aware that specificity is lower, particularly when using the converted scores and therefore additional information should be used to support clinical interpretation.

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**Keywords:** aging disorders, test validity, cognitive functioning

### **T. L. ROBINSON, M. GOGNIAT, K. JEAN, L. MILLER. Cardiovascular Risk Partially Explains Apparent Racial Differences in Executive Performance.**

**Objective:** The aim of this analysis was to understand how differences in cardiovascular risk across racial groups may explain differences in cognitive performance in Black and White older adults.

**Participants and Methods:** The sample included 221 participants (110 Black and 111 White) in the Alzheimer's Disease Neuroimaging Initiative (ADNI) database, matched on age, sex, and cognitive status. Executive functioning performance was measured using the psychometrically validated ADNI-EF composite scores for each participant. Cardiovascular risk was calculated as Framingham Risk Score (FRS) for each participant, using vital signs and medical history data available in ADNI. A simple mediation model was used to evaluate the mediating role of FRS on racial differences in ADNI-EF scores.

**Results:** Results of bivariate correlation analysis showed a negative relationship between FRS and ADNI-EF score ( $r = -.274$ ,  $p < .01$ ). Groups differed significantly on FRS ( $t_{218} = 2.145$ ,  $p < .05$ ) and ADNI-EF scores ( $t_{217} = 3.364$ ,  $p < .01$ ), but not education or age. Results of

the regression analysis showed that racial group membership was a significant predictor of FRS ( $B = -1.480$ ,  $SE = .493$ ,  $p < .01$ ), and FRS was a significant predictor of ADNI-EF ( $B = -.0383$ ,  $SE = .0192$ ,  $p < .05$ ). Approximately 16% of the variance in ADNI-EF was explained by the predictors ( $R^2 = .162$ ). The indirect effect coefficient was significant ( $B = .0566$ ,  $SE = .0331$ , 95%  $CI = .0048, .1338$ ), however, racial group membership remained a significant predictor of ANDI-EF score when controlling for the mediator ( $B = .819$ ,  $SE = .299$ ,  $p < .05$ ), indicating a partial mediating effect.

**Conclusions:** Differences in cognitive performance and cognitive health outcomes were explained, in part, by differences in cardiovascular risk. Results further suggest racial differences seen in cognitive outcomes may be explained by other health disparities which are associated with cognitive health.

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**Keywords:** cognitive functioning, cardiovascular disease, minority issues

**H. CHANG, C. LIU, Y. HSU, Y. YANG, H. WANG, Y. WANG, M. HUA. Obstructive Sleep Apnea, Blood Oxygen Saturation, and Cognitive Functions Among Middle-Aged and Elderly Individuals: A Preliminary Study in Central Taiwan.**

**Objective:** Obstructive sleep apnea (OSA) is a common and underrecognized disorder which has been suggested to predict various adverse outcomes in terms of brain functioning. Previous study suggested OSA is highly underdiagnosed, with estimated prevalence rate range from 2.6% to 97.3% among Asians. Findings regarding the association between OSA and cognitive functions have been less than clear in previous research, a result that may be attributable to severity, duration, comorbidities, and awareness of the disorder among the patients.

**Participants and methods:** This preliminary and cross-sectional study recruited 94 middle-aged and elderly individuals from communities in central Taiwan. Data regarding OSA, vascular risk factors, and cognitive functions were gathered.

**Results:** Among the participants underwent a sleep recording, 50% had suspected OSA. Approximately half of the apneic participants reported witness of the problem by their spouses or awareness of the symptoms. Presence of OSA did not associate with performance on cognitive tasks. However, suboptimal daytime blood oxygen saturation mildly and negatively impacted language abilities and orientation.

**Conclusions:** OSA did prevail among middle-aged and elderly individuals in the community of central Taiwan. Given our prefatory data, the effect of OSA on cognitive functions did not look overt. However, suboptimal daytime blood oxygen saturation appeared to be associated with poor mentally-monitoring abilities. Further longitudinal evaluation of repercussions of OSA on cognition is warrant.

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**Keywords:** sleep disorders

**P. H. MACIVER, B. TURNQUIST, L. KATZEL, S. WALDSTEIN. Interactive Relations of Body Mass Index, Maximal Oxygen Consumption, and Sex on Cognitive Function in Older Adults.**

**Objective:** Examine interactive relations of body mass index (BMI), maximal oxygen consumption (VO<sub>2</sub>max), and sex to cognitive function in community-dwelling middle-aged and older adults.

**Participants and Methods:** Participants were 196 healthy, community-dwelling middle-aged and older adults ( $M = 64.6$  years,  $SD = 12.5$  years, 56% male, 87% white) who had completed an investigation of cardiovascular risk factors, cognitive function, and neuroimaging. Study exclusions included stroke, dementia, neurological disease, cardiovascular disease (except hypertension), other major medical or psychiatric disease, and severe head injury. BMI was computed by dividing measured weight by height ( $\text{kg}/\text{m}^2$ ). Maximal oxygen consumption (VO<sub>2</sub>max) was obtained during a graded exercise treadmill test to voluntary exhaustion using a Bruce or modified Balke protocol. Standard clinical assessment of hypertension and fasting glucose and cholesterol was conducted. Self-report data were collected for age, sex, education, ethnicity, smoking status, alcohol consumption, and depressive symptoms (Beck Depression Inventory). Multivariable regression analysis, adjusted for age, education, ethnicity, alcohol consumption, smoking status, and depressive symptoms examined the interactive relations of BMI, VO<sub>2</sub>max, and sex on the following neurocognitive tests: Logical Memory - immediate and delayed recall (LMI, LMD), Visual Reproductions - immediate and delayed recall, Trail Making Test parts A and B (TMTA, TMTB), Digit Span Forwards and Backwards, Stroop Color-Word interference score (actual Color-Word – Predicted Color-Word score), Grooved Pegboard (GP), and Judgement of Line Orientation. Sensitivity analyses adjusted for hypertension, fasting glucose, and total cholesterol levels.

**Results:** A significant three-way interaction of BMI\*VO<sub>2</sub>max\*Sex was found for Grooved Pegboard dominant ( $B = -.013$ ,  $p = .019$ ) and non-dominant ( $B = -6.245$ ,  $p = .005$ ) hands. For each hand, conditional effects analysis indicated that men with lower VO<sub>2</sub>max demonstrated increased completion time as BMI increased ( $p$ 's  $< .05$ ). A significant two-way interaction of BMI and sex was found for LMD ( $B = -.838$ ,  $p = .012$ ), though conditional effects analyses were not significant ( $p$ 's  $> .05$ ). Significant main effects of BMI on TMTB ( $B = .013$ ,  $p = .025$ ) and Stroop interference ( $B = -.502$ ,  $p = .022$ ) indicated that greater BMI was correlated with longer completion times on TMTB and greater Stroop interference scores. Lastly, a significant main effect for VO<sub>2</sub>max was found for LMI ( $B = 4.930$ ,  $p = .030$ ) such that higher VO<sub>2</sub>max was associated with greater recall. These associations withstood adjustments for hypertension, and fasting glucose and total cholesterol levels, and further revealed a significant negative relation of VO<sub>2</sub>max to LMD ( $B = 5.383$ ,  $p = .046$ ).

**Conclusions:** Findings revealed both interactive and independent relations of BMI and VO<sub>2</sub>max to cognitive performance. In that regard, men with both higher BMI and lower VO<sub>2</sub>max were most vulnerable to decrements in manual dexterity and motor speed. However, irrespective of sex, higher BMI was associated with lower levels of performance on tests of cognitive flexibility and poorer response inhibition. Additionally, lower VO<sub>2</sub>Max was associated with poorer verbal memory function. Future research should examine synergistic or additive relations of BMI and VO<sub>2</sub>max to potential neurobiological underpinnings (e.g., cerebral perfusion, subclinical cerebrovascular disease) of these relations.

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**Keywords:** vascular cognitive impairment, cognitive

**M. I. LEESE, N. MATTEK, S. HARBISON, Z. BEATTIE, K. DOROCIAC, H. H. DODGE, J. KAYE, A. SEELYE. Passive Activity Monitoring Detects Everyday IADL Changes in Older Adults with Intact Cognition and Mild Cognitive Impairment during the COVID-19 Pandemic.**

**Objectives:** The COVID-19 pandemic has limited older adults' access to "non-essential," in-person medical care to reduce their risk of virus infection. Consequently, clinical work and research now require remote, technology-based in-home assessment and intervention approaches for older adults. Remote assessment of changes in older adults' daily activities could provide valuable information to supplement missed visits. The primary aim of this research was to determine whether passive activity monitoring technologies installed in older adults' homes and vehicles could detect everyday instrumental activities of daily living (IADL) changes during COVID-19. The second aim was to determine whether age, gender, education, or cognitive status impact these relationships.

**Participants and Methods:** Participants were 59 community-dwelling older adults ( $M$  age = 73.5 (5.8),  $M$  education = 15.7 (2.8), 55.9% male, 86.4% white) living in the U.S, classified as normal cognitive aging ( $M$  age = 72.7 (4.7),  $n = 41$ ) or MCI ( $M$  age = 75.35 (7.7),  $n = 18$ ) using the Clinical Dementia Rating Scale and a battery of neuropsychological tests at baseline. Daily driving and computer use data were collected as a part of an ongoing longitudinal study protocol from December 2019 through May 2020 and were separated into two time periods: 75 days pre- and 76 days post- COVID-19 national emergency declaration. A total of 55 participants had their daily driving monitored (using the on-board vehicle data port) and 36 participants had their home computer use monitored (using use activity assessment software). Outcome variables included daily driving distance, number of driving trips, highway driving, nighttime driving, and computer use time. Data were analyzed using generalized estimating equations (GEE) analyses.

**Results:** There was a significant decrease in all driving variables post-COVID-19 as compared to pre-COVID-19 across the entire participant sample ( $p$ 's <0.01). Further, there was a 12% increase in time spent on the computer per day post-COVID-19 ( $p = 0.03$ ). When models were adjusted for age, gender, and education, results showed occurrence of highway driving decreased by 43% overall and that MCI participants decreased their occurrence of highway driving by 38% more than healthy controls ( $p < 0.01$ ). No significant differences in driving or computer use were found by age, gender, or education.

**Conclusions:** Passive in-home and mobile activity monitoring detected that older adults drove less and used their computer more after COVID-19 was declared a national emergency in the U.S as compared to earlier in the year; for MCI older adults, decreases in highway driving in particular were steeper than for cognitively intact older adults. These results highlight the effects of stay-at-home orders across the U.S, which halted in-person activities and encouraged individuals to engage in socially distant activities. These results also show the potential utility of in-home and mobile technology-based assessment to detect and monitor everyday cognition and IADL changes in older adults.

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**Keywords:** activities of daily living, driving, mild cognitive impairment

**L. ROTBLATT, A. T. AIKEN-MORGAN, A. L. HORGAS, M. MARSISKE, K. R. THOMAS. Do Associations Between Vascular Risk and Mild Cognitive Impairment Vary by Race?**

**Objective:** There are reported differences in prevalence of mild cognitive impairment (MCI) and dementia by race with higher rates among older Black/African Americans (AA) than non-Hispanic Whites. A number of factors may account for these different rates, including some associated with dementia risk (education and literacy, access to healthcare, other social determinants of health) and others that may not confer a greater risk of dementia (uncertainty/distrust surrounding testing, test and normative biases). One area of particular interest is the contributions of vascular risk factors (VRFs) to cognitive impairment, given that they may be modifiable intervention targets and tend to affect Black/AA older adults at higher rates than White older adults. While VRFs have been found to be associated with increased risk for MCI, less is known about the aggregate effects of multiple VRFs on MCI subtypes and whether these effects may differ by race. As such, this study aimed to examine whether the relationship between VRFs and MCI classification varies by race.

**Participants and Methods:** Participants were 2755 older adults without dementia, aged 65-97, 26.17% Black/AA, 75.82% female, from the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) Trial. Participants were classified as cognitively normal (CN; n=2237), amnesic MCI (aMCI; n=332), or non-amnesic MCI (naMCI; n=186) at their baseline visit using comprehensive neuropsychological criteria. Individual VRFs were dichotomous (0=absent; 1=present) and defined based on subjective report and medication data and included: hypertension, diabetes, obesity, high cholesterol, and current smoking. Overall VRF burden was the sum of all individual VRFs. Data were analyzed using multinomial logistic regression models with MCI subtype as the dependent variable (CN as reference). Covariates include age, education, sex, and vocabulary.

**Results:** While there was not a significant main effect of overall VRF burden, there was a significant race by VRF interaction such that greater VRF burden was associated with increased odds of naMCI in Black/AA participants (OR=1.439,  $p=.008$ ), but not White participants (OR=0.998,  $p=.896$ ). There were no significant effects of VRF on aMCI. Across individual VRFs, high cholesterol (OR=2.061,  $p=.035$ ) and obesity (OR=2.024,  $p=.048$ ) conferred greater odds of naMCI (but not aMCI) within Black/AA participants, but not White. Across participants, having diabetes was associated with increased odds of aMCI, while hypertension was associated with increased odds of naMCI.

**Conclusions:** Findings from this study suggest that both individual (e.g. obesity, high cholesterol) and aggregate VRF burden increased odds of naMCI for Black/AA, but not White, older adults. These results may reflect a compound disadvantage related to racism/marginalization and support the continued efforts toward examining underlying mechanisms contributing to these observed discrepancies in how VRFs confer risk of MCI (e.g., access to quality healthcare and education, neighborhood factors, chronic stress due to systemic racism). Future studies will begin to explore some of the social forces that likely impact cognition in ACTIVE as well as examine the associations between VRFs, race, and progression from CN to MCI over 10 years to better capture these long-term effects in late life.

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**Keywords:** mild cognitive impairment, diversity, cardiovascular disease

**A. DENNY, F. WEBBE, A. LOGALBO. Predicting the Course of Mild Cognitive Impairment in a Memory Disorder Clinic Sample.**

**Objective:** The present study examines a number of psychosocial and medical risk factors for dementia and their association with the outcome of mild cognitive impairment (MCI) in a memory disorder clinic sample.

**Participants and Methods:** Twelve years of archival cognitive testing data from 125 East Central Florida Memory Disorder Clinic patients was utilized. Participants were included in this study if they were diagnosed with MCI following initial cognitive testing and then re-evaluated and diagnosed with either stable MCI, dementia of the Alzheimer's type (AD) or mixed dementia (dementia of the Alzheimer's type and vascular dementia), or cognition within normal limits. Patients' medical and psychosocial information was obtained from their electronic medical records (EMR) and included as predictors in this present study.

**Results:** Age of patients ( $M = 77.2$ ,  $SD = 6.2$ ) at initial visit was associated with an increase in the odds of receiving a final diagnosis of dementia, with an odds ratio of 1.074 (95% CI, 1.014 to 1.137), Wald,  $\chi^2(1) = 5.893$ ,  $p = .015$ . Individuals who were diagnosed with amnesic MCI at their initial evaluation were more likely to convert to dementia ( $\chi^2(18) = 45.65$ ,  $p < .001$ ). A history of depression was also associated with an increase in the odds of receiving a final diagnosis of dementia, with an odds ratio of 3.213 (95% CI, 1.200 to 8.605), Wald,  $\chi^2(1) = 5.396$ ,  $p = .020$ . The odds of receiving a final diagnosis of dementia were also significantly higher for patients who had a diagnosis of hypertension, with an odds ratio of 2.771 (95% CI, 1.240 to 6.197), Wald,  $\chi^2(1) = 6.166$ ,  $p = .013$ . Additionally, patients with a history of comorbid depression and hypertension had increased odds of converting to dementia, with an odds ratio of 8.894 (95% CI, 3.564 to 22.192), Wald,  $\chi^2(1) = 21.942$ ,  $p < .001$ . In contrast, patients with a history of age-related macular degeneration had increased odds of remaining stable MCI, with an odds ratio of 4.762 (95% CI, 1.115 to 20.333), Wald,  $\chi^2(1) = 4.440$ ,  $p = .035$ .

**Conclusions:** The results of the present study support previous literature that suggests advancing age is the largest non-modifiable risk factor for dementia. Prior research suggesting amnesic MCI patients are more likely to convert to dementia was also supported. The present study's findings also suggest that patients with MCI may be more likely to progress to AD if they have histories of depression and/or hypertension. This supports previous research that suggests a relationship between cardiovascular risk factors and mental health conditions such as depression, with future cognitive impairment. This highlights the importance of treating modifiable risk factors for dementia, particularly depression and hypertension, in order to delay the onset of AD in patients who have MCI. Lastly, the results of this study may assist clinicians in determining which patients with MCI may be most likely to convert to dementia, with older patients who have amnesic MCI, depression, and hypertension, being the most likely to convert.

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**Keywords:** dementia - Alzheimer's disease, aging disorders, mild cognitive impairment

**J. H. STARK, D. J. PALOMBO, J. P. HAYES, K. J. HIERSCHE, A. N. HASSELBACH, S. M. HAYES. Partial Least Squares Analysis of Alzheimer's Disease Biomarkers, Modifiable Health Variables, and Cognition in Older Adults with Mild Cognitive Impairment.**

**Objective:** To identify novel associations between modifiable physical and health variables, Alzheimer's disease (AD) biomarkers, and cognitive function in a cohort of older adults with mild cognitive impairment (MCI).

**Participants and Methods:** Metrics of cardiometabolic risk (e.g., body mass index), stress (e.g., cortisol), inflammation (e.g., c-reactive protein), neurotrophic/growth factors (e.g., brain-derived

neurotrophic factor), and AD (e.g., plasma tau) were assessed in 155 MCI participants (mean age = 74.2 years) from the Alzheimer's Disease Neuroimaging Initiative. Participants also completed a neuropsychological battery assessing premorbid IQ, working memory, executive function, episodic memory, language, processing speed, and global cognitive functioning. Partial Least Squares analysis, a model-free multivariate technique that defines latent variables in a dataset, was employed to examine associations among these physiological variables and cognitive domains.

**Results:** A unique combination of AD biomarkers, neurotrophic/growth factors (including brain-derived neurotrophic factor), and education was significantly associated with specific domains of cognitive function, including episodic memory, executive function, and processing speed. This model accounted for 47.9% of the covariance in the data (all  $ps < 0.05$ ). Age, Body Mass Index, and metrics tapping working memory, language or premorbid IQ were not significant.

**Conclusions:** Our data-driven analysis highlights significant relationships between metrics associated with AD pathology, neuroprotection, and neuroplasticity with tasks requiring fluid (episodic memory and executive function) rather than crystallized (premorbid IQ and language) ability. These data also indicate that biological metrics are more strongly associated with episodic memory, executive function, and processing speed than chronological age in older adults with MCI. Future research should assess the longitudinal impact of identified biomarkers to better elucidate risk factors associated with the trajectory of cognitive decline among older adults.

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**Keywords:** aging disorders, memory disorders, executive functions

### **K. JOHNSON, K. SHEIKH, U. PERSAUD, A. TETI, S. MOONEY. The Effects of Depression on Semantic Word Generation in a Nationally-Representative Sample of Ageing Adults with MCI.**

**Objective:** Depression can be associated with cognitive deficits and is a common neuropsychiatric symptom in older adults with mild cognitive impairment (MCI). While there is ample research investigating the differences in cognitive performance in geriatric depression *versus* MCI, the effects of *comorbid* depression in MCI are less well understood, and the extant literature on this topic remains controversial. Furthermore, only a minority of studies have included a measure of semantic word generation, which is a commonly used neuropsychological test that is important in differential diagnosis. Studies that have included semantic word generation tasks have found mixed results in depressed MCI patients. The purpose of the present study was to investigate the effects of comorbid depression on a semantic word generation task in a large nationally-representative homogenous MCI patient sample.

**Participants and Methods:** 5,345 primary English-speaking patients with MCI from the National Alzheimer's Coordinating Center Uniform Data Set who had been assessed using the Mini-Mental Status Exam (MMSE), Animal Naming (AN), and Geriatric Depression Scale-Short Form (GDS). Participants were grouped according to depression status based on GDS score. Consistent with recommended cutoffs, scores equal to or less than 5 indicated the absence of depression, while scores equal to or greater than 10 indicated probable depression.

**Results:** Out of the 5,345 participants, we identified 229 with a score of 10 or greater on the GDS. Subject mean (SD) age and education were 74.09 (8.7) and 15 (3.5) years, respectively. Our sample was 50% female, and 80% percent Caucasian and 15.5% African American. Mean

(SD) MMSE Total scores for non-depressed [27.1 (2.4)] and depressed [26.8 (2.7)], participants were not significantly different ( $p = 0.09$ ). Differences in mean performance on AN between non-depressed ( $M = 15.8$ ,  $SD = 5$ ) and depressed ( $M = 14.9$ ,  $SD = 4.8$ ) participants was significant at the .05 level.

**Conclusions:** Results of the current analysis demonstrated differences in cognitive performance between depressed and non-depressed subjects with MCI. Specifically, participants with MCI and comorbid depression performed worse on average on a measure of semantic word generation compared to subjects with MCI and no comorbid depression. It is important to note, however, that while a statistically significant difference was found, this difference constituted only a single word between groups on AN. In a clinical context, such a small difference likely would not be deemed meaningful. Given past research, the prevalence of comorbid depression and MCI in a nationally-representative sample of ageing adults was surprisingly small. Nonetheless, as depression has been found to impact cognitive ability, the current finding has important implications for practice. Semantic word generation tasks are commonly used instruments for assisting in differential diagnoses, and specifically for differentiating between conversion from MCI to Alzheimer's Disease vs another type of dementia. The current analysis suggests that the presence of depression in MCI does not impact performance on a semantic word generation task, and therefore may assist with diagnostic clarity among patients with comorbid MCI and depression.

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**Keywords:** mild cognitive impairment, depression, semantic processing

**K. L. SULLIVAN, J. D. DAVIS, E. S. HALLOWELL, G. TREMONT, L. A. DAIELLO, B. R. OTT, E. BURKE, L. NAKHUTINA, S. A. MARGOLIS. Compensatory Strategy Use in Mild Cognitive Impairment.**

**Objective:** Individuals with mild cognitive impairment (MCI) may have subtle difficulties managing instrumental activities of daily living (IADLs). Understanding how such individuals compensate for IADL difficulties, and the relationships between compensatory strategy use and cognitive functioning, may help guide intervention development aimed at prolonging functional independence. The current study characterized the most frequently used compensatory strategies and interrelationships with cognition and MCI subtypes in a clinical sample who presented for neuropsychological evaluation.

**Participants and Methods:** Participants included 42 older adults ( $M$  age = 71.9 years,  $SD = 6.5$ ; 55% female) with a clinical diagnosis of MCI according to Petersen criteria. Demographically adjusted T-score composites were derived for memory, executive functions, language, attention/processing speed, and visuospatial skills. On average, participants demonstrated mildly impaired memory ( $T = 34$ ) with low average to average mean performance across other domains ( $T_s = 41-46$ ). Participants with memory composite T-scores  $\leq 35$  were classified as amnesic MCI ( $n = 21$ ). Compensatory strategy use was assessed with the Everyday Compensation Questionnaire, which measured 40 strategies across 6 IADLs, and a novel questionnaire assessing 12 medication self-management strategies, each along a Likert-type scale (0=never - 4=always). Item-level modes were computed to identify strategies used "frequently" or "always" by most of the sample; these items were averaged to capture participants' typical strategy use. Correlations, t-tests, and multiple regression were used to elucidate interrelationships.

**Results:** Of the 52 compensatory strategies assessed, 32 (61%) were used frequently or always by most respondents ( $\alpha = .747$ ). The top 10 strategies were used by  $\geq 74\%$  of individuals; these involved using a calendar to track appointments, preparing items to bring to an appointment, taking medication at regular times, and keeping important items (i.e., medications, bills, keys) in specific locations. Women reported more frequent strategy use than men ( $t = 2.13, p = .040$ ). Partial correlations controlling for sex revealed that more frequent strategy use was associated with better memory ( $r = .42, p = .008$ ) and executive functions ( $r = .33, p = .042$ ), but not with language ( $r = .07, p = .686$ ), attention/processing speed ( $r = .16, p = .336$ ), or visuospatial skills ( $r = .06, p = .696$ ). When memory, executive functions, and sex were modeled together to predict strategy use, they collectively accounted for 29% of the variance; however, memory was the only unique predictor ( $\beta = .34, p = .029$ ). Additionally, non-amnesic MCI cases reported significantly more frequent strategy use ( $M = 2.70, SD = 0.40$ ) than amnesic MCI counterparts ( $M = 2.38, SD = 0.49$ ),  $t = 2.36, p = .023$ .

**Conclusions:** Since individuals with MCI may have subtle difficulties with IADLs, it is encouraging that compensatory strategy use was prevalent. However, strategies were used less frequently by MCI patients with worse memory and executive functions, as well as those with amnesic MCI. Future studies should assess how relationships between strategy use and cognition unfold over time and how executively demanding memory (e.g., prospective memory) and insight impact strategy use in MCI.

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**Keywords:** activities of daily living, everyday functioning, memory disorders

### **K. R. CHAPMAN, G. TREMONT. Executive Dysfunction Mediates the Relationship between Functional Impairment and Caregiver Burden in Mild Cognitive Impairment.**

**Objective:** Mild cognitive impairment (MCI) is considered an intermediate phase between normal aging and dementia. While by definition mild, executive dysfunction and functional impairment can be observed in MCI and have been linked to greater caregiver burden. However, the respective contribution of these factors is not well understood, and it is possible that executive dysfunction accounts for the relationship between functional impairment and caregiver burden. The present study examined the relationship between executive dysfunction, and caregiver burden, accounting for functional impairment.

**Participants and Methods:** 75 caregivers (average age: 61.4 years, 69.0% female) who presented with their care recipient (average age: 74.8 years, 65.3% female) for evaluation at an outpatient neuropsychology service. All caregivers completed the Executive Dysfunction subscale of the Frontal Systems Behavior Scale (eFrSBE), the Lawton-Brody Instrumental Activities of Daily Living Scale (IADL), and the Zarit Burden Interview (ZBI). Linear regression analyses examined the relationships between functional impairment, executive dysfunction, and caregiver burden independently, followed by hierarchical linear regression to determine the contribution of executive dysfunction to predict caregiver burden above and beyond functional impairment. Mediation analyses, where mediation was determined by examining the bootstrapped (5,000 bootstrap samples) confidence interval for the indirect effect (PROCESS macro), then determined if executive dysfunction significantly accounted for the relationship between functional impairment and caregiver burden.

**Results:** Two separate linear regression analyses, controlling for caregiver type (spouse (58.7%) vs. other), revealed that both greater functional impairment ( $R^2=0.15, F(2,72)=6.55, p<0.01$ ), and

executive dysfunction ( $R^2=0.27$ ,  $F(2,72)=13.21$ ,  $p<0.01$ ) predicted greater caregiver burden. Follow-up hierarchical linear regression revealed that greater executive dysfunction predicted greater caregiver burden above and beyond the contribution of functional impairment ( $\Delta R^2=0.17$ ,  $\Delta F(3,71)=17.20$ ,  $p<0.001$ ), and executive dysfunction mediated the relationship between functional impairment and caregiver burden ( $b=-0.57$ , 95% bootstrapped CI [-1.25, -0.14]).

**Conclusions:** The current study revealed that while executive dysfunction and functional impairment independently predicted caregiver burden in MCI, executive dysfunction predicted caregiver burden above and beyond the contribution of, and mediated the relationship between, functional impairment and caregiver burden. These results add to a body of work demonstrating that presence of executive dysfunction is distressing to caregivers, even in mild disease stages. Because executive dysfunction may herald swifter decline, early identification of caregivers reporting executive dysfunction in their care recipient is imperative to ensure establishment of caregiver support(s) early in the disease course.

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**Keywords:** executive functions, everyday functioning

**E. MATUSZ, M. LAMAR, C. PRICE, V. WASSERMAN, S. EMRANI, A. HOLWAY, W. SOUILLARD-MANDAR, R. SWENSON, D. LIBON, L. THOMPSON. Dissociating Statistically Determined Non-MCI and MCI Subtypes with DCTclock.**

**Objective:** Recently, a digital version of the clock drawing test (DCTclock) has been introduced. Past research using machine learning strategies was able to correctly classify normal controls (NC), mild cognitive impairment subtypes (MCI), and Alzheimer's disease patients (AD) into their respective groups. However, some 2-group comparisons required hundreds of variables. This research was undertaken to assess how DCTclock metrics can dissociate memory clinic patients classified as non-MCI, subtle cognitive impairment (SCI) amnesic MCI (aMCI), and a combined mixed/dysexecutive MCI (mixed/dysMCI).

**Participants & Methods:** Using Jak/Bondi criteria, 123 memory clinic patients were classified into the following groups (non-MCI,  $n=28$ ), SCI ( $n=37$ ), aMCI ( $n=26$ ), and mixed/dysMCI ( $n=32$ ). Groups did not differ for age ( $75.57\pm 6.76$ ) or education ( $14.66\pm 2.56$ ). Both MCI groups scored lower on the MMSE compared to non-MCI and SCI groups ( $p<.041$ , all analyses). Nine outcome variables were assessed: a single, combined command and copy total score; four command and four copy indices measuring drawing efficiency, simple/complex motor operations, information processing speed, and spatial reasoning. Outcome measures are expressed as standard scores.

**Results:** For the total combined command/copy score ( $x=50$ ;  $\sigma=10$ ), a 1-way ANOVA found that mixed/dysMCI patients ( $39.18\pm 22.55$ ) scored lower than all other groups (non-MCI= $66.25\pm 21.90$ ; SCI= $57.84\pm 23.37$ ; aMCI= $59.12\pm 24.50$ ;  $p<.009$ ,  $\eta_p^2=.162$ ). ANOVA analyses revealed significant group differences across for all four command indices with large effects for spatial reasoning ( $p<.001$ ,  $\eta_p^2=.196$ ) and drawing efficiency ( $p<.001$ ;  $\eta_p^2=.135$ ), and medium effects for simple/complex motor operations ( $p<.038$ ;  $\eta_p^2=.068$ ) and information processing speed ( $p<.038$ ;  $\eta_p^2=.068$ ). Post hoc comparisons showed that mxMCI patients scored lower than non-MCI patients across all command indices ( $p<.050$  for all) and scored lower than SCI patients on drawing efficiency ( $p=.011$ ). aMCI patients scored lower than non-MCI on spatial reasoning ( $p=.019$ ). Similar ANOVA analyses revealed relatively lower effects sizes on the four copy indices. Analysis of the spatial reasoning ( $p=.04$ ,  $\eta_p^2=.067$ ) and drawing efficiency

( $p=.003$ ,  $\eta_p^2=.112$ ) indices produced medium effect sizes compared to the large effect sizes seen for these two indices in the command condition. Similar to the command condition, the copy condition of information processing revealed a medium effect for significant differences among groups ( $p=.022$ ,  $\eta_p^2$ ). In contrast, groups did not differ on the copy condition for the simple motor/complex operations index ( $p>.05$ ). Post hoc comparisons revealed that mx/dysMCI patients scored lower than non-MCI patients on spatial reasoning, drawing efficiency, and information processing copy indices ( $p<.05$ , all analyses). Additional differences were seen in drawing efficiency index with mx/dysMCI patients also scoring lower than SCI ( $p=.039$ ) and aMCI ( $p=.014$ ) patients.

**Conclusions:** These preliminary results suggest that DCTclock command/copy parameters can dissociate mixed/MCI from other groups. aMCI versus mixed/dys MCI groups differed on some copy indices. The larger effect sizes for selected indices in the command versus copy performance suggest these metrics could be sensitive to early cognitive decline. Additional research with a larger sample is warranted.

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**Keywords:** neuropsychological assessment, cognitive functioning, test development

### **E. B. CAMPBELL, M. L. DELGADILLO, J. K. FAIRCHILD. Cognitive Improvement Following Combined Intervention for Older Adults with MCI.**

**Objective:** Approximately one in ten people ages 70-74 have mild cognitive impairment (MCI) and prevalence rates only increase with age. Several meta-analyses have suggested that combined interventions of exercise and cognitive training (CT) provide maximal benefits. Additionally, much of the previous research has included land-based exercise which places potential barriers on older adults. Water-based exercise has been proposed as an ideal alternative as it is non-weight bearing and provides many physiological benefits. The goal of the current study was to compare changes in cognitive domains following an exercise (water- or land-based) and CT intervention on older adults with MCI.

**Participants and Methods:** Participants were 67 community-dwelling older adult Veterans who were classified as having amnesic MCI (aMCI) by their performance on the Rey Auditory Learning Test (RAVLT) Delayed Memory and Wechsler Memory Scale-Fourth Edition (WMS-IV) Logical Memory II. The study was conducted as a secondary data analysis in which two trials of exercise and CT in Veterans with aMCI were compared. Primary outcome variables were performance on measures of cognition across three time points (baseline, following exercise intervention, and following CT intervention). Domains consisted of: Learning and Memory (WMS-IV Logical Memory, WMS-IV Logical Memory II, RAVLT trials I-V, and RAVLT Delayed Recall), Executive Functioning (Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV) Digit Span Forward, WAIS-IV Digit Span Backward, WAIS-IV Digit Span Sequencing, RAVLT Trial I, Trail-Making Test Part B, and the third condition from the Stroop Color Word Test (SCWT)), Processing Speed (Trail-Making Test part A, the Symbol Digit Modalities Test, and the first 2 conditions of the SCWT), Language (Visual Naming Test), and Visuospatial (Judgment of Line Orientation). Linear mixed effects modeling was used to detect group differences across time periods in an intention-to-treat analysis. Age was evaluated as a moderator for all domains. Change from Time 1 to Time 2 for Processing Speed, Working Memory, six-minute walk test total distance walked, maximum aerobic functioning ( $VO_2$  max),

and ventilation/carbon dioxide production (VeVCO<sub>2</sub>) slope were utilized in mediation analyses in an attempt to detect mechanisms of change.

**Results:** Results of the linear mixed effects modeling indicated that both water- and land-based exercise interventions in combination with CT showed significant improvement in the domain of learning and memory. Other domains including executive functioning, processing speed, language, and visuospatial abilities significantly improved only in the water-based exercise and CT intervention group. All results of moderator and mediator analyses were non-significant. There was also no significant difference in linear growth patterns between exercise intervention and CT groups in any domain.

**Conclusions:** This study implies that significant improvements were seen in multiple cognitive domains in the water-based exercise and CT intervention. While the land-based exercise and CT intervention showed improvements in learning and memory, scores did not significantly improve in the other domains assessed. Explanations for the observed benefits of water-based exercise and CT should be explored in future research, including the possibility that older adults can more fully engage in water-based activity to obtain maximum benefit from CT.

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**Keywords:** mild cognitive impairment

**C. NAYARES, J. MORENO, W. OLMOS, J. BALAKID, J. J. SIMONS, M. J. WRIGHT, L. ALVING, E. WOO. The Impact of Memory and Executive Functioning on Semantic Clustering in Mild Cognitive Impairment.**

**Objective:** Semantic clustering is an efficient memory strategy that involves grouping words by category. Past research indicates that clustering involves memory and executive functioning, though the extent to which these skills predict clustering across varying levels of cognitive decline requires further investigation. In this study, we examined the roles of memory and executive functioning on semantic clustering in those with healthy cognition, mild cognitive impairment (MCI), or Alzheimer's disease (AD).

**Participants and Methods:** The participants included healthy older controls ( $n = 56$ ), individuals with MCI ( $n = 63$ ), and persons with AD ( $n = 18$ ). We assessed clustering (from trials 1-5, short-delay free recall, and long-delay free recall) on the California Verbal Learning Test-II (CVLT-II). An Executive composite score was derived from performances on mental flexibility and generation tests. A Memory composite was derived from scores on delayed recall measures.

**Results:** Regression analyses were conducted separately for each diagnostic group, evaluating the roles of the Executive and Memory composites in semantic clustering. We found that memory significantly predicted clustering during both recall trials in all groups. Memory only predicted clustering during learning for the healthy control and MCI groups. Executive functioning only predicted clustering during short-delay free recall in the MCI group.

**Conclusions:** In general, memory was involved in semantic clustering in older controls, MCI, and AD. Only for persons with MCI, both memory and executive functioning were important in semantic clustering. These findings indicate that when older adults are at risk of developing dementia, executive skills are additionally engaged, beyond memory abilities, to perform a strategy that is shown to enhance recall performance.

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**Keywords:** mild cognitive impairment, dementia - Alzheimer's disease, executive functions

**A. BOEVE, R. K. MACAULAY, L. D'ERRICO, D. LOWE, D. SZELES, M. T. WAGNER. Impact of Demographic and Health Factors on Simple and Dual-Task Gait Speed.**

**Objective:** Slower gait speed, during normal and dual-task (DT) walking conditions, is associated with an increased risk of mild cognitive impairment (MCI) and dementia. Increasing evidence supports that assessment of gait speed may provide a sensitive measure to detect those at risk of dementia. However, the utility of gait as a diagnostic measure for MCI is currently lacking in its specificity. The present study investigated health-related group differences in gait speed to improve understanding of factors that contribute to gait speed in older adults with MCI and subjective cognitive complaints (SCC).

**Participants and Methods:** Two hundred and eighty older adults presenting to a memory clinic with cognitive concerns completed comprehensive neuropsychological and gait speed assessments. Patients' clinical diagnoses were confirmed by a licensed neuropsychologist (MTW). Univariate analysis of covariance tests, adjusting for age and metabolic risk, investigated between-group differences in cognitive status and depression in gait speed during single-task (ST) and DT (walking while spelling a word backwards) conditions. Metabolic risk scores ranged from "0" to "4" depending on the number of the following disorders present in an individual: hypertension, hyperlipidemia, diabetes, or thyroid disorder.

**Results:** The first set of analyses found a main effect of depression on ST gait speed, such that, those with depression showed significantly slower ST walking speed; however, there was no main effect of cognitive status after adjusting for the significant effects of age and metabolic risk on gait speed. The second set of analyses found main effects of both depression and cognitive status on DT gait speed, such that those with depression or MCI showed significantly slower DT walking speed regardless of the significance of age.

**Conclusions:** Gait speed is impacted by age, depression, and metabolic risk in addition to cognitive status. Results showed differential associations between gait conditions, such that after adjusting for metabolic risk and age, cognitive status is only associated with DT gait speed, while depression is associated with slower gait speed in both conditions. Better understanding the role of these factors on gait may lead to improved normative data for gait speed as an assessment measure for MCI, as well as, may potentially indicate that treatment of these modifiable risk factors may help prevent gait decline.

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**Keywords:** mild cognitive impairment, aging disorders, aging (normal)

**E. EDMONDS, K. R. THOMAS, J. EPPIG, M. W. BONDI. Actuarial Neuropsychological Criteria for MCI Predict Progression to Dementia Without the Need for Subjective Informant-Report.**

**Objective:** Our prior work has demonstrated that an actuarial neuropsychological approach to diagnosing Mild Cognitive Impairment (MCI) can be used in research studies as an alternative to conventional Petersen/Winblad criteria, given that our method has stronger associations with Alzheimer's disease (AD) biomarkers and future dementia. Our criteria are based primarily on neuropsychological test performance. However, we also include a criterion in which MCI could

be based on study partner-rated difficulties in everyday function (e.g., Functional Activities Questionnaire [FAQ] score), under the premise that cognitively normal (CN) individuals should be free of functional impairment. The current study examined whether inclusion of the FAQ in our actuarial criteria improves prediction of progression to dementia.

**Participants and Methods:** Participants were 1,392 individuals from the Alzheimer's Disease Neuroimaging Initiative (ADNI) (mean age=73.4, 45% women), including 867 diagnosed with conventional MCI and 525 classified as CN by ADNI. Baseline language, memory, and attention/executive functioning scores were converted to demographically-adjusted z-scores. Participants were classified as MCI if either of the following were met: (1) performance >1 SD below the mean on two measures within the same cognitive domain, or (2) performance >1 SD below the mean on one measure across the three cognitive domains sampled. If neither were met, participants were classified as CN. These CN participants were then re-classified with MCI if they met the additional criterion: (3) FAQ score >5, indicating difficulty in at least two areas of functioning. Survival analysis examined progression to dementia over a mean of 39.9 months (SD=29.9).

**Results:** Based on neuropsychological scores (MCI-NP), 592 (43%) participants were classified as MCI. When the FAQ was included (MCI-NP/FAQ), MCI classifications rose by 50 participants to 642 (46%). Survival analysis showed no difference in progression to dementia between MCI-NP (46%) and MCI-NP/FAQ (45%). However, MCI samples based on our actuarial methods were significantly more likely to progress than the original MCI sample based on ADNI's conventional criteria ( $p<.001$ ). Of the 50 participants who demonstrated intact cognition but a high FAQ at baseline, the majority ( $n=40$ ) were men. Thirty-four (68%) of the 50 remained dementia-free over time (mean=38.0 months), while 16 (32%) progressed over a mean of 25.1 months (range 6-96). There were no significant differences between the 34 stable and 16 progressing participants in demographic characteristics, neuropsychological performance, functional difficulty, depressive symptoms, ADNI diagnosis, APOE genotype, or cerebrospinal fluid (CSF) beta-amyloid at baseline; those who progressed had higher CSF tau and p-tau levels at baseline.

**Conclusions:** The addition of an informant-reported functional measure to our actuarial neuropsychological criteria did not significantly improve the prediction of progression to AD dementia. A high FAQ score in the context of intact neuropsychological functioning identified only a small number of participants who progressed to dementia ( $16/1,392 = 1.1\%$  of overall sample) and roughly double who did not progress ( $34/1,392=2.4\%$ ). Our neuropsychologically-defined MCI sample was more strongly tied to progression to dementia than ADNI's MCI sample, consistent with our previous work showing that data-driven approaches are more robust than those based on subjective report and clinical judgment.

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**Keywords:** mild cognitive impairment, dementia - Alzheimer's disease, neuropsychological assessment

**A. J. MACOMBER, A. J. WEIGAND, M. L. WERHANE, M. SULLAN, E. GRANHOLM, M. W. BONDI. Effects of arterial stiffness on verbal learning in nondemented older adults.**

**Objective:** The relationship between vascular risk and cognition has been well-established, and there is substantial evidence for a link between vascular burden and the development of dementia. Although studies have shown increased pulse pressure (PP), a proxy for arterial

stiffness (AS), to be a risk factor for the development of cognitive (Nation et al. 2015) and functional (Werhane et al. 2018) impairments, limited research has examined the differential association between PP and verbal learning in participants with mild cognitive impairment (MCI) versus cognitively healthy older adults.

**Participants and Methods:** Sixty-six older adults (mean age = 74.3 years, range = 62–85 years) underwent comprehensive neuropsychological assessment and were classified as MCI (N = 13) or cognitively normal (CN, N = 53) based on Jak-Bondi actuarial neuropsychological criteria (Jak, Bondi et al., 2009). PP was used to estimate AS based on the following formula derived from seated brachial blood pressure (BP) values: Systolic BP – Diastolic BP / Systolic BP. Of note, this particular calculation of AS allows for the evaluation of the effects of pulse pressure, a common proxy for AS, removing the effects of systolic BP. Systolic and diastolic BP were also assessed independently. All BP variables were log transformed to improve normality. Multiple linear regression evaluated whether cognitive diagnosis moderated the association between AS and verbal learning (CVLT-2 Trials 1-5 Total T-score) while adjusting for educational attainment

**Results:** Results from linear regression models examining the moderating effect of cognitive diagnosis on AS and verbal learning associations revealed a significant interaction ( $t = -2.58, p = .01$ ). Examination of main effects revealed that, although there was no association between AS and verbal learning among cognitively normal individuals ( $t = .90, p = .37$ ), there was a significant association within the MCI group ( $t = -2.21, p = .05$ ) such that increasing PP was associated with worsening learning. In contrast, there was no moderating effect of diagnosis for systolic ( $t = -.87, p = .39$ ) or diastolic ( $t = 1.79, p = .08$ ) BP.

**Conclusions:** Verbal learning has been observed as a reliable marker of cognitive decline in early AD (Delis et al. 1991) as well as in preclinical AD (Bondi et al. 1994, 1999; Grober & Kawas, 1997). Our study's finding of the relationship study between learning and AS highlights the utility of AS as a marker of changes in cognition in older adults with MCI compared to traditional BP measures. Clinically, AS could be used as a non-invasive and cost-effective biomarker for individuals who have been diagnosed with MCI and are at risk for AD, although more work is needed to confirm these preliminary findings. Future research in this area may also focus on whether physical activity attenuates the effects of AS on learning and memory. Further, increasing the size of the MCI sample and evaluating individuals with AD will help to validate AS as a marker of vascular dysfunction and novel predictor of cognitive deterioration in the AD prodrome.

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**Keywords:** vascular cognitive impairment, mild cognitive impairment, learning

**A. KAIRYS, S. SHAIR, A. DAUGHERTY, V. KAVCIC, B. M. HAMPSTEAD, A. BHAUMIK, J. READER, H. PAULSON, B. GIORDANI. Evaluation of Diagnostic Differentiation using the Tablet-Administered NIH Toolbox Cognitive Battery.**

**Objective:** The prevalence of Alzheimer's disease (AD) is projected to increase with the significant growth of the population age 65 years and older. This expected growth necessitates the development of rapid, effective, and efficient methods to identify individuals in prodromal stages of AD (e.g. mild cognitive impairment; MCI), so that early intervention and possible promotion of cognitive resiliency may be applied. To this end, computerized neuropsychological batteries have been developed as a means of more rapid assessment of individuals. One of the

most widely used computerized batteries is the NIH Toolbox-Cognition battery (NIHTB-CB), which measures both crystallized and fluid cognitive abilities. We sought to determine which tests on the NIHTB-CB showed the largest differences across diagnostic groups of patients within our Alzheimer's research center.

**Participants and Methods:** 165 participants underwent consensus diagnosis procedures based on the NACC Uniform Data Set criteria, and were diagnosed with: dementia of the Alzheimer's type (DAT;n=15), amnesic MCI (aMCI;n=47), non-amnesic MCI (naMCI; n=25), impaired not MCI (InMCI;n=16), or cognitively normal (NL;n=62). All participants completed the NIHTB-CB (tablet version) as part of the Michigan Alzheimer's Disease Research Center's ongoing studies. Participant's performances on the NIHTB-CB tablet subtests were entered into a multivariate analysis of variance to evaluate which NIHTB-CB subtests were significantly different across groups, with scores adjusted for age, sex, and education.

**Results:** Mean age was 69.1 (SD=8.4), with the InMCI group being significantly younger than both the naMCI and aMCI groups ( $p < 0.05$ ). The overall model revealed a significant group effect on all NIHTB-CB tests except for the Picture Vocabulary Test ( $p > 0.05$ ). Between-group comparisons showed that all subtest scores were significantly worse for DAT participants relative to the other groups (all  $p < 0.05$ ), aside from the Oral Reading subtest (DAT < NL, InMCI, and aMCI). Further, the List Sorting Task appeared to offer the best discrimination between groups (DAT < naMCI and aMCI < InMCI, which did not differ from NL). No significant differences were seen between the aMCI and naMCI groups on that task. With regard to aMCI vs naMCI differentiation, the aMCI group performed significantly worse than the naMCI group on the Picture Sequence Memory Task.

**Conclusions:** This study provides preliminary evidence for the relative sensitivity of subtests of the NIHTB-CB towards identifying individuals with a variety of neurocognitive diagnoses. As expected, the DAT group performed worst on all tasks, with the exception of a Crystallized subtest, Picture Vocabulary. Additionally, tasks of working memory and episodic memory (list sorting and picture sequence memory, respectively) showed the greatest number of significant differences between diagnostic groups. In particular, the picture sequence memory task showed significant differences between aMCI and naMCI, highlighting the importance of this subtest for early diagnostic differentiation. Research with a larger sample within each diagnostic group could explore these interactions within a discriminant function framework to determine the convergent validity of these measures with traditional paper-pencil assessments and to provide a thorough evaluation of which are the most critical subtests of the NIHTB-CB for optimal diagnostic discrimination.

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**Keywords:** computerized neuropsychological testing, memory disorders, mild cognitive Impairment

**K. L. VICKERS, S. M. MAGINGA, L. LEVY, C. W. CHENG, M. G. COLEMAN, F. C. GOLDSTEIN. Self-Reported Cognitive Barriers to Behavioral Regimen Adherence in Mild Cognitive Impairment (MCI).**

**Objective:** Individuals with Mild Cognitive Impairment (MCI) have high rates of non-adherence to healthcare recommendations due to both cognitive and motivational factors. Adherence rates decline further as regimen complexity increases. Given the importance of lifestyle changes for allaying cognitive decline in MCI, and the complexity of these unstructured behavioral regimens,

it is critical to understand and address barriers to non-adherence in this population. The present study aims to explore perceived importance of different behavioral regimens prescribed to individuals with MCI and self-reported cognitive barriers underlying non-adherence.

**Participants and Methods:** 7 individuals diagnosed with MCI ( $M_{\text{Age}} = 73.3$  years,  $SD_{\text{Age}} = 8.7$  years) who were enrolled in Emory University's Cognitive Empowerment Program (CEP) participated in virtual focus groups and reported on personal difficulties adhering to various lifestyle interventions, including physical exercise, nutrition, cognitive stimulation, social engagement, and emotional wellness. MCI participants underwent cognitive testing prior to enrollment, including a screening measure of global functioning ( $M_{\text{MOCA}} = 19.4$ ,  $SD_{\text{MOCA}} = 2.8$ ). Participants were also asked to report the subjective importance of different behavioral interventions. These were rated on a scale from 1 to 10, with 10 indicating extreme importance (Exercise:  $M = 9.3$ ,  $SD = 1.9$ ; Nutrition:  $M = 9.0$ ,  $SD = 1.8$ ; Cognitive Activity:  $M = 8.9$ ,  $SD = 2.0$ ; Social Activity:  $M = 8.4$ ,  $SD = 2.7$ ; Emotional Wellness:  $M = 8.7$ ,  $SD = 2.4$ ).

**Results:** One-way analysis of variance revealed no significant difference in perceived importance of different behavioral regimens,  $F(4, 30) = 0.15$ ,  $p = .96$ . Qualitative thematic analysis was employed to identify major themes of non-adherence. This revealed self-reported cognitive difficulties which represented barriers across all behavioral regimens assessed, though the type of cognitive barrier differed by behavior. Across physical regimens (exercise and diet), the primary cognitive complaint was forgetting. For cognitive activity, individuals with MCI reported feeling quickly losing interest and feeling cognitively fatigued. For social activity, participants reported difficulties planning ahead and a lack of confidence in communication abilities.

**Conclusions:** The present study found that individuals with MCI self-reported significant cognitive barriers to engaging in behavioral regimens that may help allay cognitive decline. Despite reporting high importance for all behavioral interventions, the MCI group generally reported significant difficulties engaging in these behaviors without the help of others. This is significant because few studies to date have queried individuals with MCI about barriers they experience and no studies have explored whether the nature of cognitive failures differs by prescribed behavioral regimen. Future directions include comparison of results to care partner reporting and quantitative exploration of adherence behaviors for different behavioral interventions.

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**Keywords:** mild cognitive impairment, cognitive rehabilitation, memory complaints

### **E. K. BRENNER, E. C. GROSSNER, R. A. BERNIER, F. G. HILLARY. Examining the Effect of Cognitive Reserve on Dynamic Connectivity in Individuals with Mild Cognitive Impairment.**

**Objective:** Mild cognitive impairment (MCI) is widely regarded as an intermediate stage between typical aging and dementia, with nearly 50% of patients with amnesic MCI converting to Alzheimer's dementia (AD) within 30 months of follow-up (Fischer et al., 2007). Given the growing relevance of MCI and AD as the older adult population grows, there is increased need for research to understand protective factors of these diseases. One such factor, cognitive reserve (CR), refers to the observation that two individuals with similar or identical disease pathology can present as functionally different (Stern, 2002). Using resting-state fMRI, dynamic connectivity is a novel approach that allows for increased sensitivity to subtle temporal

variations that can be missed using static connectivity methods. This study is a replication of previous work using dynamic connectivity to examine the distinct brain states that differentiate individuals with MCI from cognitively normal individuals (CN; Brenner et al., 2018). It also extends our previous work by investigating how CR may play a role in these dynamic profiles.

**Participants and Methods:** Data from the Alzheimer's Disease Neuroimaging Initiative were used, including 54 CNs (Age: 79.13 [SD=6.62]; 34 women [63%]; Education: 16.24 [SD=2.27]) and 60 patients with MCI (Age: 76.15 [SD=8.54]; 24 women [40%]; Education: 15.87 [SD=3.02]) who underwent resting-state fMRI and neuropsychological testing. We used dynamic connectivity modeling and graph theory to identify unique brain "states," or temporal patterns of connectivity across distributed networks. Network cost was the sum of the product of the Euclidean distance between a pair of ROIs and the absolute correlation for each significant edge (connection) (Roy et al., 2017). CR was estimated using a composite comprised of education and premorbid functioning (National Adult Reading Test). Outcome variables included immediate and delayed memory composites and confrontational naming.

**Results:** Participants with MCI largely demonstrated brain dynamics characterized by a single state dominating 41.3% of the rest-period activity, significantly more than any other state,  $p < 0.05$ , (compared to 31.7% by the CN group). They also showed a second, less frequently attended state characterized by high network cost. CR did not moderate the relationship between proportion of time spent in the costliest state to the most common state and performance in either group. Lastly, exploratory analyses examining salience network (SN) cost in each state identified significant interactions between CR and costliest state SN cost on performance in both MCI and CN groups,  $p < 0.05$ .

**Conclusions:** Individuals with MCI were more likely to spend time in a single dominant state, a finding that is consistent with both our previous results and diminished network dynamics observed in other neurological disorders that may be attributable to reduced flexibility in resource allocation. Additional results suggest that having increased SN cost in the costliest state is associated with the benefit of CR. Structural and functional SN disruption are found in both MCI and AD (He et al., 2014), so it is possible that CR is expressed in specific regional networks targeted in disease. Future research should further examine what role CR may play in moderating the relationship between SN connectivity and behavior in MCI and AD.

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**Keywords:** neuroimaging; functional connectivity, mild cognitive impairment, cognitive reserve

#### **D. WEITZNER, M. CALAMIA. Baseline Serial Position Effects Predict Functioning at 10-Year Follow Up.**

**Objective:** There has been a growing literature identifying subtle changes that occur early in mild cognitive impairment (MCI). Such changes include difficulties in instrumental activities of daily living (IADLs), and thus changes in functioning represents a potential target for intervention. Previous research has demonstrated that memory performance predicts everyday functioning 5 years after baseline; however, it is not known if there is a specific aspect of memory driving this relationship. Although total memory scores (e.g., total learning) are primarily used in clinical settings and previous research studies, process scores provide information about how a total score was obtained. Process scores, such as serial position effects, have been shown to improve prediction of later cognitive impairment beyond that of total memory scores. Specifically, some research suggests that primacy effects demonstrate the

strongest evidence of predicting future cognitive decline. However, previous research has not explored whether primacy performance can predict later functioning.

**Participants and Methods:** Participants included 2,802 older adults (75.87% female, mean age of 73.63 years ( $SD = 5.91$ ), range: 65-94 years) enrolled in the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE). ACTIVE is a multi-site, randomized, controlled cognitive training intervention study among older adults. The learning trials from the Rey Auditory Verbal Learning Test (RAVLT), Hopkins Verbal Learning Test (HVLT), and Rivermead Behavioral Paragraph Recall (RBPR) test were used to measure memory performance. The Everyday Problems Test (EPT) and Observed Tasks of Daily Living (OTDL) were performance tasks used to measure everyday functioning. The Minimum Database – Home Care (MDS-HC) everyday functioning subscales were used as subjective measures of functioning. Hierarchical linear regressions were conducted including demographic variables, training condition, Mini-Mental State Examination (MMSE) baseline score, baseline memory total scores, and process scores as predictors of performance and subjective measures of functioning at 10 years post baseline.

**Results:** Baseline primacy scores from the RAVLT added unique variance when controlling for demographic variables, training condition, MMSE score, and total scores from the RAVLT, HVLT, and RBPR on subjective measures (i.e., subjective performance ( $\beta = .310$ ), subjective difficulty ( $\beta = .274, p = .004$ ), and subjective independence ( $\beta = .203, p = .043$ )). In addition, baseline primacy scores from the RAVLT added unique variance on objective performance measures (i.e., OTDL ( $\beta = .099, p = .019$ ) and the EPT ( $\beta = .078, p = .030$ )).

**Conclusion:** Primacy has previously been demonstrated to add unique variance in predicting future cognitive decline and conversion from mild cognitive impairment (MCI) to dementia. To the author's knowledge, this is the first study to demonstrate that primacy predicts future objective and subjective functioning when controlling for total memory scores. In addition, the current study found that, for two subjective functioning measures, baseline primacy performance predicted functioning at 10 years post base-line, whereas total memory scores did not.

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**Keywords:** memory disorders, everyday functioning

### **C. PETTIGREW, A. F. SOLDAN, Y. ZHU, M. WANG, K. KUTTON, M. BILGEL, M. I. MILLER, M. ALBERT. Computerized Paired Associate Learning Task is Sensitive to Cortical Amyloid Burden.**

**Objective:** It is now recognized that AD biomarkers become abnormal among cognitively normal participants, during the preclinical phase of AD, many years prior to the emergence of clinical symptoms. With Alzheimer's disease (AD) prevention trials moving to MCI and asymptomatic populations, there is a need to identify brief, computerized measures that are sensitive to early cognitive changes, as well as the presence of AD pathology. This study examined whether a computerized measure of visual paired associate learning and retention was related to cortical amyloid burden, as measured by Positron Emission Tomography (PET).

**Participants and Methods:** Participants from the BIOCARD study ( $N = 73$  participants, including  $n = 11$  MCI and  $n = 62$  cognitively normal;  $M$  age = 70 years) completed the CANTAB Paired Associates Learning (PAL) task during their annual visit, and also received a Pittsburgh Compound B ( $^{11}\text{C}$ -PiB) PET scan within approximately 1 year ( $M$  gap = 178 days). The PAL task was administered via iPad using the CANTAB app (Cambridge Cognition,

Cambridge, UK). The primary outcome was the total number of errors at the 6- and 8-item stages. For the amyloid PET scans, Distribution Volume Ratios (DVR) were computed using cerebellar gray matter as the reference tissue. Mean cortical amyloid burden was calculated by averaging cortical DVRs, and amyloid positivity was defined at a mean cortical DVR threshold of 1.06 derived from Gaussian mixture modeling. Linear and logistic regression models were examined. Model covariates included age, sex, years of education, diagnosis (normal vs. MCI), and prior PAL task exposure.

**Results:** On average, PAL error scores were higher among the participants with MCI, relative to the cognitively normal participants ( $M$  error scores = 46.5 vs. 17.3, respectively;  $p < .001$ ). Twenty-four (33%) participants were classified as PiB positive, and PiB positivity rates were similar between the MCI (36.4%) and cognitively normal (32.3%) groups. In linear regression analyses, amyloid positivity was associated with higher PAL error scores (regression coefficient estimate = 0.55, 95% CI (0.10, 1.01),  $p = .018$ ), and the pattern of results was similar when cortical amyloid burden was treated as a continuous variable (regression coefficient estimate = 0.22, 95% CI (-0.002, 0.45),  $p = 0.052$ ). Additionally, in logistic regression analyses, PAL performance predicted amyloid positivity (odds ratio estimate = 2.03, 95% CI (1.13, 4.31),  $p = 0.031$ ).

**Conclusions:** These findings suggest that CANTAB PAL performance is sensitive to cortical amyloid burden in non-demented individuals. Additional longitudinal analyses are needed to determine whether this task is useful for tracking the progression of AD pathology during the early phases of AD.

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**Keywords:** computerized neuropsychological testing, cognitive neuroscience, positron emission tomography

**L. V. GRAVES, E. EDMONDS, K. R. THOMAS, A. J. WEIGAND, S. COOPER, A. STICKEL, Z. Z. ZLATAR, M. W. BONDI. Differences in the Degree of Discrepancy Between Consensus and Actuarial Diagnoses of Mild Cognitive Impairment and Dementia in Older Non-Hispanic White and Underrepresented Minority Individuals.**

**Objective:** Our group recently demonstrated that actuarial neuropsychological criteria may improve diagnostic accuracy relative to consensus methods in the National Alzheimer's Coordinating Center's (NACC) Uniform Data Set (UDS), across the continuum of normal aging, mild cognitive impairment (MCI), and dementia. We found that actuarial diagnostic groups based on neuropsychological performance corresponded with group comparisons on apolipoprotein E (APOE) e4 carrier status. Moreover, global Clinical Dementia Rating (CDR) scores were more consistent with consensus diagnoses than with performance on comprehensive neuropsychological testing and corresponding actuarial diagnoses. Here, we extend our previous investigation by examining differences in the degree of discrepancy between consensus and actuarial diagnoses of normal cognition (CN), MCI, and dementia in older non-Hispanic White (NHW) and underrepresented minority (URM) individuals in our original sample from the NACC UDS. **Participants and Methods:** We compared rates of baseline actuarial and consensus diagnoses of CN, MCI, and dementia in NHW (92%;  $n=1401$ ) and URM (including Black/African-American [4%], Hispanic/Latino [2%], Asian [1%], multiracial [2%];  $n=123$ ) individuals ages 55 and older in the NACC UDS. We also assessed whether neuropsychological performance, CDR scores, and APOE e4 carrier status (positive, negative) among participants

with consensus diagnoses of MCI or dementia had similar effects by race/ethnicity. **Results:** Among participants with consensus diagnoses of CN, the percentage of those actuarially-diagnosed as CN was comparable between the NHW (66%) and URM (67%) groups. Among participants with consensus diagnoses of MCI, the percentage of those actuarially-diagnosed with MCI was lower in the NHW group (66%) than the URM group (79%), which corresponded with a higher percentage of participants actuarially-diagnosed with dementia in the NHW group (18%) than the URM group (4%). Among participants with consensus diagnoses of dementia, the percentage of those actuarially-diagnosed with dementia was lower in the URM group (69%) than the NHW group (77%), which corresponded to a higher percentage of participants actuarially-diagnosed as CN or with MCI in the URM group (31%) than the NHW group (23%). Analyses of individuals with consensus diagnoses of MCI or dementia showed no effects of neuropsychological test performance, CDR global or Sum of Boxes scores, or APOE e4 carrier status by race/ethnicity ( $ps > .05$ ). However, CDR Sum of Boxes scores were significantly correlated with performance on comprehensive neuropsychological testing in the NHW group ( $ps < .005$  on 7/11 tests in the MCI group, and 10/11 tests in the dementia group), whereas this correlation was not observed in the URM group ( $ps > .005$  on 9/11 tests in the MCI group, and 10/11 tests in the dementia group). **Conclusions:** The present results highlight differences in the degree of discrepancy between consensus and actuarial diagnoses of MCI and dementia among older NHW and URM individuals in the NACC UDS. Findings further underscore the limitations of relying heavily on the CDR in diagnostic decision-making, particularly when assessing URM individuals, and bolster support for using actuarial criteria based on comprehensive neuropsychological testing to render MCI and dementia diagnoses. Further investigation of the factors contributing to the observed differences in the degree of diagnostic discrepancy by race/ethnicity is warranted.

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**Keywords:** mild cognitive impairment, dementia - Alzheimer's disease, minority issues

### **K. MAPLE, N. MATTEK, Z. BEATTIE, J. KAYE, A. HUGHES. Cognitive Functioning Moderates the Relationship Between Sleep Quality and Medication Management in Older Adults.**

**Objective.** Poor medication management is related to negative health outcomes and can be an early indicator of cognitive decline. Poor sleep quality is associated with less engagement in healthy behaviors, as well as adverse health outcomes, such as low mood, that can negatively impact medication compliance. The present study investigated: (1) the relationship between self-reported aspects of sleep quality and objective measures of medication management in older adults at risk for cognitive decline and (2) whether cognitive status or neuropsychological performance moderated this relationship.

**Participants and Methods:.** Participants included 92 community-dwelling older adults (67.4% male), 30 of whom were Veterans, classified as healthy controls ( $M$  age = 73.4,  $SD$  = 5.2,  $n$  = 48) or Mild Cognitive Impairment (MCI) ( $M$  age = 73.8,  $SD$  = 6.1,  $n$  = 44) using the Clinical Dementia Rating Scale (CDR) and a battery of neuropsychological tests at baseline. Individuals were recruited in both Oregon and Minnesota. Participants completed health questionnaires (including the Pittsburgh Sleep Quality Index or PSQI) at baseline and took their daily medications from an instrumented pillbox for 12 months. The pillbox recorded whether or not each daily compartment was opened (and closed) and the time(s) it was opened. After

aggregating the first 30 days of medication taking data for each participant, baseline medication variables were calculated, including variabilities in first and last pillbox opening time of day, as well as medication taking adherence (calculated as the number of days with pillbox activity divided by the total number of monitored days). Global PSQI and its seven component scores were used in the analysis. Cognitive variables included MCI group status and global cognitive functioning as well as executive functioning and memory composites. Multiple regressions were used to investigate PSQI and PSQI\*Cognition relationships with medication management variables.

**Results:** Greater sleep efficiency and shorter sleep onset latency were related to increased variability in last daily pillbox opening (each  $p = 0.04$ ). Among those with better global ( $p = 0.03$ ) and subjective ( $p = 0.02$ ) sleep quality, poorer global neuropsychological performance was related to more variability in first daily pillbox opening. Specifically, within those with better subjective sleep quality, poorer executive functioning performance was associated with more variability in first daily pillbox opening ( $p = 0.03$ ). Further, in participants with greater PSQI daytime dysfunction (including daytime somnolence and amotivation), poorer memory was related to greater variability in first daily pillbox opening ( $p = 0.04$ ). Increased sleep medication use was related to less variability in last daily pillbox opening within select groups – those with MCI ( $p = 0.03$ ), those with poorer global neuropsychological performance ( $p = 0.02$ ) and those with poorer executive functioning ( $p < 0.001$ ) performance.

**Conclusions.** With use of objective measurements of medication management, results suggest that better self-reported sleep quality is more strongly related to consistency in daily medication administration than overall adherence to medication regimens. Further, aspects of sleep quality interact with cognitive ability in relation to medication management consistency. These findings may facilitate development of optimally tailored interventions for medication management.

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**Keywords:** sleep, activities of daily living, cognitive functioning

**T. S. PATERSON, P. R. RAAMANA, S. C. STROTHER, K. A. STOKES, B. LEVINE, M. FREEDMAN, A. TROYER. Comparison of Predictive Power of Three Cognitive Screening Measures for the Prediction of Amnesic Mild Cognitive Impairment.**

**Objective:** in the context of our aging population, there is a very real need to establish easily administered assessments with sensitivity to mild cognitive difficulties to facilitate early identification of those who could benefit from potential treatments, and to facilitate research endeavors targeting these groups. Following from a recent examination of the sensitivity and specificity of Cogniciti's Brain Health Assessment (BHA) to detect amnesic mild cognitive impairment (aMCI) in community dwelling older adults, we compared the predictive diagnostic accuracy between the BHA, the Montreal Cognitive Assessment (MoCA), and the Toronto Cognitive Assessment (TorCA) employing the best practices in machine learning.

**Participants and Methods:** Ninety-one adults aged 60-89 were recruited from Baycrest Health Sciences, and underwent a neuropsychological assessment (gold standard) to determine diagnosis of normal cognition (NC) or aMCI (by consensus of 3 registered neuropsychologists). Participants also completed the BHA online, and were administered the MoCA and TorCA by a trained research assistant.

Participant scores on each of the three screening measures were used as input features to train a Random Forest classifier, in order to evaluate their collective predictive power in predicting

aMCI in a nested cross-validation setup with neuropredict (<https://raamana.github.io/neuropredict/>). We also investigated the weight of these subscale/domain measures to gain insight into their individual importance.

**Results:** Fifty-one participants were diagnosed with aMCI and 40 as NC based on neuropsychological assessment, with no age, gender, or education differences seen between groups. The balanced accuracy in predicting aMCI diagnosis was approximately 74% for the BHA, approximately 64% for the TorCA, and only 50% for the MoCA, equivalent to chance level. Similar differences were also observed for area under the receiver operating curve (AUROC) between these three measures. Feature importance analysis indicated that memory sub-scores carried the most weight in each screening measure's predictive utility.

**Conclusions:** Based on comprehensive evaluation of predictive power, the accuracy of the BHA (a self-administered, online measure) against the gold standard is slightly better than that of the TorCA (a practitioner-administered iPad assisted measure), while both of these screeners appear to have better accuracy than the MoCA (practitioner-administered, short paper and pencil task) in predicting aMCI. These results support the validity of the BHA and TorCA as likely cost- and time-efficient tools for use in streamlining pre-assessment for aMCI by medical practitioners. Future analyses will further examine the utility of these measures using potential multiple diagnostic decision cut-points.

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**Keywords:** cognitive screening, mild cognitive impairment, test validity

**M. E. WILLIAMS, J. A. ELMAN, L. K. MCEVOY, G. M. EGLIT, C. E. FRANZ, N. A. GILLESPIE, M. J. LYONS, M. PANIZZON, M. SANDERSON-CIMINO, W. S. KREMEN. Novel midlife Alzheimer's disease brain signature aids 12-year prediction of mild cognitive impairment.**

**Objective:** Neuroimaging signatures based on composite scores of cortical thickness and hippocampal volume predict progression from mild cognitive impairment (MCI) to Alzheimer's disease (AD). However, little is known about the ability of these signatures among cognitively normal (CN) adults to predict progression to MCI. Toward that end, a signature sensitive to microstructural changes that may predate macrostructural atrophy should be useful. We hypothesized that: 1) a validated MRI-derived AD signature based on cortical thickness/subcortical volume in CN middle-aged adults would predict progression to MCI; and 2) a novel gray matter mean diffusivity (MD) signature would be a better predictor than the thickness/volume signature. Additionally, we estimated the heritability of these signatures.

**Participants and Methods:** Participants were in the Vietnam Era Twin Study of Aging. First, we conducted non-twin analyses adjusting AD signatures for age, scanner, and clustering of twin data. Concurrent group differences compared robust-CN and MCI participants at each of three study waves ( $ns=246-367$ ). Predictive analyses included 169 CN men at wave 1 (age=56.1, range=51-60). Our previously published thickness/volume signature derived from independent data, a novel MD signature using the same regions and weights as the thickness/volume signature, age, and an AD polygenic risk score (AD-PRS) were used to predict incident MCI at a follow-up an average of 12 years later (wave 3 age=67.2, range=61-71). We also tested models adjusted for predicted brain age difference scores (PBAD) to determine if signatures were AD-related and not simply aging-related. Next, in twin models we estimated the heritability of the

thickness/volume signature ( $n=430$ ), MD signature ( $n=366$ ), and predicted brain age ( $n=502$ ) at wave 1.

**Results:** There was no group-by-wave interaction, so waves were collapsed for concurrent analyses. The MCI group had higher (worse) MD signature scores than the robust-CN group ( $t_{532.46}=4.12, p<.001, SMD=0.25$ ). This group difference was nonsignificant for the thickness/volume signature. In predictive analyses, age and AD-PRS yielded an area under the curve (AUC) of 0.74 (sensitivity=80.00%; specificity=65.10%). Prediction was significantly improved with addition of the MD signature (AUC=0.83; sensitivity=85.00%; specificity=77.85%;  $p=.009$ ), but not with addition of the thickness/volume signature. A model including both signatures did not improve prediction over a model with only the MD signature. Results held up after adjusting for PBAD. Heritabilities were similar for the signatures and predicted brain age (.65-.72), but phenotypic and genetic correlations were low-to-moderate.

**Conclusions:** An AD brain signature of gray matter MD in CN adults in their 50s enhanced prediction of 12-year progression to MCI, whereas the thickness/volume signature did not. Moreover, the MD signature may have been limited by being yoked to the independently-derived thickness/volume signature weightings. An independently-derived MD signature may thus provide even stronger prediction. AD is highly heritable, and we demonstrated that these AD brain signatures are also highly heritable, but they are not redundant phenotypically or genetically. Given that the brain signatures were examined when participants were only in their 50s, our results suggest a promising step toward improving very early identification of AD risk and the potential value of mean diffusivity and/or multimodal brain signatures.

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**Keywords:** dementia - Alzheimer's disease, neuroimaging: structural, genetics

**J. POMMY, A. M. BUTTS, J. JANECEK, A. NENCKA, Y. WANG, M. FRAN CZAK, J. REUSS, M. AGARWAL, J. HENRY, L. UMFLEET. Neuropsychologically-Driven Cognitive Subtypes in MCI Using a Graph Theoretic Approach.**

**Objective:** A variety of approaches have been utilized in an attempt to best characterize the heterogeneity of neuropsychological profiles in mild cognitive impairment (MCI; e.g., Bondi et al. 2014), however, a consensus has yet to be reached. Community Detection, an analytic approach founded within graph theory, has been applied to neurodevelopmental phenotypes (Fair et al., 2012) and may have the potential to identify novel cognitively-driven phenotypes in the context of neurodegenerative processes. Using the hierarchical map equation aMCI subtypes were examined within a subset of participants from the ADNI data repository.

**Participants and Methods:** A subset of the ADNI data within the MCI group (140 women, 250 men; mean age of 75) diagnosed with aMCI at baseline were selected. The map equation was used to assess for the presence of neuropsychological subtypes based on 19 age-corrected, standardized scores from select neuropsychological tests. Differences in volumetric measures and APOE  $\epsilon 4$  status were examined between cognitive subtypes for those subjects for whom that data was available.

**Results:** Graph analyses revealed 3 communities (i.e., aMCI subtypes) based on neuropsychological scores. The first module ( $N = 202$ ) was characterized by predominantly impaired memory, suggesting more of a single domain presentation. The second group ( $N = 99$ ) was characterized by predominant impairments in language (naming and category fluency) as well as low memory, attention and processing speed, suggesting a multi-domain presentation.

The third module (N =89) was characterized by predominantly variable processing speed and attention. In a multivariate model examining cortical measures (controlling for sex and age, with correction for multiple comparisons) there was a significant main effect of community membership and volume in the hippocampus (Group 1 was significantly smaller than 2 and 3; Group 2 was significantly smaller than Group 3) and entorhinal cortex (Group 1 and 2 were equivalent and both were smaller than Group 3). Finally, APOE  $\epsilon$ 4 status was examined across communities and a trend was found ( $p = 0.069$ ), with increased likelihood of APOE  $\epsilon$ 4 negative status in Group 3 compared to Group 1.

**Conclusions:** Community detection provides an alternative method for identifying neuropsychological subtypes in neurodegenerative disorders. Our results identified 3 cognitive subtypes within the ADNI aMCI group. A more clearly single domain aMCI group (lowest verbal learning and memory, smaller hippocampal volumes), a multidomain aMCI group (with impaired verbal learning and memory, language, attention and speed), and a third group with variable speed and attention that was in the aMCI ADNI sample due to abnormal baseline scores on a story memory measure but were found to have average memory scores on the word list measure used in our analyses. This third group also had statistically significantly larger hippocampal volumes than groups 1 and 2 likely contributing to the variable memory performance and 56% was negative for APOE  $\epsilon$ 4. Future research is needed to further examine the utility of this approach in both aMCI, naMCI, and cognitively normal controls at risk for neurodegenerative disease. It would also be beneficial to explore longitudinal patterns to determine how these aMCI subgroups may inform eventual dementia syndrome.

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**Keywords:** aging disorders, memory disorders, brain structure

**S. RUSSELL-GILLER, T. WU, A. SPAGNA, M. DHAMOON, Q. HAO, J. FAN. Impact of Unilateral Stroke on Right Hemisphere Superiority in Executive Control of Attention.**

**Objective:** In our previous study, we have demonstrated that there is a right hemisphere (RH) superiority in executive control of attention, with the RH being more efficient in dealing with conflict for stimuli presented in the left visual field (LVF). However, the unique and synergetic contribution of the two hemispheres to this superiority effect is still elusive. The purpose of this study was to determine whether the RH superiority effect was supported primarily by the RH or by both hemispheres by observing the performance of patients with unilateral stroke or a transient ischemic attack (TIA) on a lateralized task measuring executive control of attention.

**Participants and Methods:** Twenty-six patients from Mount Sinai Hospital participated in the study (age range = 26 to 81 years old) comprising of three groups: (1) ten patients with a RH ischemic stroke; (2) nine patients with a left hemisphere (LH) ischemic stroke; and (3) seven patients with a TIA without an acute infarction serving as the control group. We used the lateralized attentional network test (revised) to measure the hemispherical differences in executive control of attention. In each trial, patients indicated the direction of a central arrow (target) that appeared in between flanker arrows either pointed in the same (congruent) or opposite (incongruent) direction as the target. A larger conflicts effect (incongruent condition minus congruent condition) in reaction time (RT) indicates less efficient executive control. The conflicts effect was computed separately for the RH and LH corresponding to the presentation of target and flankers in the LVF or the right visual field (RVF). The hemispherical differences in

the conflicts effect in RT were quantified using the lateralization index ( $LI = (LH - RH) / LH + RH$ ).

**Results:** The group difference in LI values of the conflict effect in RT was significant,  $F(2, 23) = 5.50, p = .011$  (RH stroke group:  $M = -.0933$ ; LH stroke group:  $M = -.0452$ ; TIA group:  $M = .2284$ ). The first planned contrast test revealed that the LI for the TIA group was significantly higher than the LI values of the two unilateral stroke groups,  $t(23) = 3.26, p = .004$ , with the TIA group displaying a higher RH superiority in the conflict effect compared to the absence of the RH superiority effect in both unilateral stroke groups. The second planned contrast test showed that the difference between the RH stroke group and LH stroke group was not significant,  $t(23) = 0.51, p > .05$ .

**Conclusions:** In contrast to the TIA group, which demonstrated a RH superiority in conflict processing, there was no evidence for such an effect in both unilateral stroke groups. These results can be explained by our model proposing that there is bilateral hemispheric involvement for conflict processing for information received from the LVF and unilateral hemispheric involvement for conflict processing for information received from the RVF, resulting in more efficient processing for the LVF. When there is damage to either hemisphere, the responsibility of conflict processing will largely fall on the intact hemisphere, eliminating the RH superiority effect.

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**Keywords:** laterality, executive functions, stroke

**D. A. EGGLEFIELD, S. SCHIFF, J. N. MOTTER, J. R. SNEED, B. R. RUTHERFORD, A. GRINBERG. Disentangling the relationship between vascular depression and mild cognitive impairment.**

**Objective:** Vascular depression (VD) is a subtype of late life depression characterized by cerebrovascular disease and cognitive impairment, however, the diagnostic status of VD is controversial and there is a need to disentangle the relationship between VD and other late-life psychiatric disorders such as Mild Cognitive Impairment (MCI). The phenomenological and neurologic overlap between VD and MCI poses the possibility that VD may precede MCI in the depression-dementia relationship. Reduced cortical thickness and hippocampal volume are prevalent markers of late life depression as well as MCI. Specifically, the medial temporal lobe and precuneus gyrus are among the first regions to atrophy in cognitively normal individuals who later convert to MCI. These variables, however, are conspicuously absent in the vascular depression (VD) literature. This study aimed to determine differences in cortical thickness and hippocampal volume between VD and non-VD patients. In keeping with the idea that VD may be a prodromal phase to MCI, the present study hypothesized that VD patients would show reduced thickness in medial temporal regions and the precuneus and reduced hippocampal volume compared to non-VD patients.

**Participants and Methods:** Depressed adults aged 50 and older were enrolled in an 8-week open treatment antidepressant trial at two sites, the New York State Psychiatric Institute and Harlem Hospital Center. Participants ( $n=41$ ) underwent clinical and neuropsychological assessment and brain magnetic resonance imaging at baseline and were classified as VD or non-VD according to five definitions. Cortical thickness and hippocampal volume were linearly regressed on VD status for each definition of VD. Analyses were adjusted for site, age, and sex, and mean thickness or total intracranial volume for cortical regions or hippocampal volume.

**Results:** No statistical differences were found between VD and non-VD patients in thickness of the bilateral precuneus, entorhinal, or parahippocampal cortices, or hippocampal volume ( $p > .001$ ), regardless of definition. Agreement between the five classifications of VD was fairly low, Fleiss'  $K=.38$ , (95% CI, .28 to .48),  $p \leq .001$ .

**Conclusion:** The absence of statistical differences in grey matter atrophy between VD and non-VD patients raises several diagnostic, etiological, and developmental possibilities, namely that VD may not be connected with other late-life psychiatric illnesses such as MCI or dementia and that vascular disease may not be a common etiological risk factor for depression and dementia. Low agreement between the various VD definitions demonstrates the heterogeneity of the VD construct. Larger datasets, prospective longitudinal studies, and cognitively intact controls are needed to further address these types of questions.

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**Keywords:** cerebrovascular disease, depression, mild cognitive impairment

**M. S. SHAH, T. LAI, L. V. TASTARD, J. LAI, M. FRANDO, G. BRITZ, M. DULAY. Cognitive Difficulties Contribute to Post-Stroke Depression.**

**Objective:** Mood and anxiety are often considered predictors of cognitive difficulties after a cerebrovascular accident (CVA), but the relationship is likely bidirectional. Executive difficulties, such as trouble with making decisions or inhibiting responses, likely contribute to frustration and trouble managing emotions (e.g., Povroznik et al., 2018). Likewise, difficulties with concentration and memory contribute to sadness and depression secondary to increased frustration and stress (e.g., Zawadzka & Domanska, 2018). This study evaluated the relative predictive utility of 5 cognitive domains (memory, executive functioning, language, processing speed, and attention) in accounting for post-stroke depression (PSD).

**Participants and Methods:** The sample consisted of 353 patients (mean age 59.3 years, 49.3% female, average 2.5 years of college, 59.3% Caucasian, 62.3% married) evaluated 7.6 months after sustaining an MRI verified CVA of various locations (with 44.2% having a left-sided CVA, 42.8% right, and 13% bilateral). Patients were excluded if they had comorbid neurologic diagnoses (e.g., hydrocephalus, seizures), comprehension difficulties, or an MMSE score below 20. Testing included a standardized comprehensive neuropsychological battery. The Mini International Neuropsychiatric Inventory was used to determine DSM-IV-TR diagnosis of a mood disorder (major depression, dysthymic disorder, or adjustment disorder). Work or disability status, history of treatment of depression prior to the CVA, side and localization of CVA, and time since CVA were covaried in logistic regression analyses.

**Results:** There were high percentages of cognitive difficulties in the sample (71.1% with executive difficulties, 68.6% with memory difficulties, 38.8% with language difficulties, 26.1% with reduced cognitive processing speed, 25.5% with reduced attentional focus and sustained concentration, and 16.7% with visuoconstructional difficulties). PSD occurred in 30.6% of patients. Logistic regression indicated that memory and language difficulties were significant predictors of PSD ( $p$  values  $< 0.001$ ). Of the covariates, a history of treatment of depression prior to the CVA was the only significant predictor of PSD.

**Conclusions:** Results demonstrated that forgetfulness and expressive language difficulties are associated with post-stroke depression. Interventions that target memory and language problems after stroke would likely have the added benefit of contributing to co-occurring improvements in mood.

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**Keywords:** cerebrovascular injury, memory disorders, depression

**D. A. LOPEZ PALACIOS, A. O. LOPEZ, S. SAVAGE, L. Y. NO, D. GIBSON. Effects of Multiple Cerebral Vascular Accidents on an Executive Functioning Task.**

**Objective:** To determine whether there is a difference in performance on an executive functioning task between patients with a history of multiple strokes and patients with a history of a single stroke.

**Participants and Method:** The data from this study was derived from a large de-identified database from the National Alzheimer's Coordinating Center containing neuropsychological information for patients who have sustained multiple strokes (n=219) that had completed Trail Making Test Part B. The sample was divided into two groups: those that reported having sustained multiple strokes (n=159; mean age=73.29; SD=8.57), and those who reported having sustained a single stroke (n=60; mean age=74.03; SD=8.46).

**Results:** An Independent-sample-t-test showed a difference in performance between those who reported multiple strokes [ $F(6.822)=53.737, p<0.039$ ] and those who reported experiencing a single stroke. Results indicated that those with multiple strokes performed more poorly than those with a single stroke on a timed measure of visuomotor tracking, set-shifting, flexibility and executive functioning.

**Conclusions:** Strokes are a leading cause of disability in adults (Virani, et al., 2020). Multiple strokes are characterized by several strokes which happen in a short period of time in the brain. Strokes are defined as the sudden death of brain cells due to a lack of oxygen, caused by blockage of blood flow or a rupture of an artery in the brain. Studies have shown that a patient's quality of life can be negatively impacted following a stroke, specifically when affecting an individual's executive functioning abilities (Povroznik et al., 2018). Research shows that on average, 75% of patients that suffer a stroke will have executive functioning difficulties (Chung, et al., 2013). Further, multiple subcortical lacunes can lead to frontal system dysfunction, which has been correlated with deficits in shifting mental sets, inhibition control, and overall executive functioning (Wolfe et al., 1990). Studies have also indicated that the main reason for the frequent decline in executive functioning following a stroke is the absence of medical assistance post-trauma. The current results suggest that there is a significant difference in executive functioning in individuals who have experienced multiple strokes compared to those who have experienced a single stroke. Additionally, individuals who have had multiple lacunes scored significantly lower on the Mini Mental Status Exam (MMSE), further indicating that increasing lesions worsen their overall cognitive ability, specially their executive functioning (Wolfe et al., 1990). Moreover, these findings support previous research, suggesting that sustaining multiple strokes can lead to greater cognitive decline. Thus, the current results highlight the need to address strokes during the post-trauma phase in order to optimize rehabilitation outcomes.

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**Keywords:** stroke, neuropsychological assessment, brain damage

**S. DEVAUGHN, J. PRESTOPNIK, R. CAMPBELL, A. CAPRIHAN, G. ROSENBERG. Verbal Fluency and Processing Speed are Associated with White Matter Burden Beyond Vascular Disease in a Heterogenous Sample of Older Adults.**

**Objective:** There has been an increased awareness of the role of vascular risk factors and neuroinflammation in accelerating cognitive decline with aging and its implication in the development of neurodegenerative processes like Alzheimer's disease. Skeletonized mean diffusivity (PSMD) is a fully automated, robust imaging marker that quantifies white matter burden utilizing diffusion tensor imaging (DTI). White matter burden increases with age particularly among individuals with vascular disease. We sought to identify which commonly utilized cognitive measures of executive function, processing speed, and memory are associated with PSMD in a heterogeneous sample of older adults beyond vascular risk factors.

**Participants and Methods:** A total of 249 participants (age  $\bar{x}$  = 64,  $sd$  = 13) completed comprehensive neuropsychological assessment and brain MRI. Participants were classified into the following clinical groups via neurology consensus: leukoaraiosis (LA,  $n$  = 33), multi infarct (MI,  $n$  = 21), mixed ( $n$  = 16), small vessel disease (SVD,  $n$  = 60), Alzheimer's disease (AD,  $n$  = 37), and controls ( $n$  = 82). PSMD was calculated using a published, automated algorithm and standardized on the control group (PSMDZ) with higher values indicating greater white matter burden. Demographic data and history of vascular disease were obtained via neurobehavioral interview. Partial correlations were specified to determine the associations between PSMDZ with processing speed (Trail Making Test Part A, Digit Symbol, Symbol Search), episodic memory (Hopkins Verbal Learning Test immediate and delayed recall, Rey Complex Figure Test immediate and delayed recall), and executive functioning (Trail Making Test Part B, FAS, Animal Fluency) controlling for age, sex, education, and vascular risk factors (history of hypertension, diabetes mellitus, and sleep apnea). Follow up analyses were conducted in a subset of participants ( $n$  = 39) that underwent screening of cognitive functioning with the Montreal Cognitive Assessment (MoCA) using the same parameters while controlling for global cognitive functioning.

**Results:** Greater white matter burden was significantly associated with performance on all neuropsychological measures except for Trail Making Test Part A with small effect sizes. Highest partial correlations were observed for processing speed and executive function. Controlling for global cognitive function in a subset of participants revealed significant correlations of white matter burden with FAS ( $r$  = -0.34,  $p$  = 0.04), Trail Making Test Part A ( $r$  = 0.36,  $p$  = 0.03), and Digit Symbol ( $r$  = -0.39,  $p$  = 0.02) with moderate effect sizes.

**Conclusions:** Severity of white matter burden utilizing PSMD was significantly associated with neuropsychological test performance beyond vascular disease in a heterogeneous sample of older adults comprised of healthy controls and various clinical syndromes. Verbal fluency and processing speed may be sensitive markers of white matter burden beyond global cognitive functioning and vascular disease.

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**Keywords:** vascular cognitive impairment, neuroimaging: structural connectivity, aging disorders

**J. R. ANDERSON, J. T. MARTIN, K. R. CHAPMAN, A. SUCHAN, M. SPITZNAGEL.**  
**Using machine learning to predict caregiver communication patterns in a geriatric clinic.**

**Objective:** Caregiver burden is common among individuals caring for patients in geriatric settings, and this burden may increase use of clinic resources. Methods to predict communication patterns from caregivers to the clinic, the clinic to the caregiver and outside agencies, and within the clinic could facilitate preemptive allocation of resources to those who are likely to need the

most resources, improving caregiver, patient, and clinic outcomes. The current study evaluated the use of a machine learning model to determine the most useful records-based variables for predicting communication patterns in a geriatric clinic when managing patient care. In addition, the current study aimed to gauge the use of such a model in predicting clinic communication needs for future caregiver-patient dyads.

**Participants and Methods:** We reviewed the medical records of 557 consecutively registered older adults (average age: 79.42 yrs; 64.81% female) who established care at a geriatric clinic and were accompanied by a primary caregiver (average age: 62.69 yrs, 70.02% female). As part of a standard intake appointment, caregivers completed several measures pertaining to themselves and the patient, including the Zarit Burden Interview (ZBI), Cohen-Mansfield Agitation Inventory (CMAI), Positive Aspects of Caregiving (PAC), Self-Mastery Scale (SMS), and BEHAV5. Patients completed the Patient Health Questionnaire-9 (PHQ9), as well as a global cognition measure (Montreal Cognitive Assessment; MoCA; or Mini Mental State Exam; MMSE). Additional information, including medical diagnoses, mental health diagnoses and medications, was ascertained via medical record review. Two independent raters reviewed the subsequent 12 months of patient records to determine 1) the number of incoming caregiver calls to the clinic (incoming calls), 2) the number of outgoing clinic calls from the clinic related to patient care (outgoing calls), and 3) the number of electronic communications between clinic workers about each patient's care (clinic communications). We addressed missing data using multiple imputation, resulting in ten sets of complete data. Each dataset was divided into a training (80% of caregiver-patient dyads) and test (20% of caregiver-patient dyads) set to evaluate how well models would generalize to new caregiver-patient dyads. The training and test samples consisted of the same caregiver-patient dyads across datasets.

**Results:** Random forest models' average explained variance in training sets for incoming calls, outgoing calls, and clinic communications were 7.42%, 3.65%, and 6.23%, respectively. Permutation importances revealed that the strongest predictors for all three outcomes were the BEHAV5, the ZBI, CMAI subscales, caregiver and patient age, patient body mass index, and patient global cognition scores. Average explained variance in test sets for incoming calls, outgoing calls, and clinic communications were 1.79%, 0.70%, and 1.74%, respectively.

**Conclusions:** The BEHAV5, ZBI, CMAI, caregiver and patient age, patient body mass index, and global cognition measures may be useful predictors of communication patterns for patient care in a geriatric clinic. However, the models' ability to predict communication patterns was reduced when examining new patients, suggesting a need for different variables to improve generalization. Future studies should determine directionality and interactions among variables and consider additional caregiver variables, such as personality characteristics (e.g., conscientiousness, neuroticism).

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**Keywords:** caregiver burden

**A. M. SANDLIN, J. D. SAWYER, L. N. SMITH, J. H. HELPHREY, A. M. COLDIRON, B. K. MOKHTARI, J. M. MOORE, M. D. BARNETT. Validation of the Virtual Kitchen Protocol: Correlations Between Verbal Memory and Procedural Learning in Virtual Reality Among Older Adults.**

**Objective:** Neuropsychologists have argued that virtual reality may provide more valid measures of everyday functioning. The Virtual Kitchen Protocol (VKP) is a virtual reality-based measure

of procedural learning and memory for meal preparation tasks. The purpose of this preliminary study was to investigate the construct validity of the VPK by examining correlations with a traditional measure of verbal learning and memory (i.e., the CVLT-II).

**Method:** 51 older adults ages 55-90 ( $M = 72.77$ ,  $SD = 7.87$ ) without neurocognitive diagnoses completed a neuropsychological test battery that includes the CVLT-II and the VKP, which measures immediate memory, delayed memory, and recognition in virtual reality.

**Results:** Moderate to high correlations were found between the VKP and CVLT-II immediate recall ( $r = .64$ ,  $p < .01$ ), delayed recall ( $r = .41$ ,  $p < .01$ ), and forced choice recognition ( $r = .822$ ,  $p < .01$ ).

**Conclusions:** These results provide support for the construct validity of the VPK as a measure of immediate and delayed recall.

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**Keywords:** cognitive neuroscience, learning, memory: normal

**S. DUTT, B. YEW, Y. LI, A. GAUBERT, J. K. HO, J. JANG, A. E. BLANKEN, I. SIBLE, A. MARSHALL, A. KAPOOR, X. SHAO, D. J. WANG, D. A. NATION. Memory Dysfunction is Linked to Medial Temporal Hypoperfusion in APOE4 Carriers.**

**Objective:** The apolipoprotein e4 (APOE4) allele is the major genetic contributor to Alzheimer's disease (AD). Cerebrovascular dysfunction, including abnormalities in cerebral perfusion, have been linked to the presence of APOE4 in normal aging, mild cognitive impairment, and AD. However, there is no consensus regarding the directionality of relationships between regional perfusion and memory performance, as existing studies have reported both positive and negative correlations. The present study examined whether regional cerebral perfusion levels in temporal and parietal areas, as well as subregions of the medial temporal lobe, were related to cognitive markers of memory ability in aging APOE4 carriers and non-carriers.

**Participants and Methods:** Older adults free of dementia or stroke ( $n=37$ ) were recruited from the community. Pseudo-continuous arterial spin labeling MRI quantified cerebral perfusion in *a priori* regions associated with memory function (e.g., medial temporal lobe, posterior cingulate, precuneus, hippocampus, inferior temporal gyrus, parahippocampal gyrus, entorhinal cortex, perirhinal cortex). Neuropsychological testing assessed cognitive function in the domains of visual memory (Visual Reproduction immediate and delayed recall) and verbal memory (Logical Memory immediate and delayed recall). Linear regression models, tested separately for APOE4 carriers ( $n=14$ ) and non-carriers ( $n=23$ ), investigated relationships between regional perfusion and standardized cognitive performance (i.e., scaled scores).

**Results:** Within APOE4 carriers, worse Logical Memory immediate recall was associated with lower perfusion in the right medial temporal lobe ( $\beta=0.63$ ,  $p=0.015$ ), bilateral inferior temporal gyrus (Left  $\beta=0.57$ ,  $p=0.033$ ; Right  $\beta=0.54$ ,  $p=0.045$ ), bilateral perirhinal cortex (Left  $\beta=0.55$ ,  $p=0.043$ ; Right  $\beta=0.61$ ,  $p=0.02$ ), and right parahippocampal gyrus ( $\beta=0.53$ ,  $p=0.05$ ). Worse Logical Memory delayed recall was associated with lower perfusion in bilateral medial temporal lobe (Left  $\beta=0.59$ ,  $p=0.027$ ; Right  $\beta=0.69$ ,  $p=0.007$ ), bilateral inferior temporal gyrus (Left  $\beta=0.68$ ,  $p=0.007$ ; Right  $\beta=0.62$ ,  $p=0.019$ ), bilateral perirhinal cortex (Left  $\beta=0.64$ ,  $p=0.015$ ; Right  $\beta=0.73$ ,  $p=0.003$ ), and right parahippocampal gyrus ( $\beta=0.59$ ,  $p=0.028$ ). In APOE4 carriers, worse Visual Reproduction immediate recall was associated with lower perfusion in the right precuneus ( $\beta=0.53$ ,  $p=0.05$ ), bilateral inferior temporal gyrus (Left  $\beta=0.71$ ,  $p=0.005$ ; Right  $\beta=0.62$ ,  $p=0.018$ ), and bilateral perirhinal cortex (Left  $\beta=0.59$ ,  $p=0.028$ ; Right  $\beta=0.57$ ,  $p=0.033$ ),

and worse Visual Reproduction delayed recall was associated with lower perfusion in left medial temporal lobe ( $\beta=0.53$ ,  $p=0.049$ ), bilateral inferior temporal gyrus (Left  $\beta=0.68$ ,  $p=0.007$ ; Right  $\beta=0.63$ ,  $p=0.016$ ), and bilateral perirhinal cortex (Left  $\beta=0.58$ ,  $p=0.03$ ; Right  $\beta=0.56$ ,  $p=0.036$ ). In APOE4 non-carriers, no significant relationships were observed between memory performance and regional perfusion.

**Conclusions:** In older APOE4 carriers, cerebral hypoperfusion in temporal and parietal regions implicated in memory function correlates with worse memory performance, but there are no relationships between perfusion and memory in APOE4 non-carriers. Results suggest that relationships between deficient memory function and medial temporal hypoperfusion may be specific to those with genetic risk for AD. Subregional findings suggest that the parahippocampal gyrus and perirhinal cortex may experience specific risk for dysregulated perfusion in the presence of the APOE4 allele. These findings may inform interpretation of neuropsychological profiles and their corresponding regional perfusion abnormalities in older APOE4 carriers and non-carriers.

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**Keywords:** cerebral blood flow, apolipoprotein E, dementia - Alzheimer's disease

**E. J. VAN ETTEN, P. K. BHARADWAJ, D. A. RAICHLEN, G. A. HISHAW, T. P. TROUARD, G. E. ALEXANDER. Body Mass Index-related regional covariance patterns of white matter microstructure in healthy older adults.**

**Objective:** Elevated body mass index (BMI) scores are related to increased risk for cerebrovascular disease and have been associated with reductions in white matter integrity (WMI), particularly in whole brain and regional tracts of fractional anisotropy (FA). However, less is known about how BMI impacts other measures of WMI, including mean diffusivity (MD), radial diffusivity (RD), and axial diffusivity (AD). Further, previous studies have primarily utilized univariate analyses for investigating relationships between BMI and WMI. We applied a multivariate statistical method, the Scaled Subprofile Model (SSM; Alexander & Moeller, 1994), to identify regional covariance patterns associated with BMI for each WMI measure. We then examined how these BMI-related WMI patterns differed in relation to age, sex, and vascular risk factors, including white matter hyperintensity (WMH) volume, hypertension, cholesterol, history of smoking, and self-reported physical activity.

**Participants and Methods:** A cohort of 195 cognitively healthy adults (100F/95M, mean $\pm$ sd age = 69.8 $\pm$ 10.6, mean $\pm$ sd BMI 25.4 $\pm$ 4.0), ages 50 to 89 were included. Volumetric T1 and diffusion weighted 3T MRI scans were processed using Freesurfer (v5.3) and TRACULA (Yendiki et al, 2011) to generate FA, MD, RD, and AD values of 18 major white matter tracts. WMH volumes were measured using T1 and T2 FLAIR scans and the lesion segmentation toolbox (Schmidt et al., 2012) with SPM12. The SSM network analyses with 10,000 bootstrapped iterations were performed for each WMI measure to identify a linear combination of white matter tract patterns associated with BMI.

**Results:** There were significant BMI-related regional patterns for FA ( $p < .001$ ) and RD ( $p = .039$ ), accounting for 11.8% and 3.3% of the variance in BMI, respectively. The BMI-FA pattern was characterized by negative loadings from bilateral superior longitudinal fasciculus-parietal (SLFP) and superior longitudinal fasciculus-temporal (SLFT) and positive loadings from right cingulum-angular bundle (CAB) and left uncinat fasciculus (UNC). The BMI-RD pattern was characterized by negative loadings from bilateral CAB and positive loadings from bilateral SLFP

and SLFT. Increasing age was significantly associated with greater expression of the BMI-FA ( $p = .002$ ) and BMI-RD ( $p = .026$ ) patterns and sex was significantly related to the BMI-FA ( $p < .001$ ) and BMI-RD ( $p = .013$ ) patterns, with males experiencing greater expression of the patterns than females. After controlling for age and sex, hypertension status was associated with greater expression of the BMI-FA ( $p = .023$ ) and BMI-RD patterns ( $p = .015$ ) and higher self-reported physical activity was related to less expression of the BMI-FA ( $p < .001$ ) and BMI-RD ( $p = .001$ ) patterns, whereas elevated WMH volume was associated with greater expression of the BMI-RD ( $p < .001$ ), but not the BMI-FA pattern.

**Conclusions:** These findings suggest that, in cognitively healthy older adults, greater BMI is associated with regional patterns of white matter microstructural differences that are exacerbated by increasing age, male sex, and greater vascular risk. Utilizing multivariate network covariance methods, like SSM, may help to advance understanding of the influence of demographic and vascular risk factors on brain aging, with potential for evaluating the effects health and lifestyle interventions for healthy and pathological aging.

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**Keywords:** aging (normal), cerebrovascular disease, neuroimaging: structural connectivity

**Y. LI, S. DUTT, B. YEW, J. K. HO, A. E. BLANKEN, J. JANG, I. SIBLE, A. KAPOOR, A. GAUBERT, X. SHAO, D. J. WANG, D. A. NATION. Regional Cerebral Perfusion Correlates with Semantic Fluency in Older Adults.**

**Objective:** The cerebrovascular system critically supports brain health and cognition in aging in part by steadily supplying nutrients and oxygen from the blood to support energy-demanding neuronal activity. Cerebral hypoperfusion is observed in cognitive impairment and dementia, and may contribute to age-related cognitive dysfunction and neurodegeneration. However, associations between regional cerebral perfusion levels and neuropsychological function in aging have yet to be fully explored. The present study sought to investigate how regional cerebral perfusion relates to semantic fluency, an ability known to decline with aging and to decline further in Alzheimer's and other forms of dementia.

**Participants and Methods:** 41 community-dwelling older adults, free of stroke or other major neurological or psychiatric disorder, completed neuropsychological assessment and brain MRI. Semantic fluency was measured by the Animal Fluency and Fruits and Vegetables Fluency Tests. Resting state cerebral blood flow (rsCBF) was assessed with pseudo-continuous arterial spin labeling. Pearson product-moment correlations related semantic fluency measures to regional rsCBF. Hierarchical linear regression examined significant correlations after controlling for age, sex, and education.

**Results:** Animal Fluency showed medium effect size correlations with rsCBF in the whole brain ( $r=.292$ ,  $p=.032$ ), bilateral caudate (left:  $r=.329$ ,  $p=.018$ ; right:  $r=.392$ ,  $p=.006$ ), bilateral hippocampus (left:  $r=.321$ ,  $p=.020$ ; right:  $r=.344$ ,  $p=.014$ ), bilateral medial temporal lobe (left:  $r=.319$ ,  $p=.021$ ; right:  $r=.530$ ,  $p<.001$ ), right inferior frontal gyrus ( $r=.282$ ,  $p=.037$ ), and right thalamus ( $r=.359$ ,  $p=.011$ ). Fruits and Vegetables Fluency showed small effect size correlations with rsCBF in the right posterior cingulate cortex ( $r=.745$ ,  $p<.001$ ), right hippocampus ( $r=.298$ ,  $p=.029$ ), and right inferior temporal gyrus ( $r=.368$ ,  $p=0.009$ ). After controlling for age, sex, and education, better Animal Fluency correlated with higher rsCBF in left and right caudate (left:  $\beta=0.313$ ,  $p=0.049$ ; right:  $\beta=0.432$ ,  $p=0.011$ ), right hippocampus ( $\beta=0.507$ ,  $p=0.004$ ), left and

right medial temporal lobe (left:  $\beta_s=0.378$ ,  $p=0.023$ ; right:  $\beta_s=0.587$ ,  $p<0.001$ ), right inferior temporal gyrus ( $\beta=0.413$ ,  $p=0.033$ ), and right thalamus ( $\beta=0.378$ ,  $p=0.02$ )

**Conclusions:** Higher regional cerebral perfusion correlates with better semantic fluency ability in older adults. Brain regions implicated include frontal-subcortical systems, as well as medial temporal regions. Future studies should further explore how regional cerebral perfusion relates to neuropsychological function in older adults.

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**Keywords:** aging (normal), cerebral blood flow

**K. LENGU, S. RYAN, S. J. PELTIER, T. TYSZKOWSKI, A. KAIRYS, B. GIORDANI, B. M. HAMPSTEAD. Effects of HD-tDCS on Local Glutamate and GABA Levels among Older Adults with and without Mild Cognitive Impairment.**

**Background:** Prior research suggests transcranial direct current stimulation (tDCS) may exert its effects through the primary excitatory and inhibitory neurotransmitters, glutamate and gamma-aminobutyric acid (GABA), respectively. To date, such evidence has primarily come from healthy young adults. Objective: We sought to examine these putative neurometabolic mechanisms in older adults with mild cognitive impairment (MCI).

**Participants and Methods:** We used data from a double-blind, cross-over, randomized controlled trial (NCT01958437) in a mixed neurologic sample of 32 older adults ( $M_{age}=70.07$ ,  $SD_{age}=6.06$ ) to evaluate tDCS-induced changes in local glutamate and GABA via magnetic resonance spectroscopy (MRS). Participants underwent MRS following two high-definition tDCS (HD-tDCS) sessions (one active, one sham) that targeted the right parietal cortex (center anode at P2) and delivered 2mA for 20 minutes.

**Results:** Contrary to the existing literature showing reduced GABA in healthy, young adults after active tDCS, there were either no changes (whole sample; cognitively intact older adults) or a trend toward increased GABA in those with MCI. To examine the effects of *delivered* current, we used MRI-based computational modeling to estimate strength of electric field (EF) and evaluated the relationship between EF and change in the ratio of glutamate to GABA. Notably, higher EF was significantly correlated with greater inhibition in our MCI group ( $R^2 = 0.651$ ) but was less salient in the cognitively intact older adult group ( $R^2 = 0.141$ ).

**Conclusion:** Altogether, our findings suggest both clinical phenotype and the amount of *delivered* current play a role in HD-tDCS effects. Findings warrant caution in extrapolating findings from young, healthy adults and emphasize the importance of population-specific tDCS parameters.

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**Keywords:** aging disorders, magnetic resonance spectroscopy, neurostimulation

**K. EDWARDS, M. EHMANN, S. RYAN, T. TYSZKOWSKI, A. RAHMAN-FILIPAK, S. J. PELTIER, B. GIORDANI, H. PAULSON, B. M. HAMPSTEAD. Examining the Relationship Between Regional Brain Volumes and HD-tDCS Field Measures in a Mixed Sample of Older Adults.**

**Objective:** High definition transcranial direct current stimulation (HD-tDCS) is a form of non-invasive neuromodulation that may hold promise as an intervention for cognitive impairment. Traditionally, HD-tDCS uses a uniform scalp montage and dosing approach across participants

that fails to account for differences in brain morphology. These differences may impact HD-tDCS effectiveness in relation to the amount of current reaching the brain, measured by electric field (EF) and current density (J). This project investigated the relationship between regional brain volumes and delivered current in two diagnostically relevant sites in a large sample of older adults with and without cognitive deficits.

**Participants and Methods:** We created individualized finite element models (FEM using the ROAST software) and obtained brain volume (via NeuroQuant), from the T1 MRI scans of 369 older adults (n=123 cognitively unimpaired; n=200 mild cognitive impairment (MCI); n=46 dementia). FEM used a 2mA current with center (anodes) at P2 (right superior parietal) and F5 (left inferior frontal) locations of the 10-10 EEG system. Participant data was obtained from studies at the Research Program on Cognitive and Neuromodulation Based Intervention (RP-CNBI) and the Michigan Alzheimer's Disease Research Center (MADRC). We extracted the average EF/J from a 1cm sphere under the center electrode and examined the relationship between delivered values and NeuroQuant regional brain volumes (percent of intracranial volume - %ICV).

**Results:** When controlling for age in a Pearson correlation, regional volumes were positively correlated with EF at P2 ( $r=0.104$ ,  $p=0.043$ ) and both EF and J at F5 (EF:  $r=0.183$ ,  $p<0.001$ ; J:  $r=0.185$ ,  $p<0.001$ ). These relationships persisted in the clinical phenotypes at F5 within MCI (EF:  $p=0.001$ , J:  $p=0.002$ ) and cognitively unimpaired participants (EF:  $p=0.036$ , J:  $p=0.04$ ), but not at P2. Furthermore, a significant relationship was not present within the dementia population. Field measures at F5 were correlated with the frontal lobe left %ICV (EF:  $r=0.221$ ,  $p<0.001$ ; J:  $r=0.207$ ,  $p<0.001$ ). P2 field measures were associated with right parietal lobe %ICV (EF: 0.175,  $p=0.001$ ), right medial parietal %ICV (J:  $r=0.111$ ,  $p=0.031$ ), right inferior parietal %ICV (EF: 0.170,  $p=0.001$ ). %ICV of total cortical gray matter was correlated at both F5 (EF:  $r=0.296$ ,  $p<0.001$ ; J:  $r=0.283$ ,  $p<0.001$ ) and P2 (EF:  $r=0.276$ ,  $p<0.001$ ; J:  $r=0.188$ ,  $p<0.001$ ), however %ICV cerebral white matter was not significant at either P2 or F5.

**Conclusions:** We demonstrated that the volume of the targeted area is related to the delivered EF in both the parietal and prefrontal cortices in older adults. However, the overall magnitude of these relationships was fairly small. Likewise, brain volume was not consistently related to current density (J). The combination of findings indicates that brain volume should not be used as a proxy measure for determining how much electrical current is reaching the targeted brain region(s). Rather, individualized FEM that integrate additional factors (e.g., bone density, brain shape, tissue impedance) should be used to ensure optimal stimulation delivery.

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**Keywords:** aging disorders, neurostimulation, neuromodulation

## **J. AXELROD, G. H. WEISSBERGER, L. MOSQUEDA, A. L. NGUYEN, P. BOYLE, D. HAN. Memory and Economic Status in Older Age.**

**Objective:** Memory abilities are important for optimal financial decision-making, and age-related memory impairment has been identified as a risk factor for financial exploitation in older age. We examined whether an association between verbal and visual memory performance and economic status exists in older adults without significant cognitive impairment.

**Participants and Methods:** Data were gathered from 59 older participants ( $M$  age= 68.03,  $SD=$  11.3,  $M$  education = 15.9,  $SD=$  2.67, 58% female) of the Finance, Cognition, and Health in Elders Study (FINCHES) who were screened with the Montreal Cognitive Assessment (MoCA);

$M= 27.7$ ,  $SD= 1.5$ ). In regard to race, 39 were White, five were African American, nine were Asian, two reported as other/unknown, and 4 chose not to indicate race. Economic status was defined as self-reported total combined family income during the past 12 months according to 16 categories ranging from “less than \$5,000” to “\$150,000 or more”. Verbal memory was assessed with the California Verbal Learning Test-II (CVLT-II) and the Craft Story test from the National Alzheimer’s Coordinating Center Uniform Data Set (NACC UDS). Visual memory was measured with the Benson Figure test from the NACC UDS.

**Results:** Economic status was positively correlated with performance on the CVLT-II Trials 1-5 Total (CVLT-II;  $r=.27$ ,  $p=.03$ ) and Semantic Clustering ( $r= .32$ ,  $p=.01$ ). Economic status was also positively associated with performance on immediate paraphrased recall ( $r=.38$ ,  $p<.001$ ) and delayed paraphrased recall ( $r=.33$ ,  $p=.01$ ) of the Craft Story test. Controlling for education, economic status continued to be significantly associated with CVLT-II semantic clustering and immediate paraphrased recall of the Craft Story test. No significant associations were observed for visual memory.

**Conclusions:** Results suggest that there is a relationship between economic status and aspects of verbal memory in older age that may involve strategic encoding. Longitudinal and larger-scale studies are needed to further examine this association.

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**Keywords:** memory: normal, verbal abilities

### **L. DE WIT, T. LAMBERTUS, P. A. AMOFA, A. M. KURASZ, B. DEFEIS, M. CHANDLER, G. SMITH, J. J. TANNER. Parahippocampal and Temporal Neocortical Thickness as Predictors of Word-Stem Completion Priming in Individuals with Amnesic Mild Cognitive Impairment.**

**Objective:** The concept of priming is defined as the unconscious facilitation of retrieval that results from previous exposure. Priming, which can be measured with tasks such as Word-Stem Completion task (WSCT), enables a more readily and less effortful response upon multiple exposures to the same information. The current study aims to assess cortical thickness or volume of brain structures considered important for word-stem priming in individuals with amnesic Mild Cognitive Impairment (iwaMCI).

**Participants and Methods:** Forty-five iwaMCI completed the WSCT and a Magnetic Resonance Imaging (MRI) scan. MRI data were processed using FreeSurfer to produce cortical thickness and volumetric measures of the regions of interest. Hierarchical regression models were conducted to assess if thickness or volume of the left inferior temporal gyrus, fusiform gyrus, transverse gyrus, parahippocampal gyrus, entorhinal cortex, or the hippocampus predicted WSCT scores in iwaMCI. Level of education, age, and estimated total intracranial volume were entered as covariates.

**Results:** Hierarchical regression analyses showed significant associations between WSCT scores and thickness of the parahippocampal gyrus and fusiform gyrus, with medium-to-large effect sizes. In an additional model, we found that there was no association between WSCT scores and the hippocampus or the entorhinal cortex, both amongst the first to be impacted in Alzheimer’s disease.

**Conclusions:** The current study showed that while priming does not appear to rely on structures that are typically the first to be impacted by Alzheimer’s disease pathology, it does rely on structures that are important for priming as the disease progresses. These results are consistent

with and extend our previous meta-analytic findings that conceptual priming does not remain spared in the more severe stages of Alzheimer's disease. In line with personalized medicine, it may be valuable to assess the integrity of fusiform gyrus or parahippocampal gyrus before undertaking interventions reliant on conceptual mnemonic integrity.

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**Keywords:** mild cognitive impairment, memory: implicit, brain structure

**J. KOAY, C. DION, E. M. FORMANSKI, K. RODRIGUEZ, S. AMINI, R. AU, D. LIBON, C. PRICE, K. HEILMAN. Pseudoneglect in Clock Hands Drawing in Adults Age 55+.**

**Objective:** Pseudoneglect refers to the phenomenon where young adults show attentional bias favoring the left visual hemisphere (LVH; Bowers & Heilman, 1980). However, leftward bias is attenuated with healthy aging. This rightward shift when bisecting lines is likely due to age-associated decline in right hemispheric functions, resulting in decreased processing of the LVH (Benwell et al., 2014).

Healthy adults also show upward bias when bisecting vertical lines, with aging individuals showing a greater upward bias (Mańkowska et al., 2018). This increase in upward bias may be related to an aging related degradation of the dorsal attention network (Mańkowska et al., 2018).

The influence of pseudoneglect on digital clock drawing test (dCDT) is not well understood, despite its wide use in the screening of cognitive impairments in older adults. We aim to address this gap: we hypothesized that on dCDT, 1) the hour and minute hands will be shorter for older participants, and 2) the angle between the clock hands will be lesser for older participants.

**Participants and Methods:** Data from two cohorts of cognitively healthy adults ( $N=436$ , Mean age=68.3, 57.6% female) were used for this analysis. All participants were administered the dCDT using digital pen and smart paper from Anoto, Inc. (Souillard-Mandar et al., 2016). All participants completed both dCDT drawing-to-command and copy conditions.

A median split method was used to categorize the participants into two groups: the young group (YG) with participants age 66 or younger and the old group (OG) with participants age 67 or older. Data from the dCDT drawing-to-command condition (lengths of hour and minute hands, and the angle between hands) were compared between the two groups.

**Results:** Normality assumption was not met for all dependent variables; thus, the data was transformed using log transformation. Age was positively correlated with the hour hand length ( $r_s=.108, p<.05$ ) and negatively correlated with the angle between hands ( $r_s=-.119, p<.05$ ). After controlling for the clock face area, the OG has significantly longer minute hand ( $F(1,433)=3.863, p=.05, \eta^2=.009$ ) and longer hour hand ( $F(1,433)=5.731, p<.05, \eta^2=.013$ ) compared to the YG. The angle between the hour and minute hands was equivalent across both groups.

**Discussions:** Contrary to our hypotheses, older participants drew longer minute and hour hands on the dCDT command compared to younger participants. There was no difference in the angle between clock hands between older and younger participants. This suggests that pseudoneglect might have a relatively minor role in the drawing of clock hands. The dCDT is a complex task which involves multiple cognitive processes as evident by the activation of multiple brain areas during the task (Talwar et al., 2019). The longer clock hands in older participants might suggest an attentional grasp towards clock numbers instead of the clock center due to more profound age-associated decline in the prefrontal cortex than the parietal lobe (Peters, 2005). Understanding age-associated cognitive processes during dCDT could improve its ability in

screening cognitive impairments in older individuals. Future studies should examine the association between hand length, angle between hands, and the accuracy of number placement on dCDT. Funding: R01 AG055337

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**Keywords:** visuospatial functions, visuoconstruction, aging (normal)

### **S. BROTHERS, Y. SUCHY. Daily Assessment of Executive Functioning and Expressive Suppression Predict Daily Functioning among Community-Dwelling Older Adults.**

**Objective:** Executive functioning (EF) performance is negatively impacted by expressive suppression (ES; Baumeister, 2002; Franchow & Suchy, 2017; Niermeyer, Ziemnik, Franchow, Barron, & Suchy, 2019; Szczygiel & Maruszewski, 2015), an emotion regulation strategy involving the deliberate inhibition of facial or behavioral expression of emotion (Butler et al., 2003; Gross, 1998). EF also relates to instrumental activities of daily living (IADLs); it follows that ES would therefore relate to IADLs indirectly through EF. This is supported by prior research, where higher ES was related to poorer performance on a lab-based measure of IADLs, with the relationship fully mediated by EF (Suchy, Niermeyer, Franchow, & Ziemnik, 2019). Additionally, a recent study assessing EF daily at home found that *variability* in EF from day to day was more predictive of baseline self-report of daily cognitive failures than was the *average* EF performance (Schmitter-Edgecombe, Sumida, & Cook, 2020). This result was interpreted as suggesting that daily EF variability is predictive of daily cognitive functioning *at home* (as self-reported by participants), thereby also indirectly suggesting that daily fluctuations in EF could be particularly important for daily IADL functioning. However, none of these studies examined how variability in EF or ES relates to *actual* real-world performance of daily IADL activities. The present study sought to examine the relationship of EF and ES variability with real-world daily performance as well as whether any relationship between ES and daily performance is mediated by EF.

**Participants and Methods:** 54 community-dwelling older adults ( $M$  age = 69.5; 65.4% female) completed backward Digit Span and the Color-Word Interference (i.e., Stroop) tasks once daily for 3 weeks as measures of EF performance. During the same 3 weeks, they reported the amount of effort they exerted engaging in ES and completed daily tasks that resembled real-world tasks (e.g., looking up store hours, changing an appointment).

**Results:** Zero-order correlations were significant between daily IADL performance and both *EF-Variability* ( $r = -.373, p = .007$ ) and *ES-Variability* ( $r = -.304, p = .028$ ). *EF-Variability* and *ES-Variability* were also correlated with each other ( $r = .314, p = .024$ ). A hierarchical linear regression showed that *EF-Variability* significantly predicted daily IADL performance beyond *EF-Average* ( $R^2 = .171; p = .002$ ). While *ES-Variability* was significantly associated with daily IADL performance, it was no longer significant when *EF-Variability* was added into the model; *EF-Variability* explains the relationship. However, when the mediation model was tested, *EF-Variability* did not significantly mediate the relationship.

**Conclusions:** These results suggest that *EF-Variability* predicts not only self-reported cognitive complaints, but also real-world daily performance of IADL tasks. Consequently, individuals who experience more variability in factors that impact EF (e.g., ES) are more likely to have variability in EF and subsequent IADL lapses, such as forgetting to take medications or to pay bills. Additionally, while *ES-Variability* is associated with both *EF-Variability* and daily IADL performance, the mechanism by which *ES-Variability* impacts total performance is unclear.

Future research with a larger sample should evaluate a potential mediation of the relationship between *ES-Variability* and daily performance by *EF-Variability*.

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**Keywords:** executive functions, everyday functioning, ecological validity

**J. R. DAVIS, J. LAUGHTON, S. BROTHERS, Y. SUCHY. Validation of Daily At-Home Assessment of Executive Functioning in Older Adults.**

**Objective:** Executive functioning (EF) is a broad set of higher-order processes that involves the planning, selection, and execution of future-oriented and socially adaptive behaviors (Anderson, Jacobs, & Anderson, 2008; Stuss & Knight, 2002; Suchy, 2009). Certain factors, such as expressive suppression (ES), an emotion regulation strategy characterized by suppression of overt emotional expression (e.g., laughter, crying; Franchow & Suchy, 2017; Gross & John, 2003), have been shown to lead to fluctuations in EF in both experimentally-manipulated and self-reported studies (Franchow & Suchy, 2017; Niermeyer, Ziemnik, Franchow, Barron, & Suchy, 2019). However, typical office-based EF assessments are highly structured, failing to capture such fluctuations. How much EF fluctuates daily has yet to be thoroughly studied, in part due to a lack of assessment tools. The goal of the present study was to validate a method for daily at-home assessment of EF and ES. To that end, EF and ES were assessed daily in community-dwelling older adults' homes and compared to EF and ES assessed in the lab using well-validated EF and ES measures.

**Participants and Methods:** 54 community-dwelling older adults ( $M$  age = 69.5; 65.4% female) were administered the Delis-Kaplan Executive Function System (D-KEFS) as a measure of EF performance speed and accuracy, and the Burden of State Emotion Regulation Questionnaire (BSERQ) as a measure of ES at baseline. Subsequently, daily for a period of 3 weeks while at home, participants reported the amount of effort they exerted engaging in ES and completed backward Digit Span and the Color-Word Interference (i.e., Stroop) tasks as measures of EF.

**Results:** Baseline speed of EF performance on the D-KEFS (*EF-Speed*) and the average daily EF performance across 3 weeks (*EF-Average*) showed a positive correlation ( $r = .305, p = .028$ ). The variability in (i.e., standard deviation of) daily EF performance across 3 weeks (*EF-Variability*) correlated negatively with the number of errors made on EF subtests of the D-KEFS at baseline (*EF-Errors*;  $r = -.533, p < .001$ ). Variability in daily suppression (*ES-Variability*) correlated positively with self-reported recent ES on the BSERQ ( $r = .403, p = .003$ ).

**Conclusions:** The EF variables generated from the daily assessment (*EF-Average* and *EF-Variability*) were significantly correlated with the corresponding baseline EF variables (*EF-Speed* and *EF-Errors*, respectively) and variability in daily suppression correlated with recent suppression on the BSERQ. These results lend support to the validity of the daily at-home EF and ES assessment, as well as provide insight into how older adults' baseline EF performance relates to the real-world. For instance, older adults who make more EF errors at baseline are likely to have more variability in their EF performance at home. Since EF performance is related to the ability to complete instrumental activities of daily living (IADLs), such as medication and financial management, individuals who make more errors during a baseline assessment may be more at risk of functional lapses due to their variability in EF. Future research should explore whether daily variability in EF is related to real-world IADL performance.

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**Keywords:** assessment, emotional processes, activities of daily living

**C. M. REED, M. CALAMIA, M. D. BARNETT. Examining Predictors of Stroop Performance in an Older Adult Sample.**

**Objective:** The purpose of this study was to examine the role of processing speed and switching on the performance of the inhibition and inhibition/switching condition in a Stroop task. We were interested in whether visual processing speed and set switching explained additional variance beyond verbal word and color naming.

**Participants and Methods:** Older adult participants ( $N = 95$ ;  $M = 74.01$   $SD = 7.99$ ) were administered Trail Making Test-Part B (TMT-B), Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV) Digit Symbol Coding, Wisconsin Card Sorting Test (WCST) and the Delis-Kaplan Executive Function System (D-KEFS) Color-Word Interference Test (CWIT). Relationships of processing speed and set switching with D-KEFS CWIT performance were examined using correlations and hierarchical multiple regression with processing/reading speed measures in the first block and switching measures in the second block.

**Results:** TMT-B, Coding, and WCST demonstrated stronger bivariate relationships with D-KEFS CWIT condition three (inhibition) compared to condition four (inhibition/switching). For inhibition, coding, color naming, and word naming were all significant predictors in a multiple regression and explained 44% of the variance in scaled scores ( $F(3,75) = 19.96$ ,  $p < .05$ ). For inhibition/switching, color naming and word naming, but not coding, were significant predictors in a multiple regression and explained 30% of the variance in scaled scores ( $F(3,75) = 10.84$ ,  $p < .01$ ). Switching measures did not add incremental variance in predicting inhibition or inhibition-switching ( $p > .05$ ).

**Conclusions:** Inhibition was predicted by coding but inhibition/switching did not have any unique predictors compared to inhibition; neither measure of switching examined (TMT-B and WCST Perseverative Errors) was a unique predictor. This study gives evidence that processing speed could account more of the variability on traditional Stroop tasks in older adults.

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**Keywords:** executive functions, aging (normal)

**V. SANBORN, R. OSTRAND, J. GUNSTAD. Predicting MCI Status Using Automated Speech Assessment in Community-dwelling Older Adults.**

**Objective:** The population of older adults is growing dramatically and with it, there is increased prevalence of neurological disorders, including Alzheimer's disease (AD). Though existing cognitive screening tests can aid early detection of cognitive decline, these methods are limited by their low sensitivity and their need for trained administrators. As AD has previously been associated with changes in speech and language, and disease onset is thought to occur much earlier than observable cognitive decline, the current study sought to determine whether it is possible to identify persons with mild cognitive impairment (MCI) using automated analysis of spontaneous speech.

**Participants and Methods:** Participants included 88 older adults ( $N = 88$ ;  $M_{age} = 68.03 \pm 7.90$  years, 67% female,  $M_{education} = 15.41 \pm 2.56$  years) recruited from the community. Participants completed a brief, in-person neuropsychological test battery and a spontaneous speech task (retelling the story of *Cinderella*), which was audio-recorded and later manually transcribed. MCI status was determined using established research criteria (i.e.,  $Jak \geq 2$

t-scores <40). Lexical-semantic features were calculated automatically from transcribed text using Python (version 2.7.17), based on methods from past work. Logistic regression analyses compared the predictive ability of a commonly used cognitive screening instrument (the Modified Mini Mental Status Exam, 3MS) and speech indices for MCI classification.

**Results:** Sixty-two participants were identified as being cognitively intact while twenty-six participants met criteria for MCI. Intact and MCI participants did not differ on any demographic or medical characteristics (all  $p$ 's > .05). Both the 3MS [ $X^2(1)=6.18$ ,  $p=0.013$ ; AIC=41.46; 69.3% overall accuracy] and speech indices [ $X^2(16)=32.42$ ,  $p=0.009$ ; AIC=108.41; 79.5% overall accuracy] predicted MCI status better than did an intercept-only model, though neither performed significantly better than majority-class assignment. Follow-up Exact McNemar's testing revealed the full speech model was a better predictor than was the 3MS of MCI status ( $p=.049$ ).

**Conclusions:** The current findings suggest that spontaneous speech may have value as a potential screening measure for identification of cognitive deficits. Given recent advances in technology, audio-recording spontaneous speech and automated analysis may provide a convenient alternative to, or adjunct for, commonly used screening measures such as the 3MS. Confirmation of these findings is needed, including larger, more balanced prospective studies specifically recruiting persons with clinical diagnosis of MCI and/or AD.

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**Keywords:** speech, dementia - Alzheimer's disease

#### **H. A. CLARK, K. A. MARTINEZ, S. LAVIGNE, J. QUATTLEBAUM, R. W. SCHROEDER, P. MARTIN. Neuropsychological Findings in Older Adults with Normal Versus Discrepantly Low Performances on Visual Memory Tests.**

**Objective:** The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) and the Brief Visuospatial Memory Test – Revised (BVMT) are commonly used together in dementia evaluations. Sometimes scores differ substantially between BVMT Delayed Recall and the visual memory subtest of the RBANS, Figure Recall (FR), which can create an interpretive challenge for clinicians. The current study sought to 1) examine how frequently patients produce a normal score on one of these tests and a discrepantly low score on the other and 2) compare the cognitive profile of patients with normal performances on both tests to the cognitive profile of patients with normal performance on one test and discrepantly low performance on the other.

**Participants and Methods:** Participants included 227 older adults (mean age=70.1, mean education=13.3 years) who completed outpatient dementia evaluations that minimally included the RBANS, BVMT, and subtests from the Delis-Kaplan Executive Function System (D-KEFS; Trail Making, Verbal Fluency, and Tower). A normal score was defined as falling no more than 1 standard deviation (SD) below the normative mean. Patients were considered to have a discrepantly low score if their scores on BVMT Delayed Recall and RBANS FR differed by at least 1.5 SDs and if one of the scores was normal while the other score was below normal. Participants with normal performance on one test and below normal performance on the other, but whose score difference was not discrepant as defined above ( $n=25$ ), were excluded from further analyses, as were participants who produced below normal scores on both tests ( $n=117$ ). Patients were then categorized as producing 1) normal performances on both BVMT and FR ( $n=50$ ), 2) discrepantly low FR performance amidst normal BVMT performance ( $n=2$ ), or 3) discrepantly low BVMT performance amidst normal FR performance ( $n=35$ ). Because of the

prohibitively small sample size, participants with discrepantly low FR performance could not be included in group comparison analyses. Independent samples t-tests were used to compare mean scores between patients with discrepantly low BVMT performance and patients with normal performances on both BVMT and FR on RBANS tests of verbal immediate recall, verbal delayed recall, processing speed, attention, language, and visuospatial ability, as well as D-KEFS tests of executive functioning.

**Results:** A normal FR score with a discrepantly low BVMT score was observed in 35 patients (15%), whereas the inverse occurred in only 2 patients (1%). Participants with discrepantly low BVMT scores performed significantly lower ( $p < .01$ ) than participants whose BVMT and FR scores were both normal on tests of verbal immediate recall ( $d = .61$ ), verbal delayed recall ( $d = .78$ ), and processing speed ( $d = .64$ ).

**Conclusions:** Whereas low RBANS Figure Recall performance rarely accompanies normal BVMT Delayed Recall performance, low BVMT performance in the context of normal Figure Recall performance occurs more frequently. Further, when BVMT performance is discrepantly low, this is generally associated with increased cognitive difficulty in other domains.

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**Keywords:** cognitive functioning, memory disorders, neuropsychological assessment

**L. CHILDERS, S. S. SHORTER, T. L. GLOVER, L. M. WILLIAMS, D. C. LEE, A. M. COLDIRON, T. D. PARSONS, M. D. BARNETT. Differential Relationships Between Working Memory and Episodic Memory in Virtual Reality Among Young Adult and Older Adult Age Cohorts.**

Working memory has been linked with episodic memory among different age groups; indeed, working memory may mediate the relationship between age and episodic memory. Much of this work has utilized traditional neuropsychological tests; no extant studies have assessed verbal working memory with episodic memory within virtual reality.

**Objective:** The purpose of this study was to assess the relationship between verbal working memory and episodic memory for meal preparation tasks in a VR environment among young and older adults.

**Participants and Methods:** Young adults ( $n = 40$ ; age 18 – 25,  $M = 18.68$ ,  $SD = 1.10$ ) and older adults ( $n = 97$ ; age 55 – 90,  $M = 73.69$ ,  $SD = 8.23$ ) were administered the WAIS-IV Digit Span subtest and the Virtual Kitchen Protocol (VKP), which measures learning and recall of meal preparation tasks in a virtual reality kitchen.

**Results:** Fisher's  $r$ -to- $z$  transformation found that the relationship between verbal working memory and delayed recall was stronger among older adults than young adults ( $Z = -2.13$ ,  $p = .03$ ).

**Conclusion:** Compared to young adults, older adults' episodic memory for meal preparation tasks may be more closely linked with working memory.

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**Keywords:** working memory, aging (normal), visual imagery

**Symposium 01: The Wisdom Workgroup in Indigenous Neuropsychology Global Strategies (Wisdom WINGS) Initiative: An International Collaboration to Advance the Understanding of Neurocognitive Health in Indigenous Peoples**

**Co-Chairs and Presenters: Monica Rivera Mindt, Micah J. Savin**  
**Presenters: Kylie Radford, Cara Crook, Maral Aghvinian**

**11:00 AM - 12:00 PM**

**M. SAVIN, M. AGHVINIAN, C. CROOK, R. ARMENTA, D. FRANKLIN, T. MARCOTTE, S. VERNEY, D. BYRD, K. RADFORD, S. ROURKE, L. CYSIQUE, M. RIVERA MINDT. The Wisdom Workgroup in Indigenous Neuropsychology Global Strategies (Wisdom WINGS) Initiative: An International Collaboration to Advance the Understanding of Neurocognitive Health in Indigenous Peoples.**

Globally, Indigenous peoples (e.g., First Peoples of Australia, American Indians/Alaska Natives) are disproportionately impacted by chronic health conditions (e.g., HIV, Hep C, hypertension, diabetes) and disadvantageous sociocultural experiences (e.g., poor quality of education, social adversity, intergenerational poverty) that are increasingly recognized as risk factors for neurocognitive impairment (NCI). This is of great importance as Indigenous peoples of Australia and North America are rapidly growing populations whose older adult subpopulations are projected to increase from two to five-fold from the year 2005 to 2030. *Yet, Indigenous peoples have been profoundly underrepresented in neuropsychological research and there is limited understanding of brain health among these populations, especially within the context of age-related diseases.* Although no epidemiologic data exists that collectively capture prevalence and incidence of Alzheimer's Disease and Related Dementias among Indigenous peoples, small scale studies suggest some Indigenous subpopulations of Australia and Canada may have three to five times greater risk for atypical performance as defined by dementia proxies. These disparities remain unqualified by robust neuropsychological methodologies, including the utilization of comprehensive neuropsychological and neurobehavioral evaluations, application of demographically adjusted normative data, integration of sociocultural factors, and consideration of comorbidities. Regardless, it does not seem that age alone accounts for the aforementioned disparity, emphasizing the probable role of other determinants of health. Subsequently, there is a dearth of data to inform culturally targeted, evidence-based interventions to improve brain health outcomes in these populations. To address these significant gaps in the literature, the **Wisdom Workgroup in Indigenous Neuropsychology Global Strategies (Wisdom WINGS)** initiative was formed in 2018 to raise awareness surrounding the neurocognitive needs and wants of Indigenous peoples, to elucidate biopsychosociocultural mechanisms that explain disparities in neurocognition among Indigenous peoples, and to address the marked absence of valid neuropsychological assessments for Indigenous peoples worldwide. This international symposium includes investigators from Australia, Canada, and the United States and leverages secondary data from as many as 39 different community-based participatory research studies. The symposium aims to: 1) provide an overview of the Wisdom WINGS initiative and strategies to integrate Traditional Knowledge approaches with westernized neuropsychological research and scholarship; 2) identify health disparities relevant to NCI among Indigenous peoples worldwide as well as locally; 3) examine new, cutting edge research on the neuropsychological profiles and prevalence of NCI among Indigenous peoples within community-dwelling HIV- and HIV+ populations across the adult lifespan (younger to older adults); 4) identify sociocultural determinants of NCI and modifiable risk factors to promote

brain health equity in these populations; and 5) offer recommendations to further advance neuropsychological research among Indigenous peoples worldwide. The structure of this symposium will be comprised of an introductory overview presentation by Dr. Monica Rivera Mindt, four presentations of empirical studies conducted in either Australia or the U.S., and a panel discussion of Wisdom WINGS investigators and audience QA session lead by the Symposium Discussant.

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**Keywords:** aging disorders, HIV/AIDS, mild cognitive impairment

**K. RADFORD. The Neurocognitive Assessment, Prevalence and Social Determinants of Mild Cognitive Impairment in Older Aboriginal and Torres Strait Islander Australians.**

**Objective:** To determine the neuropsychological profile and prevalence of mild cognitive impairment (MCI) and relationships to sociocultural factors in a population-based cohort of older Indigenous Australians.

**Participants and Methods:** Participants (N=336) comprised 62% of the total population aged 60+ across five urban/regional communities in New South Wales, Australia. MCI and dementia were diagnosed based on cognitive screening, comprehensive medical and neurocognitive assessment, and clinical consensus using standard international criteria. Participants completed a baseline structured interview covering psychosocial, cultural and biomedical factors across the life course; 165 participants completed 6-year follow-up (68 died). Factors associated with prevalent MCI diagnosis were examined. Incidence of MCI and dementia were assessed at follow-up.

**Results:** Deficits were observed across a range of neurocognitive domains for MCI compared to the cognitively intact group. Prevalence of MCI was 17.7% (95% CI, 13.4–21.9), with cases broadly classified as amnesic (n=29) or non-amnesic MCI (n=24). Distinct risk factor profiles emerged: amnesic MCI was associated with age, head injury, depression and lower blood pressure; whereas non-amnesic MCI was associated with low education, unskilled work, higher body mass index and hearing loss. The majority of baseline MCI cases progressed to dementia and/or death (n=17; 41%) or retained a MCI diagnosis (n=18; 44%) over 6 years. Alzheimer's disease was the common clinical dementia outcome.

**Conclusions:** Reducing the high rates of cognitive decline and dementia is a priority for Indigenous communities. This study provides insights into appropriate neurocognitive assessment and potential risk reduction targets, particularly highlighting social determinants of health disparities.

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**C. L. CROOK. The Effects of Aging, HIV-infection, and American Indian/Alaska Native Ethnoracial status on Neurocognitive Health.**

**Objective:** Little is known regarding neurocognitive aging among American Indian/Alaska Native adults (AI/AN), across both healthy and chronically ill populations (e.g., HIV). Thus, this cross-sectional study aimed to identify disparities in neurocognition (NC) across the lifespan of HIV-/+

AI/AN.

**Participants and Methods:** A sample of 210 AI/AN (36% Latinx) and 210 Non-Latinx White adults (NLW; 75% Male; M Age =  $48 \pm 11$  years; M Education =  $12 \pm 3$  years [TM1]) completed comprehensive neurocognitive, psychiatric/substance use, and neuromedical evaluations. An ANCOVA tested the interactive effects of age (e.g., younger (18-30), middle (30-50), and older age (>50)), HIV status (HIV- vs. HIV+), and ethnoracial identity (AI/AN vs. NLW) on global NC function (age, gender, and education adjusted average T-scores). A comorbid condition propensity score (CCPS) identified the probability to which comorbid conditions (e.g., stroke; diabetes; literacy) informed group classification by age, HIV, and ethnoracial identity.

**Results:** After accounting for the CCPS, our model (age, HIV, and ethnoracial identity) significantly associated with global NC function ( $R^2=13.0$ ,  $p < .0001$ ). Broadly, while NC remained relatively consistent across NLW groups regardless of age or HIV status, decreases in NC function coincided with older age among HIV+ AI/AN. Post-hoc comparisons also showed significantly worse global NC among middle age HIV+ AI/AN in comparison to middle age HIV+ NLW ( $t=3.85$ ,  $p < .01$ ).

**Conclusions:** Within the context of HIV, NC disparities appear to begin in middle age and increase across age groups among AI/AN. HIV may uniquely contribute to accelerated neurosenescence in the AI/AN population. Intergenerational longitudinal research should investigate the role of biopsychosociocultural factors that may alter aging trajectories of HIV+ AI/AN.

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### **M. AGHVINIAN. The Roles of Age, HIV, and Bilingualism on Risk for Neurocognitive Impairment among American Indian/Alaska Native .**

**Objective:** The “graying” of the HIV epidemic coincides with accelerated aging and increased risk for neurocognitive (NC) impairment. However, no research examines the interactive effects of age and HIV on NC functioning among American Indians/Alaskan Natives (AI/AN), nor the role of sociocultural factors (e.g., bilingualism). This case-control study aims to identify whether there are NC disparities in aging among AI/AN HIV- controls and AI/AN people with HIV (PWH), as well as the possible independent effects of bilingualism.

**Participants and Methods:** An English-speaking sample of 44 AI/AN HIV- controls and 45 AI/AN PWH (80% Latinx; 56% Male; M Age= $50 \pm 16$  years; M Education= $12 \pm 4$  years; 62% bilingual) completed comprehensive NC and neuromedical examinations. A logistic regression model tested the interactive effects of age (young (18-30) vs. old (>50)) and HIV status (HIV- vs. HIV+), as well as the independent effect of self-reported bilingualism (monolingual vs. bilingual) upon risk for NC impairment (NCI; unimpaired vs. impaired) as defined by T-score based global deficit scores ( $>.05$  = impaired).

**Results:** After adjusting for covariates, the interaction of HIV status and age was significantly associated with NCI  $X^2(7)=15.48$ ,  $p=.03$ ,  $R^2=.16$ , such that older AI/AN PWH had 7.87 times (52.4% vs. 15.4%; CI: 1.82-34.03,  $p=.01$ ) higher odds for NCI in comparison to older AI/AN HIV- controls. Older AI/AN PWH had 4.1 times (52.4% vs. 33.3%; CI: 1.03-16.27,  $p=.0451$ ) higher odds of NCI in comparison to younger AI/AN PLWH. Bilinguals had 3.48 times lower odds for NCI compared to monolinguals,  $b=-1.24$  (SE=.54),  $X^2=5.16$ ,  $p=.02$ , CI: 1.19-10.20,  $p=.02$ .

**Conclusions:** Age and HIV may synergistically increase risk for NCI among AI/AN adults. Bilingualism may protect against these effects in AI/AN communities.

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**M. J. SAVIN. The Prevalence and Determinants of HIV-associated Neurocognitive Disorders Among American Indian/Alaska Native people with HIV..**

**Objective:** AI/AN people with HIV (PWH) have the poorest HIV survival rates of any U.S racial/ethnic group (CDC, 2015 & 2016), suggesting limited access and utilization of health care. However, no studies to date have examined HIV-associated Neurocognitive Disorder (HAND) or the potential determinants of HAND in this population. This cross-sectional study aimed to identify the prevalence and determinants of HAND among AI/AN PLWH.

**Participants and Methods:** An English-speaking sample of 102 AI/AN (33% Latinx) and 119 non-Latinx white PWH (88% Male; M Age=42±10 years; M Education=13±3 years) completed comprehensive neurocognitive, functional, neuromedical, and psychiatric/substance use evaluations. The Wide Range Achievement Test- 4 (WRAT-4) Reading Subtest served as a proxy for quality of education. A chi-square tested for ethnoracial differences in HAND status (Normal vs. HAND). A propensity score analysis identified the probability to which determinants of neurocognitive health (as defined by HIV clinical characteristics, comorbid conditions, and quality of education [e.g., Heaton et al., 2010]) informed ethnoracial classification. The propensity score was significantly associated with HAND,  $X^2(1)=6.14, p=.0132, R^2=.04$ . A log-binomial regression adjusting for the aforementioned social determinants of neurocognitive health then tested the relationship between ethnoracial identity and HAND prevalence.

**Results:** The prevalence of HAND was 1.72 times higher in the AI/AN group compared to the NLW group (61% vs. 39%;  $X^2(1)=4.18, p=.04$ ). After adjusting for determinants of neurocognitive health, AI/AN PWH were 4.7 times at greater risk for HAND, CI: 1.01-21.97,  $p=.0492, X^2(2)=8.23, p=.0163, R^2=.0950$ .

**Conclusion:** Reducing the increased risk for HAND is a priority among AI/AN PWH. This study provides insight into the modifiable risk factors for HAND, particularly emphasizing determinants of neurocognitive health. Future work should examine possible disparity in functional decline among AI/AN PWH.

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**Symposium 02: Beyond Brain-Behavior Correlations: Using Connectome-Based Approaches to Derive Markers of Cognition**

**Chairs and Presenter: Ruchika S. Prakash**

**Presenters: Monica Rosenberg, Oyetunde Gbadeyan, Amy Kuceyeski, Lucina Q. Uddin**

**11:00 AM - 12:00 PM**

**R. S. PRAKASH, M. ROSENBERG, O. GBADEYAN, A. KUCEYESKI, L. Q. UDDIN. Beyond Brain-Behavior Correlations: Using Connectome-Based Approaches to Derive Markers of Cognition.**

The advent of functional magnetic resonance imaging (fMRI) allowed neuropsychologists to systematically examine individual differences in brain function and relate them to variation in cognitive phenotypes. In the last two decades, these brain-behavior association studies provided significant insight into our understanding of the functional topology of key cognitive domains and how they may change as a function of neurological and psychiatric diseases. However, the majority of brain-behavior studies, investigate one or two canonical networks and are often cross-sectional examinations between brain function and metrics of cognitive functioning. With recent incorporation of machine learning approaches in analyses of neuroimaging data, the field has witnessed a significant shift in our reliance on investigating one or two canonical networks of the brain, to conceptualizing complex psychiatric and neurological disorders as byproducts of systemic changes in the entire connectome. In this symposium, going beyond brain-behavior association studies, we will present novel imaging-based analytic techniques that allow for the identification of connectivity patterns within the individual's entire connectome in predicting cognitive functioning. Abstracts included in this symposium include individuals with Alzheimer's disease, autism, attention deficit/hyperactivity disorder (ADHD), and traumatic brain injury, thus underscoring the application of connectome-based approaches across a wide range of clinical populations.

Prakash et al. using data from the Alzheimer's Disease Neuroimaging Initiative (ADNI) derive a whole-brain functional connectivity marker of Alzheimer's disease pathology that predicts the rate of decline in global cognition and executive functioning over a 12-month period in individuals with mild cognitive impairment and Alzheimer's disease.

Rosenberg et al. employing connectome-based predictive modeling derive a marker of sustained attention that predicts symptoms of attention in individuals with ADHD. Moreover, they demonstrate the utility of this marker of attention as a surrogate endpoint in a clinical trial of methylphenidate, an ADHD medication.

Gbadeyan et al. demonstrate the utility of individual connectomics in deriving a marker of mind-wandering – defined as the qualitative shift from exogenous, stimulus-dependent processing to endogenous, internal mentation – in task-based and resting-state fMRI. Using data from three independent samples of healthy older adults, they demonstrate the success and limitations of connectome-based approaches when working with populations like healthy older adults that are characterized by significant brain-behavior heterogeneity.

Kuceyeski et al. employ dynamic functional connectivity – variation in functional connectivity estimates across the time period of data collection – to explain individual differences in attentional functioning in patients with traumatic brain injury (TBI). Their results, going beyond static measures of functional connectivity, evince support for restricted dynamic range of functional connections to predict better cognitive performance for individuals with TBI.

Uddin et al. use connectome-based approaches to better understand executive functioning deficits in autism spectrum disorder (ASD) and ADHD. Given the phenotypic heterogeneity and comorbidity across these two disorders, they use latent profile analysis and connectome-based mapping to identify valid and reliable subgroups. Their results identify limitations to modeling heterogeneous behavioral and brain connectivity profiles.

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**Keywords:** attention, brain function, neuroimaging: functional connectivity

**R. S. PRAKASH. A Whole-Brain Functional Connectivity Model of Alzheimer's Disease Pathology.**

**Objectives:** Previous AD research has linked changes in functional connectivity to biomarker accumulation. However, much of the prior research tends to focus on one or two canonical networks, with the majority of studies essentially involving correlational designs. Predictive modeling, utilizing connectome-wide nodes, allows for the identification of connectivity patterns within the individual's entire connectome that are predictive of disease states, symptom severity, or cognitive functioning.

**Participants and Methods:** In this study, we employed connectome-based predictive modeling (CPM) to build a model of functional connections that would predict CSF p-tau/A $\beta$ <sub>42</sub> (PATH-fc model) in individuals diagnosed with Mild Cognitive Impairment (MCI) and AD ( $N=83$ ). fMRI, CSF-based biomarker data, and longitudinal data from neuropsychological testing from the Alzheimer's Disease NeuroImaging Initiative (ADNI) was utilized to build the PATH-fc model.

**Results:** Our results provide support for successful in-sample fit of the PATH-fc model in predicting AD pathology in MCI and AD individuals. The PATH-fc model, distributed across all ten canonical networks, additionally predicted cognitive decline on composite measures of global cognition and executive functioning.

**Conclusions:** Our highly distributed pathology-based model of functional connectivity disruptions had a striking overlap with the spatial affinities of amyloid and tau pathology, and included the default mode network as the hub of such network-based disruptions in AD. Future work, validating this model in other external datasets, and to midlife adults and older adults with no known diagnosis, will critically extend this first step of neuromarker development work using fMRI.

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**M. ROSENBERG. Predicting attentional abilities with functional brain connectivity.**

**Objective:** Perhaps no cognitive capacity is more crucial to navigating daily life than the ability to pay attention. Attention function, however, is impaired in clinical populations such as attention deficit hyperactivity disorder (ADHD) and varies widely even in the healthy population. Despite the central importance of attention, we have no way to characterize attentional abilities as a whole. To address this challenge, I will demonstrate that functional brain connectivity can provide such a measure.

**Participants and Methods:** Functional MRI data were collected while individuals performed attention tasks and rested. Following data preprocessing, task-based and resting-state connectivity patterns were generated for each individual by correlating the BOLD signal timecourses of every pair of regions in a 268-node brain atlas. Connectome-based models (Shen et al., 2017) were trained to predict attentional performance from whole-brain functional connectivity patterns.

**Results:** Connectome-based models generalized across individuals and groups to predict aspects of attention function, including symptoms of ADHD, from task-based and resting-state

functional connectivity. The same models also captured changes in attention over time, including fluctuations in task performance and changes that arose from the administration of methylphenidate, an ADHD medication. Finally, pilot data demonstrated the technical feasibility of calculating whole-brain functional connectivity in real time during fMRI data collection.

**Conclusion:** This work suggests that functional connectivity can provide a generalizable neuromarker of sustained attention. Looking ahead, a connectome-based neurofeedback approach may be used to train individuals to express functional connectivity signatures of stronger sustained attention and potentially improve attention function.

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### **L. Q. UDDIN. Modeling behavioral and connectomic heterogeneity in autism and ADHD.**

**Objectives:** Autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) are characterized by considerable phenotypic heterogeneity and comorbidity. Traditional diagnostic classification schemes are imperfect predictors of etiology and treatment response. Alternative systems such as the Research Domain Criteria (RDoC) focus on the full range of variation in behavior across clinical and non-clinical populations. As neurodevelopmental disorders are often accompanied by executive function (EF) deficits (Dajani & Uddin, 2015), we focus on this set of abilities.

**Participants and Methods:** Latent profile analysis including behavioral measures of EF collected from children with ASD, ADHD, ASD + ADHD, and typically developing (TD) children were conducted, followed by analysis of brain networks. We then attempted to parse heterogeneity in this mixed sample using individual connectome mapping.

**Results:** We found evidence for three classes of children exhibiting “above average”, “average”, and “impaired” EF abilities (Dajani et al., 2016; Baez et al., 2020). Subgroups of children identified by EF ability did not exhibit differences in functional connectivity metrics (Dajani et al., 2019a). In neurotypical adults, there is significant individual variability in functional network topography supporting EF (Dajani et al., 2020). We did not find evidence for stable or valid subgroups based on brain connectivity metrics in this mixed sample of children (Dajani et al., 2019b).

**Conclusions:** This work suggests that neither traditional diagnostic categories nor subgroups derived from behavioral profiles clearly define neurobiologically separable groups. These studies highlight the difficulties associated with modeling heterogeneous behavioral and brain connectivity profiles in neurodevelopmental disorders.

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### **A. KUCEYESKI. Increased Range of Dynamic Functional Connectome Trajectories Predict Better Attention in Individuals with Traumatic Brain Injury.**

**Objective:** Individuals with traumatic brain injury can suffer from impairment of attention; however, the mechanisms of this pathology are not yet known. In recent years, dynamic functional connectivity (dFC) analyses of functional MRI data have gained popularity for understanding mechanisms of cognition as well as neurological and neuropsychiatric disease. In contrast to classic static functional connectome analyses that estimate physiological connectivity networks using the entire resting-state fMRI time series, dFC estimates connectivity over smaller sliding windows and quantifies the dynamic properties of these sliding window dFCs. The goal

of our work was to determine if dFC properties relate to measures of attention in traumatic brain injury (TBI) subjects and healthy controls. Our hypothesis was that individuals with more dynamic FCs would have shorter mean reaction time on an attention task.

**Participants and Methods:** We enrolled 11 healthy controls and 11 individuals with TBI (14 males and 8 females aged  $47 \pm 14$  years). The subjects underwent an Attention Network Test (ANT) and an MRI, including anatomical (T1, T2), diffusion and resting-state functional scans (15 mins, TR = 800 ms). We extracted regional fMRI time series and applied fuzzy meta-state dFC analysis, as implemented in the GIFT package. We calculated four measures of dFC for each subject: number of unique meta-states, number of changes in meta-states, total distance travelled in meta-state space and state span (maximum distance between any two meta-states). We correlated these measures with mean reaction time from the ANT (as a proxy measure attention) and performed stepwise linear regression to predict mean reaction time from the four dFC metrics and age, sex and patient status.

**Results:** We found a significant (after Bonferroni correction) negative correlation between mean reaction time and state span (Spearman's  $r = -0.63$ ,  $p = 0.007$ ) and total distance travelled in state space (Spearman's  $r = -0.57$ ,  $p = 0.022$ ). The stepwise linear regression model predicting mean reaction time explained 44% of the variance (adjusted  $R^2$ ) with only two variables, state span ( $b = -25.7$ ,  $p = 0.002$ ) and TBI status ( $b = 95.3$ ,  $p = 0.015$ ). These results indicate that a smaller dynamic range of dFC meta-states relates to longer reaction times in both controls and TBI patients.

**Conclusions:** Analysis of the dynamic nature of individuals' functional connectomes revealed a coupling between more restricted dynamic range of FC and slower responses on an attention task. This relationship could be correlative or causative; future work should explore longitudinal relationships between these measures and how they relate to recovery of attention after TBI. If causative, this finding could be used to design novel therapeutics by targeting this mechanism to boost recovery of attention in individuals with TBI.

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## **O. GBADEYAN. Predicting Mind-Wandering from Task and Resting-State Functional Connectivity in the Aging Brain.**

**Objective:** Whole-brain functional networks associated with mind-wandering (MW) in aging have not yet been characterized. Here, we used connectome-based predictive modeling (CPM) to predict individual MW from whole-brain functional connectivity during task (task-FC) and resting-state (rest-FC). Model generalizability to independent cohorts was also tested.

**Participants and Methods:** We used fMRI data from the Human Connectome Project-Aging (N=135, 67 Females, 65-85 years). Participants completed two resting-state sessions and a Go/No-Go task intrascanner. Whole-brain connectome mapping yielded task-FC, rest-FC and combined-FC (i.e. task-FC and rest-FC) for each participant. MW was assessed using the reaction time coefficient of variation (RT\_CV), a validated objective marker of MW. We employed CPM to predict MW from task-FC, rest-FC and combined-FC separately. Model performance was measured as the Spearman's correlation ( $r_s$ ) between predicted and observed RT\_CV scores. The generalizability of task-FC derived model was tested in two validation datasets that comprised previously unseen older adults.

**Results:** We found that task-FC, rest-FC, and combined-FC successfully predicted MW, with task-FC yielding the best-performing model. The brain connections associated with high MW are

concentrated in the frontoparietal, medial frontal and default-mode networks. Despite the robust in-sample prediction, our model did not generalize to predict MW in both out-of-sample datasets. **Conclusion:** We provide a novel demonstration that MW can be predicted using task and resting-state FC. The present work sheds light on the neural correlates of MW in aging. The finding that our model did not generalize to validation datasets may be attributed to the highly heterogeneous and multifaceted nature of MW experiences.

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## **Plenary B: The Neuropsychological Syndrome of Primary Progressive Aphasia (PPA) as a Dementia Syndrome**

**Presenter: Sandra Weintraub**

**12:00 PM - 12:55 PM**

### **S. WEINTRAUB. The Neuropsychological Syndrome of Primary Progressive Aphasia (PPA) as a Dementia Syndrome.**

Primary Progressive Aphasia (PPA) was first named “Slowly Progressive Aphasia” and described as an atypical clinical presentation of dementia in 1982. In the years that followed, there was controversy about its legitimacy as a distinct “disease” and some argued that it was a “variant” of Alzheimer’s disease. This controversy blossomed into years of research that revealed PPA as a clinical dementia syndrome, characterized by early aphasia that can persist in isolation for many years and that can be caused by a variety of neurodegenerative brain diseases, including Alzheimer’s disease (AD) and one of the several forms of frontotemporal lobar degeneration (e.g, tauopathies, TDP-43 proteinopathy), albeit in distinct probabilities. The single unifying theme in PPA, as would be predicted by neuropsychological principles, is that the patients with the syndrome have an neuroanatomical vulnerability of the left cerebral hemisphere language areas, to neurodegenerative disease. Successive post mortem studies of the brains of individuals with PPA revealed asymmetric left hemisphere distribution of neuropathologic change, regardless of the disease. Thus, Alzheimer’s plaques and tangles, TDP-43 inclusions and Pick’s disease tauopathy have all been observed in higher frequency in the left than in the right cerebral hemisphere at post mortem. Even when disease spreads to the right hemisphere, the asymmetry can persist for many years to death. Even when PPA is caused by AD neuropathology, the ApoE E4 allele, the best known genetic risk factor for AD, is not as highly represented in the clinical syndrome of PPA as in the clinical syndrome of amnesic dementia with AD, suggesting that AD itself is not a unitary disease. Recently, we have proposed that individual risk for PPA, regardless of the cause, might be linked to intrinsic left hemisphere vulnerability to disease. In some members of families we have studied, there is a strong history of developmental dyslexia while in others, PPA emerges in late life, both conditions reflecting left hemisphere biological vulnerability. The neuropsychological evaluation of an individual with PPA is challenging because many of our test instruments rely on normal verbal communication skills. We have developed some clinical tests to circumvent the aphasia in assessing retentive memory and reasoning. The nosology of dementia, previously considered a neuroanatomically diffuse and cognitively widespread condition, has been transformed by the study of PPA. We

now recognize the principle of anatomical specificity of neurodegenerative diseases of the brain that cause dementia, that result in highly focal neuropsychological profiles, especially in early years of illness. Because aphasia is different from amnesia in its impact on daily life, we have also designed specialized care pathways for patients with PPA and their caregivers tailored to their distinct needs

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe the most up-to-date criteria for the clinical diagnosis of primary progressive aphasia (PPA) and how it is differentiated from other clinical dementia syndromes in the early stages 2) List developmental risk factors that might underlie early cortical vulnerability to the PPA syndrome as opposed to other dementia syndromes that feature episodic memory loss 3) Explain neuropsychological tests to clinically distinguish PPA from other dementia syndromes as well as interventions for treatment of patients with PPA and their caregivers.

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## **Invited Symposia 2: Decolonizing Neuropsychology**

**Co-Chairs: Xavier Cagigas, Paola Suarez**

**Presenters: Mirella Díaz-Santos, Jean Ikanga, Lily Kamalyan and Janet J. Yáñez**

**1:00 PM - 1:55 PM**

**L. KAMALYAN, L. A. GUAREÑA, M. DÍAZ-SANTOS, P. A. SUAREZ, M. CHERNER, M. Y. GARCÍA ALCORN, A. UMLAUF, D. R. FRANKLIN, M. RIVERA MINDT, L. ARTIOLA I FORTUNY, R. K. HEATON, M. J. MARQUINE. Influence of Educational Background, Childhood Socioeconomic Environment and Language Use on Cognition among Spanish-speaking adults in the U.S..**

**Objective:** We investigated the impact of culturally-relevant educational, childhood socioeconomic, and language use measures on cognitive test performance among Spanish-speakers living near the US-Mexico border. Participants and method: Participants included 254 healthy native Spanish speakers from the Neuropsychological Norms for the US-Mexico Border Region in Spanish (NP-NUMBRS) project (Age:  $M=37.3$ ,  $SD=10.4$ ; Education:  $M=10.7$ ,  $SD=4.3$ ; 59% Female). A neuropsychological battery assessing seven domains was administered in Spanish. Individual test scaled scores, and T-scores based on region-specific norms adjusted for age, years of education, and sex were averaged to create a Global Mean Scaled score and T-score. Measures of culturally-relevant factors included self-reported educational background (proportion of education in Spanish-speaking country, quality of school setting, classroom size, stopped attending school to work), self-reported childhood socioeconomic environment (parental education, proportion of time living in Spanish-speaking country, childhood socioeconomic and health status, access to basic services, working as a child), and language (Spanish/English use based on self- and examiner-report, and performance-based fluency in Spanish and English). We examined univariable associations between culturally-relevant factors and global cognition

(unadjusted scaled scores and demographically adjusted T-scores). A multivariable stepwise regression examined associations of educational, socioeconomic, and language variables with Global Mean T-score. Results: Several educational background, childhood socioeconomic environment and language characteristics were associated with the unadjusted global scaled score in univariable analyses. When using region-specific demographically adjusted T-scores, fewer culturally-relevant characteristics were significantly associated with global cognition (i.e., quality of school setting, access to basic services, work as a child and bilingualism). In multivariable analyses, being bilingual ( $p = .04$ ) and working as a child for one's own benefit compared to not working as a child ( $p = .006$ ) were significantly associated with higher Global Mean T-score, accounting for a modest 9% of variance in demographically corrected T-scores. Of note, in this multivariable model, there were no significant differences in Global Mean T-scores between participants who reported working as children to help their family financially and those who reported not working as children. Conclusions: While several culturally-relevant factors were associated with absolute levels of global cognition, the effects of these variables were considerably reduced when utilizing region-specific cognitive T-scores adjusting for demographics (i.e., age, education, gender). These findings underscore the utility of demographically-adjusted normative data for the identification of brain dysfunction via neuropsychological tests, as these appear to account for much of the variance of sociocultural factors on cognitive test performance. Yet, bilingualism and working as a child to benefit one's own financial situation still contributed to cognitive test performance above and beyond basic demographics among this population. While being bilingual was associated with better cognitive test performance in this sample, the notion of a bilingual advantage on cognition across cultures remains unclear and warrants further investigation. The cognitive advantage observed among those who reported working as children to benefit one's own financial situation may be a potential indicator of grit, conscientiousness, and/or ambition. Future studies might investigate the role of such psychological factors on cognitive test performance in diverse Latina/o/x populations living in the US.

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### **J. N. IKANGA. A Call for Shifting from the Western to African Neuropsychology.**

To date, there is no culturally appropriate neuropsychological batteries and neuropsychological textbook of African neuropsychological syndromes to assess the impact of the burden of disease on the brain and to know their presentation. Cognitive tests and neuropsychological syndromes from Western countries have simply been translated for use in Africa, without regard to the cultural appropriateness of the content.

The goal of this talk is to propose a new paradigm shift in neuropsychology. We propose that an African neuropsychology and neuropsychological syndrome will be based on African cultures and environment. We will present differences between the Western and the Sub-Saharan cultures. We will illustrate the presentation with concrete cases of patients we have worked with in either with African Immigrants in the USA or Congolese in Africa. These differences will be mostly in clinical interview, conception of cognitive assessment, element of neuropsychological assessment test, and feedback of neuropsychological results. While the Western neuropsychology interview is mostly patient-oriented, it is family oriented in the Sub-Saharan African neuropsychology approach. The Western neuropsychology puts emphasis on both verbal and visuospatial modalities in neuropsychological assessment. However, the strong oral

tradition in Africa provides an advantage in auditory verbal modality and a serious disadvantage with any test that requires written language, organizational skills, categorization, drawing, or graphomotor skill. On the other hand, the western neuropsychology batteries select items based on education and high technological cultures. The African neuropsychological battery uses items based on the context of illiteracy, low technology, and based on oral tradition, respect of elders, and rite of initiation. Finally, in the western neuropsychology the feedback is oriented toward providing the etiology and recommendations to the patient. Contrary, in the African neuropsychology the feedback is family oriented and has the goal to heal “the community neuropsychological syndrome.” This suggests that there is a need for an African neuropsychology approach and neuropsychological syndrome which recognize the impact of the culture and the environment on the brain and brain pathology.

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### **J. J. YÁÑEZ, S. GUTIERREZ, M. DÍAZ-SANTOS. Lead Contamination & Environmental Injustice: Implications for Neuropsychology .**

The World Health Organization has identified lead contamination as a public health crisis placing the highest burden in low-income communities throughout the U.S. and the world. According to the Institute for Metrics and Evaluation (2017), lead contamination accounted for 1.06 million deaths across the globe, approximately 24.4 million year of health life loss (disability-adjusted life years (DALYs)), 63.2% of idiopathic developmental intellectual disability, 10.3% of hypertensive heart disease, 5.6% of ischaemic heart disease, and 6.2 % of stroke. Additional health outcomes include cancer, cardiovascular, and cerebrovascular disease. In this presentation, we highlight one case of lead contamination in Southeast Los Angeles, California, and illustrate how lead contamination is a mechanism of oppression of historically marginalized communities leading to health disparities. For 30 years, a battery plant in Vernon, California, has been polluting Southeast Los Angeles neighborhoods, whose residents are predominantly Latinx, undocumented, Spanish-speaking, with low/no formal education, and of low-socioeconomic status. A study conducted by the University of Southern California (Johnston, Franklin, Roh, Austin, and Arora, 2019), collected 50 baby teeth from 43 children (while in utero & postnatal) in five communities within 2 miles from a battery plant. Higher levels of lead were found in children from communities with the highest soil lead levels. More recently, over 650 people attended a public health hearing, after the battery plant filed for bankruptcy with the Department of Justice (DOJ), and advocated for government officials to deny their claim and press charges for their neglectful practices impacting the community’s health. The community has been organizing for years to shut down the battery plant, demanding the Department of Toxic Substances Control (DTSC) be held accountable for cleaning up homes, schools, and parks, and hold the battery plant financially responsible for contaminating neighborhoods and deteriorating the health of residents. Unfortunately, the DOJ granted the bankruptcy. Currently, it remains unclear whether the contaminated soil will be cleaned. Research has shown that lead exposure can persist for decades. Lead exposure has been associated with structural volume loss in frontal gray matter, prefrontal cortex, anterior cingulate cortex, brain areas important in executive functioning, mood regulation, and decision-making. At low levels, lead exposure has been linked to neurodevelopmental complications, and compromise of the central nervous system, resulting in deficits in fine motor abilities, aggression, and delinquent behavior. Given this global health crisis, it is imperative that

neuropsychologists be cognizant of the social and environmental context where their patients reside, to consider inequities that increase the risk of lead contamination, and how these inequities directly and indirectly impact the pathognomonic expression of known neuropsychological syndromes.

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**M. DÍAZ-SANTOS, J. MIN CHOI, P. A. SUAREZ. Decolonizing Neuropsychology Research WITH (alongside) the Underserved.**

As the urgent call to increase representation of historically marginalized communities in neuropsychology continues to make headlines, researchers are searching for ways to develop equitable and sustainable partnerships between the university and the underserved communities. Although multiple strategies have been used by the university to build and sustain trust, many community members remain wary of researchers and their motives. Building trust is a complex social and interpersonal experience where multiple factors directly and indirectly impact the community decisions of deeming a researcher trustworthy. This presentation will (re)present a neuropsychology research model where the researcher is responsible in understanding, acknowledging, and accepting the narratives of those who have been historically marginalized. This (re)presentation challenges researchers to recognize that science and its universal claims have long been used to legitimize unequal racial, ethnic, and cultural hierarchies and justify assimilationist practices and policies that have been detrimental to the plight of specific groups deemed inferior and “in urgent need of salvation.” How can personal stories measure up to universal knowledge in an equitable manner when the outcome of scientific objectivity is cultural erasure? The (re)presentation of a science that is truly generalizable is dependent on building and sustaining trust with communities who continue to be unheard, unseen, and used to advance a science that is meant to be universal.

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**X. E. CAGIGAS, P. A. SUAREZ, UCLA CULTURAL NEUROPSYCHOLOGY PROGRAM ALUMNI & TRAINEES. Training in cultural neuropsychology as a proof of concept through community, sacrifice, and disruptive innovation amidst an inevitable paradigm shift.**

The development and ongoing evolution of UCLA’s Cultural Neuropsychology Program will be shared as an outgrowth of personal struggles, communal inspirations, and an alternative to the status quo. The guiding principles, anchoring evidence base, and bilingual/bicultural lens that form the central methodological axis for the training program will be described to illustrate one particular way of re-constructing neuropsychological training with a focus on what goes into, and comes out of, trying to better serve the culturally heterogenous Latina/o/x bilingual community. Examples of convergence and divergence with other current models of training will be used to highlight the inevitable paradigm shift that ensues within a community of practice whose point of departure is an acknowledgment that the current state of neuropsychological science and practice does not optimally serve communities who have otherwise been neglected, forgotten, or rendered invisible by current diagnostic methods.

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### **Paper Session 04: Multiple Sclerosis**

**1:00 PM - 2:00 PM**

#### **H. M. GENOVA, K. LANCASTER, J. MORECRAFT, A. SMITH, N. CHIARAVALLI, J. LENGENFELDER. A Randomized Clinical Trial to Treat Facial Affect Recognition Deficits in Multiple Sclerosis.**

**Objective:** Individuals with Multiple Sclerosis (MS) can experience significant and debilitating impairments in social cognitive skills, such as facial affect recognition and emotional processing. Although these deficits are well-documented, there is no published treatment to improve these deficits in MS. Research in other populations (such as Schizophrenia) have shown that emotional processing can be improved using behavioral interventions which teach facial affect recognition skills and facial mimicry. The objective of the current study was to examine the efficacy of a 12-session behavioral intervention teaching facial affect recognition skills and mimicry to improve emotional processing abilities in persons with MS.

**Participants and Methods:** This double-blind, placebo-controlled, randomized clinical trial included 36 participants with clinically definite MS, 21 in the treatment group and 15 in the placebo control group. All participants were screened for facial affect recognition impairments prior to enrollment. Participants completed a baseline neuropsychological assessment, which consisted of social cognition tasks and questionnaires and a repeat assessment immediately post-treatment. Repeated measures ANOVA was used to examine whether those in the intervention group improved in facial affect recognition tasks compared to those in the placebo control group.

**Results:** At baseline, there were no demographic differences between the treatment and control groups. There was a statistically significant interaction between group (treatment vs. control) and time (pre vs. post) on facial affect recognition skills,  $F(1, 34) = 5.791, p < .022, \text{partial } \eta^2 = .146$  such that the treatment group showed improved facial affect recognition skills relative to the placebo group post-treatment.

**Conclusions:** This study provides Class I evidence that an emotional processing behavioral intervention improves facial affect recognition in individuals with MS, through repeated practice of the skills of identifying facial affect and mimicry. Future directions include examining the long-term effects of treatment, as well as identifying factors predict responsiveness to treatment.

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**Keywords:** multiple sclerosis, facial affect, cognitive rehabilitation

#### **M. CHEN, J. DELUCA, H. M. GENOVA, B. YAO, G. R. WYLIE. Cognitive Fatigue is Associated with Altered Functional Connectivity in Interoceptive and Reward Pathways in Multiple Sclerosis.**

**Objective:** Cognitive fatigue is common and debilitating among persons with multiple sclerosis (MS). Neural mechanisms underlying fatigue are not well understood, which results in lack of adequate treatment. We previously demonstrated that cognitive fatigue may be the result of inefficient cerebral activation when meeting increased task demands. However, our previous study examined activations of isolated brain regions without accounting for the inter-connections

between them, which precluded us from being able to implicate specific brain networks (and thus mechanisms) involved in fatigue. To investigate the neural mechanisms underlying MS-related cognitive fatigue, the current study assessed functional connectivity among brain regions previously associated with fatigue, including the dorsolateral prefrontal cortex, the ventromedial prefrontal cortex, the dorsal anterior cingulate cortex, the insula, and the striatum of the basal ganglia.

**Participants and Methods:** The sample consisted of 26 persons with MS and 14 demographically matched healthy controls. Participants underwent functional magnetic resonance imaging (fMRI) scanning while performing a working memory task (n-back). The task consisted of two conditions: one with higher cognitive load (2-back) to induce fatigue, and one with lower cognitive load (0-back) as a control condition. Cognitive fatigue was measured repeatedly throughout the task using the Visual Analogue Scale of Fatigue (VAS-F). Task-independent functional connectivity among fatigue-related brain regions was correlated with VAS-F scores and compared between the two conditions among both persons with MS and healthy controls.

**Results:** As VAS-F scores increased, healthy controls showed a left lateralized connectivity pattern and increased connectivity between the striatum and the ventromedial prefrontal cortex (which are crucial in reward processing) during the fatigue-inducing, higher cognitive load condition (2-back) compared to the lower cognitive load control condition (0-back). In contrast, persons with MS displayed a more bilateral connectivity pattern and increased connectivity from interoceptive hubs – the insula and the dorsal anterior cingulate cortex – to the striatum in the 2-back condition relative to the 0-back condition.

**Conclusions:** The current study identified altered cognitive fatigue-related functional connectivity in the interoceptive and reward pathways among persons with MS. Specifically, persons with MS showed a hyperconnectivity within the interoceptive network and disconnection within the reward circuitry. Such alterations may be the result of inefficient brain connectivity when meeting increased task demands.

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**Keywords:** fatigue, neuroimaging: functional

## **F. ERANI, M. T. SCHULTHEIS, J. D. MEDAGLIA. Assessing Fatigue in Individuals with Multiple Sclerosis Using a Clinically Accessible Measure of Switching .**

**Objective:** As many as 95% of individuals with multiple sclerosis (MS) experience fatigue. Research demonstrates the association between switching and cognitive fatigue in individuals with MS, which has stimulated new approaches using switching tasks to improve the understanding of cognitive fatigue. While computerized switching tasks do well in research settings to inform researchers and clinicians, the methodology used lacks appropriate clinical utility. The Trail Making Test (TMT) is one clinically accessible measure that provides a relatively pure indicator of switching ability. The current study examines the relationship between performance on a clinically accessible task of executive functioning (TMT B) and fatigue. We hypothesized that performance on a switching measure would be associated with increased fatigue, above and beyond other cognitive deficits commonly associated with MS.

**Participants and Methods:** Eighty-three participants with MS were administered a battery of standardized tests of attention, working memory, processing speed, and executive functioning which included: TMT A and B, the Paced Auditory Serial Addition Test, and the Symbol Digit

Modalities Test. Fatigue severity was reported using the Fatigue Severity Scale (FSS). We constructed a series of models using ordinary least squares regression to estimate the association between fatigue severity and switching, as well as attention, working memory, and processing speed.

**Results:** The models supported our hypothesis. We found that on average, each second increase in TMT B-A performance was associated with a .21 (95% CI: .05-.36) point increase in FSS score,  $p < .01$ . When other cognitive domains were assessed in the models, the switching measure continued to uniquely contribute to fatigue severity.

**Conclusions:** This study was designed to explore the relationship between a clinically accessible measure of switching and fatigue and found that performance on the TMT was associated with reports of increased fatigue. The data in the models show that there may be a more isolated relationship between fatigue and switching, which can be captured by a clinically accessible neuropsychological tool.

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**Keywords:** fatigue, neuropsychological assessment, executive functions

### **M. CADDEN, C. A. ROMÁN, E. T. GUTY, K. RIEGLER, P. A. ARNETT. Examining Cognitive Reserve as a Moderator of Neuropsychiatric Sequelae of Multiple Sclerosis .**

**Objective:** Current literature has found that measures of Multiple Sclerosis (MS) pathology consistently correlate with depression symptoms, suggesting that MS pathology may *directly* cause depression. However, not everyone with severe MS pathology develops depression suggesting a potential role for a construct such as cognitive reserve. The goal of this study was to examine whether cognitive reserve moderates the relationship between measures of MS brain pathology and depression among people with MS (PwMS)

**Participants and Methods:** Forty-one PwMS were examined. Depression symptoms were measured using the Beck Depression Inventory-Fast Screen (BDI-FS). Cognitive reserve (CR) was operationalized in two ways: Fixed CR (composite of the TOPF and years of education), and malleable CR (composite consisting of measures of physical exercise, engagement in intellectually stimulating activities, and socializing from the Cognitive Health Questionnaire). Participants underwent high resolution structural MRI. The recon-all pipeline from FreeSurfer was used to calculate corpus callosum (CC) volume. CC volume was used as an estimate for MS brain pathology.

**Results:** Controlling for age, there was a significant interaction between anterior-central CC volume and Fixed CR ( $t(36) = -2.70$ ,  $p = .01$ ,  $PRE = .17$ ) when predicting depression severity.

Controlling for age, there was a trending interaction between anterior-central CC volume and Malleable CR ( $t(36) = -1.9$ ,  $p = .06$ ,  $PRE = .09$ ) when predicting depression severity. Simple effects were examined to better understand these interactions.

**Conclusions:** The pattern of results indicated that those with low CR demonstrated high levels of depression irrespective of their corpus callosum volume. Among those high in CR, only those with larger (healthier) corpus callosum volumes were not depressed. In short, both high levels of CR and larger CC volume were needed to prevent depression. Overall, it appears that CR can be protective against depression among a subset of PwMS. At present, it remains unclear whether cognitive reserve functions to attenuate depression through a neurobiological mechanism – e.g., that those with higher levels of cognitive reserve have more efficient brain networks that allow them to maintain normal psychological functioning despite MS pathology – or if cognitive

reserve is an independent protective factor – e.g., individuals with higher cognitive reserve have more psychosocial resources to manage their disease successfully without experiencing depression. Of course, both of these mechanisms may be working synergistically or in tandem. Longitudinal work examining cognitive reserve as a moderator of neuropsychiatric sequelae of disease burden would be beneficial for better addressing the causal nature of this relationship and the role cognitive reserve could play in interventions.

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**Keywords:** cognitive reserve, depression, multiple sclerosis

**T. EILAM-STOCK, M. SHAW, K. SHERMAN, L. KRUPP, L. CHARVET. Reliability of Cognitive Screening Measures Administered Remotely Through a Virtual Platform to Individuals with Multiple Sclerosis.**

**Objective:** The recent COVID-19 pandemic reinforced the need for reliable administration of neuropsychological measures through virtual tele-neuropsychological platforms. Individuals with multiple sclerosis (MS) often have cognitive involvement, and it is important to provide remote options for cognitive screening in advance of comprehensive neurological evaluation. The goal of the current study was to test the reliability of remote administration of two cognitive screening measures commonly used in MS research and clinical care.

**Participants and Methods:** We tested reliability between an in-person and a virtual administration of the Wide Range Achievement Test – Fourth Edition (WRAT-4), Word Reading subtest, and the Symbol Digit Modalities Test (SDMT), oral administration. Participants had confirmed MS and were enrolled in a clinical trial of a cognitive remediation program. Both tests were remotely administered using a web-based tele-assessment approach in advance of in-person testing. Participants meeting eligibility criteria for mild to moderate cognitive impairment (SDMT normative z-score = -1.0 to -3.0) and were otherwise eligible for enrollment next attended an in-person baseline study visit where the alternate forms of both tests were repeated.

**Results:** Data for  $n = 134$  participants (age = 49.7, range 18 to 69 years; median EDSS = 2.0, range 1.0 to 3.0) was available for analysis. Strong correlations were found between scores on the virtual and in-person visits for both the WRAT ( $r = .82, p = .000$ ) and SDMT ( $r = .81, p = .000$ ).

**Conclusions:** Administration of cognitive screening tests remotely through a virtual platform is feasible and reliable for screening of individuals with MS with mild to moderate cognitive impairment.

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**Keywords:** multiple sclerosis, cognitive screening, test reliability

**C. A. ROMÁN, P. A. ARNETT. Examining Depression in Multiple Sclerosis Using Multi-Shell Diffusion Imaging and Structural Connectometry.**

**Introduction:** Depression impacts persons with multiple sclerosis (PwMS) at a higher rate than the general population. White matter (WM) investigations via diffusion-weighted imaging have correlated compromised WM to depression, showing greater damage in WM pathways is associated with the presence and severity of depression in MS. Connectometry is a novel statistical approach created by Yeh et al. (2016) that maps the local connectome of WM (i.e.,

“tracks the differences”) to identify specific subcomponents of WM tracts that are associated with a variable of interest. Unlike global methods, connectometry is highly sensitive to regional variability within WM tracts and provides information about the local orientation and integrity of fiber bundles that can sometimes get washed out by whole brain analyses. Using this novel approach and advanced acquisition methods (i.e., multi-shell diffusion imaging), the current study aims to examine local WM changes and how they relate to depression in PwMS.

**Methods:** Forty-four participants were divided into three groups: (1) persons with MS and depression (MS+Depression; N=18); (2) persons with MS without depression (MS-Depression; N=11); and (3) persons with depression but no MS (Depression-MS; N=15). Each participant underwent a clinical interview to determine depression status and completed self-report depression questionnaires. Multi-shell diffusion MRI data were collected using three different gradient tables (12, 29, and 64 directions) with each table acquired twice (A>>P, P>>A). Data were preprocessed using FMRIB Software Library’s (FSL) topup and eddy tools. The protocol of Yeh et al. (2016) was used as a guide to conduct group connectometry analysis in DSI Studio. Diffusion data of each participant was reconstructed in MNI space using q-space diffeomorphic reconstruction to obtain the spin distribution function. Then a deterministic fiber tracking algorithm was implemented to connect local fiber directions. A false discovery rate of 0.05 was used to identify significant group differences (i.e., MS+Depression vs. MS-Depression; MS+Depression vs. Depression-MS), controlling for age and sex. In addition, the WM connectome of the MS+Depression group was examined in relation to depression severity.

**Results:** Groups did not significantly differ across demographic variables. Results showed significant decreases in the local connectome of the MS+Depression group compared to the MS-Depression group in the corpus callosum, anterior commissure, right inferior longitudinal fasciculus, and right arcuate fasciculus. When compared to Depression-MS, the MS+Depression group also showed significant decreases in the local connectome of the anterior commissure, left and right cingulum, corpus callosum, and right inferior fronto occipital fasciculus. Regarding associations with depression severity among the MS+Depression group, there were significant inverse relationships ( $p<.05$ ) between depression scores and the local connectome of the middle cerebellar peduncle, corpus callosum, inferior fronto occipital fasciculus, anterior commissure, cortico striatal pathway, and fronto pontine tract.

**Conclusions:** The current study is among the first to use connectometry and multi-shell diffusion imaging to examine local structural connectivity in a sample of individuals with MS+Depression compared to individuals with MS-Depression and Depression-MS. Results provide evidence for the contribution of structural network disruption to the presence and severity of depression in MS. These results support previous studies suggesting MS-specific damage contributes to a “disconnection syndrome” and depression.

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**Keywords:** neuroimaging; structural connectivity, multiple sclerosis, depression

## Paper Session 05: Sports-Related Concussion

1:00 PM - 2:00 PM

**M. URETSKY, Y. TRIPODIS, S. BOUIX, R. KILLIANY, A. MIAN, K. BUCH, C. W. FARRIS, B. MARTIN, J. PALMISANO, C. PUZO, L. GOLDSTEIN, B. DWYER, D. I. KATZ, R. CANTU, N. KOWALL, B. R. HUBER, R. STERN, T. STEIN, A. MCKEE, J. MEZ, M. ALOSCO. Clinical-Pathological Correlates of FLAIR White Matter Hyperintensities in Deceased Former American Football Players.**

**Objective:** White matter hyperintensities (WMH) on fluid attenuated inversion recovery (FLAIR) magnetic resonance imaging (MRI) scans are non-specific markers of pathology of presumed vascular origin. Our *in vivo* work suggests WMH may capture white matter degeneration from repetitive head impacts (RHI), like those from contact sports (e.g. football) and military service. The etiology, risk factors and clinical correlates of FLAIR WMH in people exposed to RHI are unknown. Here, we examined the clinical, pathological, and RHI exposure correlates of antemortem FLAIR WMH in brain donors exposed to RHI.

**Participants and Methods:** The sample included 67 deceased men exposed to RHI, all of whom had available antemortem FLAIR scans obtained via medical record requests. Scans with severe motion artifact were excluded. The Lesion Segmentation Toolbox (LST) derived total lesion volume (TLV). Brain donors also had visual ratings of FLAIR WMH severity, performed by three neuroradiologists, and the LST and visual evaluations were compared. The Cognitive Difficulties Scale (CDS) and Geriatric Depression Scale (GDS-15) were administered in retrospective interviews to informants of brain donors. Neuropathological evaluations included semi-quantitative ratings of white matter rarefaction, arteriolosclerosis, p-tau burden across 14 brain regions (summed to form one composite), and neuritic amyloid plaques (i.e., CERAD score). Ordinal and/or linear regressions examined associations with log-TLV, controlling for age at death, time from MRI to death, race, education, diabetes, hypertension, and MRI resolution (1T, 1.5T, 3T). A single indicator of the presence of neoplasms, stroke, and/or encephalomalacia (1=yes, 0=no) was included in clinical and exposure models.

**Results:** The mean (SD) age at MRI was 59.54 (19.34) years, with a mean (SD) time to death of 5.40 (9.10) years. Fifty-five played football and the other 12 were non-football contact sport athletes and/or military veterans. FLAIRs were acquired on 1T (5, 7.5%), 1.5T (53, 79.1%), and 3T (9, 13.4%) magnets. TLV were associated with visually-rated severity scores of deep (Kendall's tau-b=0.59,  $p<0.001$ ) and periventricular (Kendall's tau-b=0.61,  $p<0.001$ ) FLAIR WMHs. Greater log-TLV corresponded to white matter rarefaction severity at autopsy (OR=2.24,  $p=0.02$ ), but not with arteriolosclerosis, or p-tau and amyloid severity ( $ps>0.05$ ). Greater log-TLV was associated with higher CDS (beta=0.30,  $p=0.02$ ), but not GDS-15 scores ( $p>0.05$ ). Among those who played football, more years of play was associated with greater log-TLV (beta=0.24,  $p=0.02$ ). MRI resolution was not an effect modifier of the results ( $ps>0.05$ ).

**Conclusions:** FLAIR WMH may capture white matter degeneration associated with RHI and contribute to cognitive symptoms. Larger clinical-pathological studies with research-grade scans are needed to clarify the etiology, risk factors and clinical correlates of WMH in the setting of RHI.

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**Keywords:** neuroimaging: structural, traumatic brain injury, cerebrovascular disease

**C. CHAMPIGNY, S. D. ROBERTS, D. P. TERRY, B. MAXWELL, P. D. BERKNER, G. L. IVERSON, M. WOJTOWICZ. Student Athletes with High Preseason Anxiety Report Greater Symptoms Acutely Following Concussion.**

**Objective:** In the United States, one-third (31.9%) of adolescents meet clinical criteria for an anxiety disorder. The demands placed on student athletes can trigger and exacerbate psychological difficulties, thereby increasing the possibility of an anxiety disorder in this population. Emerging research on the impact of anxiety on symptom presentation following concussion suggests that anxiety plays an important role in symptom reporting. The current study examined the associations between pre-injury anxiety symptoms and post-concussion symptoms and neuropsychological functioning in adolescent student athletes who sustained a suspected concussion.

**Participants and Methods:** Between 2009 and 2015, 46,920 student athletes between the ages of 13 and 18 underwent baseline pre-participation testing using the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT®). Of those, 4,732 underwent post-injury testing following a suspected concussion. Approximately 11% (n=517) were assessed within 72 hours after a suspected concussion. Of those, 19 (3.7%) endorsed nervousness and at least one other anxiety symptom (e.g., fatigue, difficulty concentrating, irritability, sleep difficulty, dizziness, or feeling more emotional) at a severity of moderate or greater during baseline preseason testing and were placed in the high anxiety group. Using a nested case-control design, these athletes were each matched to 2 athletes (from the sample of 517 athletes) who did not endorse high levels of anxiety symptoms during baseline preseason testing (total N=57). The main outcome measures were the ImPACT® cognitive composite scores, Post-Concussion Symptom Scale (PCSS) total score, and individual symptom endorsement. To examine whether the differences in the PCSS total score were driven by anxiety-like symptoms, a modified symptom score was calculated by excluding those symptoms used to identify participants in the high anxiety group at baseline.

**Results:** The ImPACT® cognitive composite scores were similar between groups across testing times ( $p > .05$ ;  $\eta^2 = .004-.032$ ). The high anxiety group endorsed a greater number of symptoms than the control group across testing times ( $p < .001$ ;  $\eta^2 = .452$ ) and rated symptoms as more severe across testing times ( $p < .001$ ;  $\eta^2 = .555$ ). When examining the modified symptom score, a mixed ANOVA indicated a group-by-time interaction ( $p = .034$ ;  $\eta^2 = .079$ ); the high anxiety group displayed a greater increase in overall symptom severity from baseline to post injury compared to the control group. There were also group differences when examining individual symptom severity. For example, a greater proportion of the high anxiety group endorsed post-injury physical symptoms than the control group (e.g., headache, nausea, balance problems, dizziness, sensitivity to light, sensitivity to noise, visual problems;  $p < .05$ ;  $\phi^2 = .306-.408$ ).

**Conclusions:** Adolescent athletes who have an anxious profile at baseline are likely to experience a greater symptom burden acutely following injury. Consideration of pre-injury anxiety may help inform clinical management of concussion through tailoring intervention strategies (e.g., incorporating mental health treatments targeting anxiety) to facilitate concussion recovery.

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**Keywords:** concussion, anxiety, sports-related neuropsychology

**J. SCHAFFERT, N. DIDEHBANI, C. LOBUE, J. HART, L. H. LACRITZ, H. ROSSETTI, M. MOTES, M. CULLUM. Neuropsychological Functioning in Aging Retired NFL Players.**

**Objective:** Identify baseline and longitudinal differences in neuropsychological performance among older National Football League (NFL) retirees compared to matched controls and examine the potential influence of head-injury exposure on later-in-life neuropsychological functioning.

**Participants and Methods:** In a prospective cohort design, 53 NFL retirees aged 50 to 79 diagnosed as cognitively normal (CN) or cognitively impaired (CI) based on clinical consensus diagnosis and Jak and Bondi actuarial criteria underwent baseline and follow-up (*M retest interval*= 26 months) neuropsychological evaluations. CN retirees (n=26) were age, education, and IQ-matched to normal controls (NC; n=26). CI retirees with MCI (n=22) or dementia (n=5) were matched to a clinical sample (CS) with MCI or dementia by age, education, and diagnosis (n=22). T-tests and repeated measures ANCOVAs were used to evaluate the normative neuropsychological performance between retirees and controls, controlling for time between visits. Pearson correlations, partial correlations, and quadratic regressions were used to examine linear and non-linear relationships between head-injury exposure and baseline and longitudinal neuropsychological performance. Head-injury exposure variables included total concussions, number of concussions with loss of consciousness, years played professionally, games played, games started, and age beginning tackle football. P-values were adjusted using the Holms-Step Down procedure.

**Results:** At baseline, CN retirees performed significantly worse than NC on the Boston Naming Test-2<sup>nd</sup> edition (BNT-2;  $M_{CN}=44.55$  [7.17];  $M_{NC}=56.62$  [11.66];  $t$  [43]=4.113,  $p < .001$ ) and the California Verbal Learning Test – 2<sup>nd</sup> edition (CVLT-II) total recall ( $M_{CN}=52.80$  [11.01];  $M_{NC}=62.65$  [8.29];  $t$ [49]=3.253,  $p = .002$ ), as well as endorsed significantly more depressive symptoms on the Beck Depression Inventory-2<sup>nd</sup> edition ( $M_{CN}=10.20$  [9.33];  $M_{NC}=2.92$  [3.62],  $t$  [49]=3.698,  $p = .001$ ). Similarly, CI retirees performed worse on the BNT-2 than the clinical sample at baseline ( $M_{CI}=38.93$  [8.93];  $M_{CS}=51.23$  [12.41];  $t$  [47]=4.030,  $p < .001$ ). When evaluating changes in neuropsychological performance, there were no significant differences between CN or CI retirees and their matched control groups over time on neuropsychological measures. Number of reported concussions ranged from 0 to 18 ( $M=5.63$ ,  $SD=4.50$ ) over an average of 8.89 years in the NFL ( $SD=3.49$ ). Only baseline performance on CVLT-II total recall ( $R = -.639$ ,  $p = .001$ ) and delayed free recall ( $R = -.505$ ,  $p = .002$ ) correlated with games played ( $M=108.4$ ,  $SD=53.6$ ) in CN retirees. There were no other statistically significant relationships between head-injury exposure and neuropsychological functioning in CN or CI retirees at baseline or change over time.

**Conclusions:** In this small sample of CN and CI retired NFL players, we found no significant differences on most measures of neuropsychological functioning between NFL retirees and diagnosis, age, and education matched peers. Confrontation naming was lower compared to matched controls, but there was no association between confrontation naming and six head-injury exposure variables. As a group, CN retirees displayed worse verbal memory performance than NC, and a moderate to strong negative correlation was observed between NFL games played and verbal memory performance. However, verbal memory in CN retirees was still average overall and showed no decline over time, suggesting additional longitudinal research in larger samples is needed to determine the clinical significance of this finding.

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**Keywords:** aging disorders, concussion, neuropsychological outcome

**A. WALLACE, R. SULLIVAN, E. A. STINSON, N. E. WADE, K. LISDAHL. Sports Engagement Predicts Cognition in Nine and Ten Year Old Children in the ABCD Study.**

**Objective:** A relationship between physical activity and cognition has been well established in the literature in adults but remains sparse in relation to pre-adolescent children. A few studies have indicated a positive relationship between sports engagement and cognitive domains such as attention, memory, and academic achievement in late childhood; however, this work is still in its early stages. We aim to investigate how sports involvement impact cognition in a nationally representative cohort of nine and ten year old children.

**Participants and Methods:** The present analysis included 10,201 participants between the ages of 9-10 years old and balanced for gender (52% male) who were enrolled in the Adolescent Brain Cognitive Development (ABCD) Study. Participants were administered the NIH Toolbox Cognition Battery. Parents of participants were given the Sports and Activities Questionnaire assessing the number of sports children participated in and the Sleep Disturbance Scale to determine the youth's sleep quality. Anthropometric data was collected and used to determine participant's body mass index (BMI). A series of GAMMs were run to examine how sports engagement predicted cognitive subtests of the NIH Toolbox while controlling for BMI, sleep quality, age, and demographic variables (i.e., race, sex, parental education, parental marriage status, and household income).

**Results:** More involvement in sports was related to increased attention ( $p=.003$ ), working memory ( $p=.025$ ), processing speed ( $p=.002$ ), and planning ( $p<.001$ ) performance. Unexpectedly, higher BMI was associated with increased language skills ( $p<.001$ ) and decreased memory performance ( $p=.015$ ). Greater sleep disturbance was associated with better language performance ( $p=.002$ ) and decreased sleep disturbance was associated with better planning ( $p=.003$ ), processing speed ( $p<.001$ ), and memory ( $p=.039$ ) performance.

**Conclusions:** Greater involvement in sports was associated with increased cognitive functioning in domains of attention, working memory, processing speed, and planning. Participating in sports provides an opportunity for children to engage in physical activity during a time of ongoing neurodevelopment and corresponding increases in cognitive functioning. Cognitive domains observed correspond to functioning in the frontal lobes, a region which is just beginning its most extensive neuromaturation during this time. Therefore, early optimization of development through sports engagement may contribute to better cognitive and life outcomes in youth down the line. Future research should investigate the longitudinal relationship between sports involvement and cognitive functioning as well as how involvement in specific sports may have more nuanced effects on particular cognitive domains.

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**Keywords:** cognitive functioning, child development (normal)

**C. E. GAUDET. Do multivariate base rates of low scores aid in concussion detection? A comparative study.**

**Objective:** Neuropsychology is uniquely positioned to aid in concussion detection. Given the often subtle alterations in cognitive functioning following this form of head injury, measures that

are able to accurately detect slight decrements relative to an individual's baseline, or typical level of functioning, offer significant clinical value. Recent research has yielded multivariate base rates (MBRs) of low scores in healthy populations using a widely-adopted computerized neurocognitive test (CNT), Immediate Post-concussion and Cognitive Testing (ImPACT; Houck et al., 2019). However, the extent to which individuals with concussion produce low scores at divergent frequencies relative to healthy individuals is largely unknown. As such, the present study aims to examine whether MBRs of low scores, using regression-based reliable change scores (RBRCs), accurately discriminate between those with and without concussion.

**Participants & Methods:** This archival review included 210 secondary school students between the ages of 13 and 17. The sample consisted of 129 healthy individuals and 81 individuals that sustained a concussion. All individuals completed ImPACT at multiple time points; healthy individuals completed a baseline assessment on two separate occasions and individuals with concussion completed a baseline assessment and post injury assessment. RBRCs were computed for ImPACT's four cognitive composites. MBRs of low scores were evaluated at varying cutoffs (<25<sup>th</sup>, <9<sup>th</sup>, & 2<sup>nd</sup> percentiles) and frequencies of obtained low scores between those with and without concussion were appraised.

**Results:** Among the cognitive composites, Visual Motor Speed appeared most sensitive to differences between those with and without concussion. It exhibited medium effect sizes when using the 9<sup>th</sup> and 2<sup>nd</sup> percentile cutoffs, respectively. Conversely, Verbal Memory and Reaction Time showed very small relative effect sizes across cutoffs. Regarding MBRs of low scores, the 9<sup>th</sup> percentile cutoff displayed medium effects sizes at frequencies of  $\geq 2$  and  $\geq 3$  low scores, respectively. The 2<sup>nd</sup> percentile cutoff evidenced a medium effect size using  $\geq 1$  low score as a criterion. Even in instances when medium effect sizes were demonstrated, classification accuracy was often less than desirable. For example, when using the 9<sup>th</sup> percentile as the cutoff for low scores, although only 3.1% of healthy individuals obtained  $\geq 2$  low scores (i.e., false positives), only 21.0% of those with concussion obtained  $\geq 2$  low scores (i.e., 79% false negatives).

**Conclusions:** Results of the present study suggest that MBRs of low scores on ImPACT using RBRCs may differentiate between those with and without concussion to some extent; however, this approach's classification accuracy does not appear optimal. CNTs and intraindividual comparison procedures remain promising pursuits given the numerous advantages these approaches offer in concussion assessment and management. Yet in order for these approaches to maximize their utility in identifying cognitive changes attributable to concussion, methodologies aimed at improving reliability and validity warrant further research.

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**Keywords:** concussion, psychometrics, computerized neuropsychological testing

**J. M. LAING, D. H. SCHULTZ, S. AL-MOMANI, E. CARLSON, L. ALBERS, J. TUTTLE, M. MAYER, M. NETA, C. SAVAGE. Alterations in Brain Network Organization Following Sports-Related Concussion.**

**Objective:** In the United States, an estimated 1.6 to 3.8 million sports-related concussions (SRC) occur annually. Concussions have been associated with functional connectivity disruption, as well as short- and long-term effects on neurologic and psychiatric health. Prior studies have examined individual regions between-network connectivity using participation coefficient (PC) and normalized PC (PCnorm). There is limited research on how PC/PCnorm changes following SRC, but research in mild blast-related traumatic brain

injuries found that veterans with these injuries have lower PCs, suggesting the internetwork connections are less uniformly distributed, compared to controls. We evaluated changes in functional connectivity and PC following SRC in a sample of collegiate football players.

**Participants and Methods:** Resting-state functional magnetic resonance imaging data were obtained for male student athletes ( $n=29$ ;  $M\ age=20.17$ ,  $SD\ age=2.02$ ) at baseline and after SRC, roughly 48 hours following injury. Functional connectivity matrices were constructed using 264 brain regions (Power et al., 2011). PCnorm was used in addition to PC because it reduces the influence of intramodular connectivity, while PC assumes all networks are the same size. All analyses were performed on baseline and post-SRC scans. Consistent with the literature, functional connectivity matrices underwent thresholding and binarizing to prepare them for PC and PCnorm functions, calculated using the Brain Connectivity Toolbox and code provided by Pederson et al. (2020). Paired t-tests comparing baseline to post-SRC were performed for the network mean PC and PCnorm for each subject. Multiple comparison corrections were performed using false discovery rate (FDR) ( $p=.05$ ). Mean functional connectivity changes from network to network were calculated and paired t-tests comparing baseline to post-SRC were performed.

**Results:** PC and PCnorm paired t-tests from baseline to post-SRC revealed that the mean PC in the somatomotor network decreased (PC: FDR corrected  $p<.05$ ,  $t=-4.08$ ; PCnorm: FDR corrected  $p<.05$ ,  $t=-5.06$ ), and the mean PC in the default mode network (DMN) increased (PC: FDR corrected  $p<.05$ ,  $t=2.9$ ; PCnorm: FDR corrected  $p<.05$ ,  $t=4.56$ ). The somatomotor network showed increased functional connectivity with the salience network following concussion (FDR corrected  $p<.05$ ,  $t=-3.38$ ). Although we found significant PC differences in the DMN, mean network connectivity between the DMN and all other functional networks was not significantly different.

**Conclusions:** These results suggest that there are PC- and functional connectivity-related changes following SRC. Specifically, somatomotor network PC decreases, suggesting the nodes in the somatomotor network are less uniformly connected to other networks, while FC increases with the salience network. In other words, connectivity may increase selectively with the salience network, which results in a decrease in the uniformity of internetwork connections for the somatomotor network. While we did see an increase in DMN PC, we don't see significant changes in mean networks functional connectivity that could potentially explain that effect. This may suggest more subtle changes in DMN than somatomotor network. Future research will pursue follow-ups directed at identifying more subtle shifts in functional connectivity and PC, and how they are related to post-SRC recovery.

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**Keywords:** concussion, neuroimaging; functional connectivity, brain injury

### **Poster Session 3: Drug/Toxin Related Disorders/Infectious Disorders/Mood, Emotion, Psychiatric/Intervention/Other**

**1:00 PM - 2:00 PM**

**R. L. HUGHES, T. SCHULTE, T. DURAZZO, C. PADULA. Memory and Alcohol Craving Interact to Predict Relapse in Veterans After AUD Treatment.**

**Objective:** Alcohol use disorder (AUD) is four times more common in Veterans than civilians, yet treatment utilization is low and relapse rates high among this group, posing a critical need to identify predictors of relapse (Burnett-Zeigler et al., 2011; Glass et al., 2010). Understanding the role of cognitive functions in this process may yield improvements in treatment outcomes (Bates et al., 2013), although recent research suggests this influence is more likely to be indirect, via interaction with other demographic, psychiatric, or substance sensitivity factors. Therefore, we aimed to elucidate the role of cognition in predicting relapse among Veterans seeking AUD treatment.

**Participants and Methods:** Veterans with a primary AUD diagnosis (n=114) were recruited from VA residential AUD treatment programs. Participants completed several self-report questionnaires and neuropsychological assessments during treatment and were followed for 6 months to determine treatment outcome (i.e., abstinence or relapse). Several factors were identified as potential predictors, based on the literature, and included: level of education, gender, depression symptoms, anxiety symptoms, posttraumatic symptoms, smoking status, and alcohol craving. Mediation and/or moderation analyses were conducted to test if these factors were predictive of relapse, and if global cognition mediated or moderated these relationships.

**Results:** Among the models tested, alcohol craving singly demonstrated a significant and interactive relationship with cognition in predicting relapse status ( $b=-1.9351$ ,  $p=.0467$ , 95% CI [-3.8417, -.0285]). When examining the relative contributions of specific cognitive domains (i.e., attention, executive functions, memory), only memory demonstrated a significant interaction with craving to predict relapse ( $b=-1.1298$ ,  $p=.0030$ , 95% CI [-1.8771, -.3826]). These models suggest the risk of relapse among Veterans with higher craving is magnified by lower baseline global cognitive status—and in particular, memory capacity. These models remained significant even after adjusting for age, gender, medical history, chronic pain, and sleep.

**Conclusions:** To our knowledge, this study is the first to identify an *interactive* relationship between alcohol craving and cognition in predicting relapse. While addressing stress response (as elicited by alcohol craving) is a target of current AUD treatment, these results highlight a critical need to identify baseline cognitive functioning upon treatment entry and integrate cognitive rehabilitation strategies into the treatment course. This study supports current literature suggesting a positive impact on cognitive training in treating AUD (Verdejo-Garcia, 2016).

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**Keywords:** alcohol, cognitive functioning, memory: normal

### S. P. MADDEN, M. JOHN, N. P. VADHAN. Cognitive performance during a laboratory model of cocaine bingeing in experienced cocaine users.

Introduction. Studies have found an association between naturalistic cocaine bingeing and decreased cognitive performance in humans (e.g., Spronk et al., 2013). In contrast, controlled laboratory studies in similar cocaine users have typically found enhanced cognitive performance during periods of cocaine bingeing (e.g., Pace-Schott et al., 2005, 2008). However, these laboratory studies have not incorporated the variation in binge cocaine use that is typically seen with naturalistic use, nor counterbalanced the tasks within the cognitive battery. Therefore, in the present laboratory study, cognitive performance was compared between two binges, during which the amount of cocaine consumed varied, and enforced abstinence.

**Method.** Twelve experienced and physically/psychiatrically healthy cocaine users participated in one of two inpatient studies where cocaine was delivered in an experimenter- (n=7) or a self-administered (n=5) protocol. Participants smoked 25mg of cocaine at 14min intervals for up to 12 times per day, for a total of 4-5 consecutive days during each of the cocaine binges, separated by a period of monitored abstinence. Cognitive performance was assessed nightly via 4 computerized and repeatable tasks: 1) The Digit Symbol Substitution Test, 2) Digit-Recall Task, 3) Divided Attention Task (DAT), and 4) Repeated Acquisition Task (RAT). Performance for each task was analyzed as a function of cocaine phase alone (binge 1 vs abstinence vs binge 2) and by day (day 1 vs day 2, day 1 vs day 3, etc) with a mixed model approach. Secondary analyses adjusted for the total cocaine doses taken during each binge. Pairwise comparisons probed any significant main effects of phase or phase  $\times$  day interactions.

**Results.** More cocaine was consumed during the first cocaine binge (M=42.9 doses, SD=14.9) relative to the second (M=26.0 doses, SD=19.4;  $t(9) = 2.7, p = 0.02$ ). There was a main effect of cocaine phase ( $F = 12.70, df = 2,48.6, p = 0.002$ ) on DAT false alarms, whereby more false alarms occurred during the first cocaine binge, relative to abstinence ( $t(44.8) = 4.56, p < 0.001$ ) and the second binge ( $t(47) = 3.92, p < 0.0003$ ). The main effect of cocaine phase remained significant after adjusting for total dose ( $F = 6.73, df = 2,54.8, p = 0.002$ ). On RAT sequences completed, there was a cocaine phase  $\times$  day interaction ( $F = 2.54, df = 8,82.5, p = 0.02$ ), such that within the abstinence phase, performance was significantly worse on the 5<sup>th</sup> relative to the 4<sup>th</sup> day ( $t(75.3) = 2.92, p = 0.005$ ), which remained significant after adjusting for total doses ( $t(80.3) = 2.57, p = 0.01$ ).

**Conclusion.** Complex attentional response inhibition was weaker during a period in which a relatively greater amount of cocaine was taken, compared to periods when less or no cocaine was consumed. Further, visuomotor learning was variable on a daily basis only during cocaine abstinence. These preliminary findings from a controlled laboratory study may suggest a relationship between response inhibition, visuomotor learning, and amount of cocaine use. Based on animal research, future analyses should compare cognitive effects between experimenter-administered and self-administered cocaine binges in humans.

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**Keywords:** cocaine

**R. BACA, N. E. WADE, K. E. COURTNEY, C. J. MCCABE, M. A. INFANTE, M. A. HUESTIS, J. JACOBUS. Preliminary Evidence for Cannabis and Nicotine Urinary Metabolites as Predictors of Verbal Memory Performance and Learning Among Young Adults.**

**Objective:** Epidemiological data show alarming increases in cannabis and nicotine use rates among high school and college age youth. Cannabis use has been linked to decreases in verbal memory, but the extant literature has typically relied solely on self-report measures of substance use and has limitedly addressed the added complexity of co-use with nicotine. Limitations of self-report metrics may contribute to variability in findings related to the neurocognitive effects of cannabis use. Therefore, the present study utilizes toxicological analyses to quantitatively measure the influence of urinary THC metabolites (THCCOOH) and cotinine concentrations, and their interaction, on verbal learning and memory scores.

**Participants and Methods:** One hundred and three participants (aged 16-22) completed urinary drug testing, detailed substance use records, and a verbal memory assessment (RAVLT). Linear regression models examined the influence of quantitative THCCOOH and cotinine on the four subtests of RAVLT performance: initial learning, total learning, short delay recall, and long delay recall. Additional regressions examined whether cannabis use frequency moderated the relationship between metabolite concentrations and cognitive performance. Hierarchical regressions were run to test if metabolites predicted cognitive performance above and beyond self-reported use over the past month or self-reported recency of substance use.

**Results:** Creatinine-normalized THCCOOH concentrations were negatively associated with total learning ( $p = .043$ ) and long delay recall ( $p = .018$ ). Higher cotinine concentration was related to fewer words recalled on short ( $p = .027$ ) and long delays ( $p = 0.45$ ). THCCOOH concentrations continued to relate to long delay recall ( $p = .047$ ), controlling for self-reported recency ( $p = .93$ ). Similarly, when controlling for self-reported past month use, higher THCCOOH concentrations continued to relate to long delay recall performance ( $p = .021$ ), while self-reported past month use was not related. Cotinine concentration was negatively associated with short delay performance ( $p = .041$ ) when controlling for self-reported recency of use, which was not found to be related.

**Conclusions:** As anticipated, THCCOOH concentration was related to poorer total learning and long delay recall, confirming the negative relationship between verbal memory and cannabis use. Cotinine concentration was independently associated with poorer short delay recall. No interaction was found between cannabis and nicotine metabolites on verbal memory performance, and self-reports of cannabis and nicotine were not found to predict verbal memory performance. Together, these findings support the use of urine toxicology metrics in substance use research in addition to self-report, as both THCCOOH and cotinine concentrations were negatively related to learning and memory performance.

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**Keywords:** cannabis, learning

**J. L. BAIR, S. M. MALONE, M. MCGUE, W. G. IACONO. Cannabis Use Across Early Neurodevelopmental Stages and Young Adult Cognitive Outcomes: Exploring Relationships, Alternative Explanations, and Influencing Factors. .**

**Objective.** The perceived risks of cannabis use have been steadily declining, particularly among adolescents and young adults. Yet, potency of cannabis products has increased over recent decades, raising concerns regarding the consequences of cannabis exposure. Research suggests non-acute cannabis exposure is associated with impairments in a number of cognitive domains and highlights early initiation of cannabis use as a specific vulnerability for cognitive deficits. However, the etiological connection between cannabis and cognition remains to be elucidated given limitations within the literature. These include inadequate control of confounders (e.g. alcohol use, acute intoxication), inability to account for pre-exposure cognitive ability, over-reliance on group comparisons (i.e., users versus non-users) and retrospective report of early cannabis use behaviors often a decade after initial events. Additionally, the role of sex is understudied within the substance use literature and little-to-no work has focused on the potential interaction between sex and age of initiation despite sex-related differences in neurodevelopmental trajectories, which may influence the impact of cannabis exposure. As such, we sought to characterize the relationship between cannabis use occurring across key

neurodevelopmental periods and cognitive outcomes, focusing on normative cannabis use behaviors, alternative explanations, confounding factors, and the interaction between sex and age of cannabis initiation.

**Participants and Methods.** Dimensional measures of cannabis and other substance use were obtained across four assessment waves from age 11 to 24 in a population-based sample of 809 twins (55% female). Primary variables of interest were cumulative cannabis exposure across all waves (cumulative cannabis index) and age of first cannabis use (age of initiation). Participants completed a battery of cognitive assessments at age 24 and pre-exposure cognitive ability was assessed at age 11. Linear mixed models were utilized to explore the relationships between cannabis use variables of interest and cognitive outcomes. All models included age, sex, premorbid IQ, and zygosity as covariates.

**Results.** We found that cannabis use was significantly associated with decreased general cognitive ability, processing speed, inhibition, spatial attention, spatial working memory, and decision-making. After statistically adjusting for SES, alcohol and nicotine use, acute intoxication, and education, a significant negative relationship remained between our cumulative cannabis index and spatial working memory. Additionally, an earlier age of initial cannabis use was related to slower processing speed and poorer decision-making in ambiguous situations. These deficits were evident even in individuals with more normative cannabis use behaviors and were thus not solely driven by extreme use behaviors. There was no evidence of interaction effects between our cannabis use variables and sex.

**Conclusions.** Findings suggest that while confounding factors may account for or overlap with much of the relationship between lifetime cannabis use and cognitive outcomes in young adulthood, aspects of spatial working memory, processing speed, and decision-making continue to be negatively associated with cannabis use behaviors, even in individuals who use at moderate levels. It will be important for future studies to explore the clinical relevance of these findings and their potential impact later in adulthood.

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**Keywords:** cannabis, neuropsychological outcome, adolescence

**M. ROCKHOLD, A. KRUEGER, M. SCHUMACHER, S. MATTSON, K. JONES, E. RILEY, C. CONSORTIUM, J. WOZNIAK. The Association of ADHD Symptoms and Learning Ability in Children with Prenatal Alcohol Exposure .**

**Objective:** Prenatal alcohol exposure (PAE) is a leading cause of neurodevelopmental impairment. Children with PAE display a variety of externalizing behaviors, including many Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms. In non-alcohol-exposed children, ADHD symptoms have been linked to learning difficulties and lower school achievement. This study aims to examine this relationship in children with PAE by comparing the differences across various learning abilities between children with PAE who have high levels of ADHD symptoms, children with PAE who do not exhibit high levels of ADHD symptoms, and a typically developing control group.

**Participants and Methods:** Children ages 8-16 (n = 173) were divided into three groups: PAE with high ADHD scores (PAE-ADHD; n = 66), PAE without high ADHD scores (PAE; n= 53), and a typically developing control group (CON; n = 57). The PAE-ADHD group inclusion criteria was a CBCL-ADHD Scale score greater than or equal to two standard deviations above

the mean. All participants were administered a battery of neuropsychological tests as part of the Collaborative Initiative on Fetal Alcohol Spectrum Disorders (CIFASD) study. Measures included the Wechsler Individual Achievement Test (WIAT; Numerical Operations, Word Reading, and Math Problem Solving scales) and a parent-reported Child Behavior Checklist (CBCL).

**Results:** All three WIAT scales were significantly negatively correlated with the CBCL-ADHD scores ( $r = -.327$  to  $-.503$ ,  $p < .001$ ). One-way ANOVAs showed significant between-group effects on WIAT Numerical Operations ( $F(2, 173) = 40.133$ ,  $p < .001$ ), Word Reading ( $F(2, 173) = 13.304$ ,  $p < .001$ ), and Math Problem Solving ( $F(2, 173) = 43.291$ ,  $p < .001$ ). The PAE-ADHD group had the lowest mean scores across all three WIAT scales. Post-hoc comparisons utilizing Fisher's LSD indicated all three mean WIAT scores were significantly different between the CON group and PAE group as well as the CON group and PAE-ADHD group. The Numerical Operations mean score difference between the PAE-ADHD group and PAE group was approaching significance ( $p = 0.055$ ). Word Reading and Math Problem Solving mean scores were not significantly different between the PAE-ADHD and PAE group.

**Conclusions:** Individuals with PAE showed marked deficits in all three learning domains in comparison to typically developing controls. Children with both PAE and high levels of ADHD symptoms showed a trend towards lower numerical operations performance in comparison to children with PAE who did not exhibit as many ADHD symptoms. Even though the PAE-ADHD group had the lowest mean scores across all three learning scales, Numerical Operations was the only domain that was associated with higher ADHD behaviors. Future research should aim to examine this relationship further as it may indicate that comorbid ADHD and PAE could be linked to specific learning deficits in the numerical operations domain.

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**Keywords:** attention deficit hyperactivity disorder, learning, adolescence

## **I. PACHECO-COLON, M. J. SALAMANCA, S. COXE, S. W. HAWES, R. GONZALEZ. Exercise, Decision-Making, and Cannabis-Related Outcomes Among Adolescents.**

**Objective:** Poor decision-making may represent a risk factor for adverse cannabis-related outcomes, whereas exercise has been linked to better executive functioning and substance use outcomes. This study examines associations between self-reported exercise and cannabis use (CU) outcomes among adolescents, and whether these are mediated by exercise-related effects on decision-making. We hypothesized that adolescents reporting more exercise at baseline would demonstrate better decision-making 6 months later, which would in turn be associated with better cannabis-related outcomes.

**Participants and Methods:** Participants were 387 adolescents ages 15-18 who completed two assessments 6 months apart. Past 6-month time spent on exercise was assessed at baseline through a self-report questionnaire ( $n=138$ ). At the 6-month follow-up, participants completed measures assessing past 6-month CU frequency, presence of CUD, and CU-related problems. They also completed three risky decision-making tasks (Iowa Gambling Task, Game of Dice Task, Cups Task), which we used to derive a latent construct of decision-making. First, we examined the direct effect of exercise on each of the three CU outcomes using three separate bootstrapped regression models. We then used three prospective mediation models to examine the role of decision-making in the relationship between exercise and each CU outcome. Models

were re-tested after controlling for the effects of age, sex, and alcohol and nicotine use. We used full information maximum likelihood to handle missing data.

**Results:** The direct effect of past 6-month exercise at baseline on past 6-month CU frequency at the 6-month follow-up was significant (Path c:  $b=3.02$ ,  $p=.001$ ), such that more exercise predicted greater CU frequency. Direct effects of exercise on CUD (Path c:  $b=.02$ ,  $p=.197$ ) and CU-related problems (Path c:  $b=.06$ ,  $p=.700$ ) were nonsignificant.

Our three hypothesized mediation models revealed significant paths from past 6-month exercise at baseline to decision-making at the 6-month follow-up, such that more exercise predicted better decision-making (Paths a:  $bs=-.04$  to  $-.05$ ,  $ps=.026$  to  $.056$ ). Associations between decision-making and CU-related outcomes were not significant (Paths b: CU frequency [ $b=1.26$ ,  $p=.818$ ]; CUD [ $b=-.003$ ,  $p=.979$ ]; CU-related problems [ $b=.55$ ,  $p=.106$ ]). After accounting for the role of decision-making, the direct effect of exercise on cannabis outcomes were slightly attenuated (Paths c': CU frequency [ $b=2.99$ ,  $p=.002$ ]; CUD [ $b=.02$ ,  $p=.224$ ]; CU-related problems [ $b=.08$ ,  $p=.620$ ]). Across models, indirect effects of exercise on CU outcomes via decision-making were small and nonsignificant (Paths a\*b: CU frequency [ $b=-.04$ ,  $p=.841$ ]; CUD [ $b=.001$ ,  $p=.981$ ]; CU-related problems [ $b=-.05$ ,  $p=.246$ ]).

After controlling for covariates, associations between exercise and decision-making were nonsignificant, but the relationship between baseline exercise and CU frequency at the 6-month follow-up remained significant.

**Conclusions:** Our results indicated that more exercise at baseline predicted better decision-making at the 6-month follow-up; however, this association was better explained by other factors, such as age and sex. Contrary to hypotheses, even after controlling for covariates, adolescents reporting more exercise at baseline also reported higher CU frequency. This association may be explained by type of sports involvement, but more work is needed to explore this further. Results did not support a mediating role for decision-making in the associations between exercise and CU-related outcomes among adolescents.

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**Keywords:** cannabis, adolescence, decision-making

**L. A. GUAREÑA, L. KAMALYAN, E. E. MORGAN, W. WATSON, A. UMLAUF, R. K. HEATON, M. J. MARQUINE. Impact of Emotional Health on Cognition amongst Hispanic and Non-Hispanic White People Living With HIV.**

**Objective:** Stress and adverse emotional health have been linked to worse neurocognitive outcomes among persons living with HIV (PLWH). Hispanic/Latino/a/x (henceforth Hispanic) PLWH are at increased risk for HIV-associated neurocognitive impairment and are likely to face greater adverse life circumstances than non-Hispanic White (henceforth White) PLWH. We examined whether the relationship between emotional health and cognition was moderated by Hispanic ethnicity.

**Participants and methods:** Two-hundred PLWH (Age:  $M=51.55$ ,  $SD=11.98$ ; Education:  $M=13.68$ ,  $SD=2.98$ ; 10% Women, 54% AIDS, 94% on antiretroviral therapy), including 76 Hispanics (41% tested in Spanish) and 124 Whites completed the NIH Toolbox (NIH-TB) Emotion and Cognition Modules. NIH-TB Emotion battery summary  $T$ -scores of negative affect (i.e. anger affect, anger hostility, sadness, fear affect, perceived stress), social satisfaction (i.e.

friendship, loneliness, emotional support, instrumental support, perceived rejection) and psychological well-being (i.e. life satisfaction, meaning, positive affect) were computed based on established methods. The main outcome was demographically-adjusted fluid cognition *T*-score from the NIH-TB Cognition Module. Covariates considered included demographic characteristics, HIV disease characteristics, lifetime psychiatric diagnoses, and lifetime substance use disorders. Covariates that differed by ethnic group were included in models examining the association of emotion and cognition. Three separate multivariable regression models analyzed two-way interaction effects of each Emotion summary *T*-score and ethnicity on fluid cognition. Significant interaction effects ( $p < 0.10$ ) were followed up with models stratified by ethnicity, while non-significant effects were removed and the model rerun.

**Results:** Hispanics had significantly fewer years of formal education, were more likely to be women ( $ps < 0.0001$ ), less likely to have lifetime major depression disorder or substance use diagnoses ( $ps < 0.05$ ), and had fewer years of estimated duration of infection and months of exposure to antiretroviral drugs ( $ps < 0.05$ ) than Whites. Hispanics had higher social satisfaction than Whites ( $p = 0.02$ ), with no significant group differences on negative affect ( $p = 0.41$ ) or psychological well-being ( $p = 0.13$ ). We found a significant interaction between negative affect and ethnicity on cognition ( $p = 0.05$ ), such that higher negative affect was significantly associated with lower cognition among Whites ( $b = -0.29$ ,  $SE = 0.10$ ,  $p < 0.01$ ), but not among Hispanics. Higher social satisfaction was associated with better cognition across ethnic groups ( $b = 0.18$ ,  $SE = 0.06$ ,  $p < 0.01$ ), and there was no significant association between psychological well-being and cognition ( $p > 0.10$ ). Post hoc analyses investigating whether the relationship between emotion and cognition differed among English- and Spanish-speaking Hispanics showed no significant interactions.

**Conclusion:** Greater negative affect was related to worse cognition among White PLWH, but not among Hispanic PLWH, indicating that there may be factors associated with Hispanic ethnicity that buffer the adverse impact of negative affect on cognition. Higher social satisfaction appears to have cognitive benefits for PLWH across ethnicity, underscoring its importance in the development of prevention/intervention approaches aimed at reducing HIV-associated neurocognitive impairment. Future longitudinal studies that include culturally-relevant measures, such as familism, fatalism, resilience, or nativity, may reveal whether these or other factors associated with Hispanic ethnicity buffer the adverse effect of negative affect on cognitive change over time.

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**Keywords:** emotional processes, ethnicity, neurocognition

**H. AUNG, M. BLOCH, T. VINCENT, D. QUAN, A. JAYEWARDENE, Z. LIU, T. GATES, B. J. BREW, L. MAO, L. A. CYSIQUE. Evidence of Premature Cognitive Aging Among a Community Sample of Optimally Treated People Living with HIV.**

**Objective:** While some research has indicated that there may be premature cognitive aging among people living with HIV (PLHIV), results are derived from non-community samples with suboptimal combination antiretroviral therapy (cART) access and virological control. The current study assessed whether age and HIV status interact to lead to premature cognitive aging among a community sample of PLHIV with high cART coverage and their age and lifestyle-matched HIV negative (HIV-) counterparts while considering the mental health and non-HIV comorbidity burden.

**Participants and Methods:** This study enrolled 254 HIV+ and 72 HIV- gay and bisexual men (mean age = 49 years; SD=10.2) from a primary care clinic in Sydney, Australia. Neurocognitive function was evaluated with the Cogstate Computerized Battery (CCB) at baseline and 6 months assessing speed of processing, attention/working memory, and verbal learning and memory. Linear mixed-effect models examined main and interaction effects of HIV status and chronological age on CCB age-uncorrected global neurocognitive z-score (GZS) adjusting for repeated testing, and then adjusting sequentially for HIV biomarkers, mental health, and comorbidities.

**Results:** The majority of HIV+ participants were on cART (92%) and were virally suppressed (84%). Only 15% had a history of HIV disease CDC stage C. HIV positive status and age interacted to produce lower GZS ( $b=-0.43$  (95% CI= $-0.85, -0.02$ ),  $p<0.05$ ). Among covariates, a higher level of con-current anxiety symptoms ( $b=-0.11$  (95% CI= $-0.19, -0.04$ ),  $p<0.01$ ), historical AIDS ( $b=-0.12$  (95% CI= $-0.22, -0.03$ ),  $p<0.05$ ), and historical HIV brain involvement ( $b=-0.12$  (95% CI= $-0.22, -0.01$ ),  $p<0.05$ ) were associated with lower GZS.

**Conclusions:** We found a robust medium size premature aging effect on cognition in a community sample with optimal HIV care. Our study supports routine screening of cognitive and mental health among older PLHIV.

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**Keywords:** aging disorders, HIV/AIDS, cognitive functioning

### **C. BOWERS, J. LICHTENSTEIN, . AMATO, H. HAILE, A. FELLOWS, A. MAGOHE, C. EALER, E. MASSAWE, N. MOSHI, J. C. BUCKEY. Assessing Cognition in HIV+ and HIV- Children in Tanzania: A Nonverbal Approach.**

**Objective:** HIV infection can lead to diffuse central nervous system dysfunction. In children, this can manifest as developmental delays and impaired acquisition of cognitive functions. Cognition can be challenging to assess, particularly in very young children. Historically, assessing intellectual functioning has been restricted to resource-rich countries. This has created a gap in available measurements suitable for resource-limited or non-Western cultures. To fill this gap, we used the Leiter-3, a nonverbal measure of reasoning, to assess cognition in Tanzania. While the Leiter-3 was developed in the United States, it is language-free and believed to be more culture-neutral than others currently in the marketplace. We hypothesized that cognitive differences between HIV+ and HIV- children would be detected using the Leiter-3.

**Participants and Methods:** Data were gathered for 162 HIV+ and 154 HIV- children between the ages of 3 and 8 ( $5.6\pm 1.6$ ) as part of an ongoing longitudinal study in Dar es Salaam, Tanzania. Results from the 10 core subtests of the Leiter-3 and the three composite scores (Nonverbal IQ, Attention/Memory, & Processing Speed) were all used for analysis. Scores were normally distributed; we used independent-sample t-tests to determine group differences. On measures where group differences were found linear and hierarchical regressions were applied to examine the most pertinent predictors.

**Results:** Composite scores for Nonverbal IQ (HIV+ =  $73.77 \pm 14.79$ , HIV- =  $77.9 \pm 16.46$ ,  $p = 0.019$ ), Attention/Memory (HIV+ =  $74.04 \pm 13.39$ , HIV- =  $77.16 \pm 14.39$ ,  $p = 0.047$ ), and Processing Speed (HIV+ =  $65.06 \pm 11.28$ , HIV- =  $71.84 \pm 14.86$ ,  $p < 0.001$ ) were all significantly different across groups, where HIV+ children performed worse than their HIV-controls. As expected, results were less stable at the subtest level, where seven subtests showed

significant differences across groups and seven did not. Hierarchical multiple regression was performed to examine the role of HIV in predicting composite and subtest scores. The addition of HIV to the initial model of gender, age, school attendance, and socioeconomic status significantly improved prediction of some Leiter-3 subtest scores, as well as the Nonverbal IQ (model without HIV status:  $R^2 = 0.111$ ,  $p < 0.001$ ; model with HIV status:  $R^2 = 0.140$ ,  $p < 0.001$ ;  $\Delta R^2 = 0.030$ ,  $p = 0.001$ ) and Processing Speed (model without HIV status:  $R^2 = 0.101$ ,  $p < 0.001$ ; model with HIV status:  $R^2 = 0.160$ ,  $p < 0.001$ ;  $\Delta R^2 = 0.058$ ,  $p < .001$ ) indices.

**Conclusions:** To our knowledge, this study represents the first attempt to use a nonverbal IQ measure in Sub-Saharan Africa to assess cognition in HIV+ and HIV- children. Findings revealed significantly worse performance in the HIV+ group for both global reasoning and processing speed independent of socio-economic status. Additionally, we found HIV status to be a significant predictor of cognitive performance. The Leiter-3 may be a suitable, non-language-based solution for assessing cognition in a variety of nations, cultures, and disease populations around the globe.

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**Keywords:** HIV/AIDS, cognitive functioning, pediatric neuropsychology

**J. L. THOMPSON, I. BELTRAN-NAJERA, B. JOHNSON, Y. L. MORALES, S. P. WOODS. Evidence for Neuropsychological Health Disparities in Black Americans with HIV Disease.**

**Objective:**

Black Americans are at high risk for HIV disease and associated morbidity. However, we know little about the neuropsychological impact and correlates of HIV disease among Black Americans.

**Participants and Methods:**

Participants included 40 Black HIV+, 83 White HIV+, 28 Black HIV- and 64 White HIV- individuals. Neurocognitive performance was assessed with sample-based z-scores from a well-validated and comprehensive battery. Everyday functioning was assessed using self- and clinician-rated measures of cognitive symptoms and activities of daily living. HIV-associated neurocognitive disorders were classified using the Frascati criteria.

**Results:**

A MANOVA revealed a significant three-way interaction between HIV, race, and domain on neurocognitive sample-based z-scores. This omnibus effect was driven by lower performance in the Black HIV+ group for semantic memory and processing speed, which were associated with a large effect size. Black HIV+ participants also demonstrated higher frequencies of HIV-associated neurocognitive disorders as compared to their White counterparts ( $p=.001$ ). Within HIV+ individuals, global neurocognition was negatively related to everyday functioning for White participants ( $r_s=-.39$ ,  $p<.001$ ), but not for Black participants ( $r_s=.01$ ,  $p=.96$ ).

**Conclusions:**

Systemic disadvantages for Black Americans may combine with HIV disease to compound the neurocognitive impairments in this vulnerable population. Future work must investigate how the current educational, sociocultural, and healthcare systems fail Black Americans and contribute to worse neurocognitive and functional outcomes for those affected by HIV.

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**Keywords:** neurocognition, HIV/AIDS

**J. BRETON, L. KAMALYAN, A. MORLETT PAREDES, L. A. GUAREÑA, W. WATSON, M. CHERNER, R. C. MOORE, M. J. MARQUINE. Psychological Acculturation and Cognition among Older Latinos Living with and without HIV.**

**Objective:** Higher degrees of acculturation have been associated with better cognitive performance among older Hispanics/Latinos/as/x (henceforth Latinos), though this appears to be attenuated in the presence of brain pathology. Most studies have assessed acculturation via measures that incorporate language use/bilingualism, which have been separately associated with cognition. This study aimed to examine: 1) whether a measure that assesses psychological acculturation (and does not include language use) is associated with cognition among Latinos; and 2) whether this association might differ between Latinos with and without HIV.

**Participants and Methods:** Participants included 95 older Latinos (female 43%, mean age=63.4±11.1, mean years of education=13.0±4.0, 77% of Mexican origin/descent, 42% primarily Spanish-speaking) living with ( $n=53$ ) and without ( $n=46$ ) HIV enrolled in the HIV in Older Latinos (HOLA) study at the University of California San Diego HIV Neurobehavioral Research Program. Participants completed the Psychological Acculturation Scale (PAS), which assesses emotional connection to and knowledge of both Anglo-American and Latino cultures, with higher scores indicating increased psychological acculturation (range 1 to 9). Our main outcome was fluid cognition  $T$ -scores from the NIH Toolbox Cognition Module, which were adjusted for age, education, sex, and race/ethnicity with separate norms for English- and Spanish-speakers. A multivariable linear regression was conducted to identify independent and interactive effects of acculturation and HIV status on cognition.

**Results:** Latinos with HIV were younger, had less years of education, and were more likely to be male and primarily Spanish-speaking ( $p < .02$ ) than Latinos without HIV. There were no significant differences on level of acculturation between Latinos with ( $M=44.3$ ;  $SD=18.2$ ) and without ( $M=48.5$ ;  $SD=15.2$ ) HIV ( $p = .23$ ). We did not find a significant effect of acculturation (Estimate=  $-.06$ ,  $SE=.07$ ,  $p=.38$ ) on cognition, nor a significant interaction between HIV status and acculturation on cognition ( $p=.69$ ).

**Conclusions:** Findings from these cross-sectional analyses indicate that psychological acculturation is not associated with cognition over and above the effect of demographics among older Latinos with or without HIV. The lack of a significant association between acculturation and cognition in our comparison group is at odds with prior findings, and might be explained by the fact that our measure of acculturation did not include language. Future studies considering both acculturation and language use/bilingualism might shed further light onto whether the previously found effect of acculturation on cognition is mediated by language factors.

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**Keywords:** HIV/AIDS, acculturation, minority issues

**R. SALONER, J. D. LOBO, E. PAOLILLO, S. L. LETENDRE, M. CHERNER, I. GRANT, R. K. HEATON, D. J. MOORE. Cognitive and Physiologic Reserve Uniquely Relate to Superior Neurocognitive Abilities in Adults Aging with HIV.**

**Objective:** Research on older people with HIV (PWH) is predominated by deficit models that focus on the combined neurobiological burdens of HIV and aging, yet many older PWH exhibit

intact neurocognition. We have recently identified a subset of older PWH with “youthful” and resilient neurocognitive abilities characteristic of SuperAging (SA). Cognitive reserve (CR) and physiologic reserve (PR), which reflect the capacity to withstand neural and systemic stressors, respectively, are putative neuroprotective factors that have not been jointly studied in the context of SA among older PWH. The present study examined the independent contributions of CR and PR to global and domain-specific patterns of superior neurocognitive abilities in older PWH.

**Participants and Methods:** : 475 PWH (age range: 50-69 years) underwent neuropsychological and neuromedical evaluations. Three neurocognitive status groups were defined as follows. SA was defined as demographically-corrected (i.e., sex, race/ethnicity, education) global cognitive performance within the normal range for 25-year-olds. Non-SA participants were subsequently classified as cognitively normal (CN) or impaired (CI) based on actual age-corrected norms. The same normative thresholds were applied for secondary analyses in which neurocognitive status was re-classified based on single-domain performance. CR was operationalized using actual age-corrected standard scores on the Wide-Range Achievement Test-IV Reading subtest. PR was operationalized using a cumulative index of medical disease burden comprising 39 general (e.g., hypertension, triglycerides) and HIV-specific health deficits (e.g., HIV plasma viral load). Health deficits were reverse coded as present (0) or absent (1) such that higher scores indicated a lower proportion of health deficits (i.e., higher PR). Statistical methods included analysis of variance with confirmatory multinomial logistic regression to determine global and domain-specific group differences in CR and PR.

**Results:** : Groups were 74 (16%) SA, 206 (43%) CN, and 195 (41%) CI. Univariably, SA exhibited significantly higher CR and PR compared to CN (CR:  $d=0.46$ ,  $p<.001$ ; PR:  $d=0.39$ ,  $p=.004$ ) and CI (CR:  $d=0.35$ ,  $p=.01$ ; PR:  $d=0.32$ ,  $p=.02$ ), whereas CN and CI did not significantly differ on CR ( $d=0.11$ ,  $p=.27$ ) or PR ( $d=-.07$ ,  $p=.48$ ). Covarying for age, higher CR and PR uniquely predicted higher odds of classification as SA (odds ratios  $>1.42$  per 1 SD increase,  $ps<0.05$ ). Domain-specific analyses indicated significantly higher 1) PR in participants who met SA criteria for information processing speed, psychomotor speed, and delayed recall, and 2) higher CR in those who met SA criteria for executive functioning, working memory and delayed recall ( $ps<.05$ ).

**Conclusions:** SuperAgers had higher CR and PR, even compared to cognitively normal (but not Super) older PWH, suggesting high premorbid intelligence and physiological functioning independently buffer against adverse neurocognitive effects in older PWH. Reserve factors related to discrete SA domain profiles and may reflect nonoverlapping pathways of neuroprotection. Specifically, PR may support cognitive efficiency through maintenance of psychomotor and processing speed, whereas CR may reflect optimal higher-order neurocognitive functions. Both reserve dimensions related to superior memory, a particularly aging-vulnerable neurocognitive domain. Determining how these factors jointly support optimal real-world outcomes in SA with HIV points towards development of specific interventions to improve or maintain quality of life in older PWH.

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**Keywords:** cognitive reserve, HIV/AIDS, aging (normal)

**N. SUN-SUSLOW, E. PAOLILLO, R. SALONER, S. L. LETENDRE, E. E. MORGAN, D. J. MOORE. Frailty and Cognition: Cross-Sectional Comparison of the Fried Phenotype,**

**Rockwood Frailty Index, and Veterans Aging Cohort Study (VACS) Index on HIV-Associated Neurocognitive Disorders.**

**Objective:** Frailty has long been recognized as a geriatric syndrome, but to date there has yet to be an agreed upon standard operational definition, which poses challenges to both clinical and research settings. Despite this limitation, frailty is reliably associated with poorer cognitive functioning. Among people with HIV (PWH), rates of frailty are higher and are predictive of future cognitive decline. To determine which measure has the strongest association to cognition among PWH, this study compared common measures of frailty as they relate to HIV-Associated Neurocognitive Disorders (HAND).

**Participants and Methods:** Participants were 289 PWH, older than 50 years (mean age=59.6,  $SD=7.3$ ) enrolled in UC San Diego's HIV Neurobehavioral Research Program from 2014 to 2020. Frailty measurements included the (1) Fried Phenotype criteria (0-5 symptoms: weight loss, exhaustion, low physical activity, slowness, weakness), the (2) Rockwood Frailty Index (proportion of general and HIV-specific health deficits ranging from 0 [no deficits] to 1 [all 34 deficits]), and the (3) Veterans Aging Cohort Study (VACS) Index 1.0. HAND was diagnosed according to the Frascati criteria using a seven-domain neuropsychological battery. Separate ANOVAs (i.e., one for each frailty measure) were used to examine differences in frailty severity between HAND subgroups, and ROC analyses evaluated sensitivity and specificity of each frailty measure to detect symptomatic HAND [mild neurocognitive disorder (MND) and HIV-associated dementia (HAD)] from cognitively normal cases.

**Results:** Individuals diagnosed with HAD had higher rates of frailty than those without HAND among all three frailty measures ( $p's < .05$ ,  $d's > .41$ ). Significant differences in frailty severity were observed between no HAND and MND ( $p's < .05$ ,  $d's > .48$ ), as well as ANI and HAD ( $p's < .05$ ,  $d's > .53$ ) when using the Fried Phenotype or the Rockwood Frailty Index, but not with the VACS Index. To detect symptomatic cases from those who were cognitively normal, an optimal cutoff of  $\geq 3$  was identified for the Fried Frailty index (AUC = 0.71), with sensitivity of 37% and specificity of 92%; an optimal cutoff of  $\geq 0.206$  was identified for the Rockwood Frailty index (AUC = 0.66), with sensitivity of 85% and specificity of 43%; and an optimal cutoff of  $\geq 29$  was identified for the VACS index (AUC = 0.59), with sensitivity of 58% and specificity of 65%.

**Conclusions:** Based on pairwise comparisons, the Fried Phenotype was the best at distinguishing among HAND subtypes; this is followed by the Rockwood Frailty Index and then the VACS Index. However, when considering an optimal balance between sensitivity and specificity, all three measures were poor at detecting HIV-related neurobehavioral dysfunction, and thus highlighting the heterogeneity in neurobehavioral status among PWH at varying frailty levels. Together, frailty may help clinicians stratify risk for HAND, but is an inadequate proxy for HAND and further supports the need for cognitive assessments in clinical settings.

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**Keywords:** aging disorders, cognitive functioning, HIV/AIDS

**E. E. MORGAN, J. E. IUDICELLO, W. WATSON, N. SUN-SUSLOW, R. K. HEATON.**  
**Alexithymia is Associated with Worse Real-World Functioning Among People with Controlled HIV Disease.**

**Objective:** Alexithymia, or difficulty understanding one's own internal emotional states, is elevated among people with HIV (PWH), and linked to negative outcomes including poorer disease management, greater disease progression and severity, and lower quality of life. It is also associated with lower cognitive functioning, suggesting that its prevalence among PWH may result from the effect of HIV on frontostriatal circuits and related cortical regions. No studies have yet examined whether alexithymia contributes to poorer real-world functioning among PWH. We hypothesize that alexithymia will be associated with a range of real-world outcomes based on the observed downstream effects of chronic emotional dysregulation due to alexithymia across multiple populations, including maladaptive coping, somatization, and risk for worse disease outcomes.

**Participants and Methods:** Participants included demographically-comparable groups of 121 PWH (virally suppressed on antiretroviral therapy) and 131 HIV- individuals. Participants with significant medical/neurological (e.g., stroke), or serious psychiatric (e.g., schizophrenia,) conditions were excluded, as were those with current substance use disorder (SUD). Participants completed the Toronto Alexithymia Scale – 20 Item version (TAS-20). This well-validated, widely-used scale has published cutpoints for “possible” (52-60) and “definite” (>60) alexithymia, which were collapsed into a single “clinically elevated” category ( $\geq 52$ ). Participants also completed a battery of neuropsychological tests designed to be sensitive to HIV-associated neurocognitive impairment (NCI), which yielded a validated dichotomous measure of global cognitive impairment. Several domains of real-world functioning were assessed, including instrumental activities of daily living (IADL, from the Lawton and Brody Activities of Daily Living Scale), employment status (from the Patient’s Assessment of Own Functioning Inventory), social satisfaction (composite from the NIH Toolbox Emotions Battery), and frailty status (Fried Frailty Phenotype, collapsing pre-frail and frail status).

**Results:** In PWH, 29% of participants scored in the clinically elevated range on the TAS-20 compared to 12% of the HIV- group ( $p=0.0009$ ). In a logistic regression predicting clinically elevated alexithymia (controlling for current affective disorder, lifetime SUD, and sex/gender), PWH were 2.4 times more likely to score in the clinically elevated range (chi square=5.49,  $p=0.02$ ) than HIV- individuals. Within PWH, a significantly higher proportion of cognitively impaired individuals had clinically elevated alexithymia (47%) compared to those whose cognition was within normal limits (23%; chi square=6.5,  $p=0.01$ ). Controlling for relevant covariates (demographic, psychiatric, NCI, and/or HIV indices selected based on univariable association with outcomes), higher TAS-20 total score was a significant predictor of worse real-world functioning, including dependence in instrumental activities of daily living ( $p=0.01$ ), unemployment ( $p=0.02$ ), poor social satisfaction ( $p<0.0001$ ), and frailty ( $p=0.02$ ).

**Conclusions:** Our findings support the association between alexithymia and HIV-associated NCI, and extend evidence of the negative impact of alexithymia to multiple poorer real-world outcomes in PWH with controlled HIV disease. Alexithymia appears to have a broad impact on functional status, leading to worse psychosocial and physical health outcomes, though future studies should confirm this directionality. Recent work suggests that alexithymia can be improved with targeted therapy (e.g., emotion training), with downstream benefits for disease outcomes. For PWH vulnerable to HIV-associated NCI and functional decline, alexithymia may be a valuable and productive intervention target.

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**Keywords:** emotional processes, HIV/AIDS, everyday functioning

**M. BRITTON, E. S. PORGES, V. E. BRYANT, R. A. COHEN. Profiling Cognitive Deficit in HIV-Alcohol Use Disorder Comorbidity: A Review.**

**Objective:** Up to 50% of people living with HIV (PLWH) experience neurocognitive deficits, which Alcohol Use Disorder (AUD) exacerbates. The current project surveys structural imaging, fMRI, magnetic resonance spectroscopy, and neuropsychological evidence that HIV and AUD interactively compromise brain health and cognitive performance. Additionally, we review evidence linking cognitive deficit in HIV/AUD to direct neurotoxicity, increased viral replication, gut microbial translocation, and liver damage. From this evidence we describe a model of multiple organ compromise and systemic and localized inflammation contributing to cognitive deficit in HIV/AUD.

**Participants and Methods:** PubMed and Google Scholar were searched for papers published before July 31st, 2020. Papers were selected for inclusion if they reported cognitive, fMRI, structural imaging, or magnetic resonance spectroscopy findings in participants with HIV/AUD. Because some studies did not include a control group, papers reporting findings in singly-diagnosed (HIV or AUD) groups were included for comparison. Additionally, papers describing HIV/AUD pathophysiology or cognitive data in HIV/other comorbidities were included.

**Results:** 225 papers were included in the final review. HIV/AUD interaction effects were reported in the domains of executive function, working memory, attention, episodic and procedural memory, processing speed, and motor performance, such that these domains are compromised more dramatically in HIV/AUD than in singly-diagnosed groups. Executive function, working memory, and attention are associated with frontostriatal circuits showing disrupted task-related activation in HIV and, separately, in AUD. However, cognition has not been studied in direct relation to functional activation changes in HIV/AUD. Memory deficit is associated with reduced thalamic and hippocampal volumes, and callosal white matter integrity predicts deficits in fine motor performance and increased ataxia. Because executive function is associated with antiretroviral adherence, cognitive deficits that impact medication adherence likely contribute to HIV disease progression. No existing studies relate cognition to cerebral metabolites in HIV/AUD comorbidity, although metabolite disruptions in singly-diagnosed groups correlate with cognitive and motor deficits.

The detrimental effects of HIV/AUD are likely mediated by multiple physiological mechanisms, prominently including inflammation. Ethanol and HIV Tat protein synergistically induce localized neuroinflammation in murine models. Alcohol exposure and HIV induce gut microbial translocation into the circulatory system, leading to systemic inflammation, alcohol-induced hepatotoxicity, and increased HIV transport into the brain via monocytes. This pathway has been experimentally linked to processing speed deficit. Hepatitis C, which compounds hepatic damage and systemic and cerebral inflammation in HIV/AUD, may also contribute to cognitive deficit, consistent with this model.

Extant studies typically rely on retrospective measures of alcohol use, rather than biomarkers, biosensors, or daily diaries; retrospective reports may underestimate AUD. Another gap in current research is the potential contribution of binge drinking (versus chronic nonbinge drinking) to cognitive deficit in HIV/AUD: in several recent studies, binge drinking more strongly predicts executive function, memory, and motor function in HIV/AUD than does drinking frequency.

**Conclusions:** A review of existing literature indicates that HIV/AUD is associated with a pattern of cognitive deficits, likely related to localized neuroinflammation with concomitant gray and

white matter damage. Systemic inflammation and organ damage also significantly contribute to HIV/AUD-related cognitive deficits.

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**Keywords:** alcohol-related brain damage, HIV/AIDS

**L. A. CYSIQUE, D. JAKABEK, C. RAE, B. J. BREW. Premature and Accelerated Brain Aging in Chronic and Virally Suppressed HIV Infection Involves Cardiovascular Disease Factors: A Longitudinal Shape and Volume MRI Analysis.**

**Objective:** The study aimed to quantify the relative contributions of HIV, chronological age, HIV-associated neurocognitive disorder (HAND) severity, and cardiovascular risk factors on longitudinal subcortical atrophy using MRI volume (size of atrophy) and shape analysis (regional distribution) in virally-suppressed HIV+ individuals compared to closely comparable HIV-negative (HIV-) controls.

**Participants and Methods:** The study included 75 virally suppressed HIV+ participants and 31 geographically, demographically, and lifestyle matched HIV-negative (HIV-) controls who completed baseline and 18-month follow-up anatomical MRI scans, neuropsychological evaluation, cardiovascular exam, and HIV laboratory tests. HAND was categorized into two groups in the HIV+ participants: mild HAND (asymptomatic neurocognitive impairment), and moderate to severe HAND (mild neurocognitive disorder + HIV-associated dementia). Cardiovascular risk factors were summarized into the 10-year Framingham, and the 12-month Data Collection on Adverse Effects on Anti-HIV Drugs Cohort (DAD) risk scores. MRI volumes were processed using Freesurfer V.6 to extract subcortical volumes expressed as percent of the total intracranial volumes. Subcortical shape analysis was conducted with SPHARM-PDM. Analyses were conducted using linear mixed-effect models incorporating interactions between chronological age, time, and each of HIV status, HAND category, HIV disease factors, and cardiovascular risk scores on volumes and shapes.

**Results:** HIV+ participants had smaller volumes of the pallidum ( $p < .02$ ), hippocampus ( $p = .007$ ) and thalamus ( $p = .001$ ) at both study time points compared to HIV- participants. Age\*HIV status interaction revealed premature aging in the pallidum on both volume and shape analyses. Age\*time\*HAND category interaction revealed accelerated aging in the caudate for the moderate to severe HAND subgroup ( $p = 0.008$ ) compared to mild HAND group. Age\*Time\*HIV duration interaction was associated with atrophy in the putamen ( $p < 0.4$ ). Higher CD4 counts had a protective effect on hippocampal volume in older HIV+ participants ( $p < 0.4$ ). Cardiovascular risk scores were associated with smaller volumes at both time points [for the DAD, putamen ( $p = .002$ ), thalamus ( $p < .001$ ), hippocampus ( $p < .001$ ); for the Framingham, pallidum ( $p < .02$ ), thalamus ( $p = .005$ ), hippocampus ( $p < .02$ ). Only the putamen demonstrated accelerated atrophy in those with a higher DAD score.

**Conclusions:** The study demonstrates a three-hit model of mostly diffuse (no systematic shape effect) subcortical injury in virally suppressed HIV+ people: 1. HIV-driven atrophy in the basal ganglia and hippocampus; 2. Normal/abnormal brain aging and HIV infection/HAND synergy for basal ganglia atrophy; 3. Cardiovascular-related injury linked to premature atrophy in basal ganglia and hippocampus, plus emerging accelerated atrophy in the putamen.

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**Keywords:** HIV/AIDS, aging disorders, basal ganglia

**E. PECK, M. K. CASTLE, M. PUGH, E. PEREZ. A Case Study of Neuropsychological Function in an Adult Female with Behçet's Disease.**

**Objective:** Behçet's disease is a rare multi-system and vascular inflammatory condition with prevalence estimates per 100,000 people ranging from 0.64 in the UK to 421 in Turkey. The disease is primarily characterized by physical features, such as oral and genital ulcerations and skin lesions. Prior research has also noted the presence of neurological and central nervous system abnormalities within individuals with Behçet's disease. Persons with this condition typically exhibit impairment in visual-perceptual processing and working memory, and for those with neuro-Behçet's symptomology, processing speed and long-term memory, and anxiety/depression are typically impaired. The purpose of the case study was to assess the neuropsychological functioning of a patient with this disease. These findings can contribute information regarding cognitive functioning to the literature, which can also aid in differential diagnostic considerations. The neuropsychological literature is sparse and is primarily from Eastern Mediterranean/Middle East/Asia regions. This patient is of Northern-Eastern European origin.

**Participants and Methods:** The patient was a 31-year-old female with a graduate degree who was diagnosed with Behçet's Disease ~ 8 years ago. It is important to note that her symptoms were not reported as present during childhood/young adulthood, but were reported as emerging in the time span concurrent with the emergence of the physical symptoms of the disease and prior to the medical diagnosis being made. She was referred by her PCP for a neuropsychological evaluation with complaints of executive thinking, fluency, memory and concentration deficits, and anxious/depressed mood. A comprehensive test battery was administered which addressed these domains. The test battery included: Neuropsychological MSE, ACS, Reliable Digit Span Test, FAS Controlled Oral Word Association, NAB-Naming Test, Category Fluency - Animals, Brown Adult ADHD Questionnaire, Booklet Category Test, Wisconsin Card Sort, Trailmaking, Connors' Continuous Performance Test-III, Connors Continuous Auditory Test Of Attention, California Verbal Learning Test-2, Wechsler Memory Scale-IV (Portions), Rey Osterrieth Complex Figure, CNS Vital Signs Test, Personality Assessment Inventory, Epworth Sleepiness Scale, Pittsburgh Sleep Quality Index, Neuropsychological Symptom Questionnaire.

**Results:** Summary of results: Normal range/pass level scores for domains of Performance Validity, Attention, Visual Spatial Construction and Sequencing, Verbal/Visual Memory, Confrontation Naming, Processing Speed & Reaction Time. Mixed normal - abnormal findings for Timed Fluency and Executive Thinking. Also elevated anxiety and depression. Specific data table with scores and interpretation will be provided.

**Conclusions:** This case study presents comprehensive neuropsychological data and analysis regarding a well educated female diagnosed with Behçet's Disease. The data do show support for several of the recognized neurocognitive and mood features associated with this disease. It is importantly noted that the referring PCP had to be educated regarding the association of the disease with the patient's thinking and mood related symptoms; this study suggests that North American physicians should have a better understanding of this rare disease and of the symptoms associated with this condition.

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**Keywords:** autoimmune disorders, infectious disease, vascular cognitive impairment

**J. R. FESTA, Y. AZRIELI, J. IVANIDZE. Does Covid-19 Unmask Nascent Neurocognitive Disorders?**

**Objective:** Information is emerging about the neurocognitive impact of Covid-19 infection. Recovered patients are reporting issues ranging in severity from “brain fog” to disabling cognitive impairment. We present the case of a man with Covid-19 infection whose daily functioning abruptly changed after recovery.

**Participants and Methods:** A 60 year-old man presented to his PCP for cough and fatigue. There was high suspicion for Covid-19 infection and he was treated with albuterol, azithromycin, and guaifenesin-codeine. He was subsequently found positive for Covid-19 antibodies. Following resolution of cough and fatigue, he complained of clouded memory and difficulties performing professionally. PCP noted abnormalities on serial 7’s, recalling past presidents, and reciting “world” backward. Medical history included prediabetes and two remote concussions (bike accidents /no LOC) with subsequent mild memory dysfunction. He was referred to see his neurologist for cognitive changes and mild headache. Information from the patient’s wife revealed that mild forgetfulness progressed to significant memory problems after Covid-19 infection and that cognitive difficulties appeared worse when he returned to his work of 24 years. He reported confusion, cognitive “fog,” difficulty writing (alphabet); he was laid off from work for declined performance. Comprehensive neurological evaluation was undertaken including neuropsychological, EEG, Sleep Study, MRI, and [F18]FDG PET/ MRI examinations.

**Results:** *Neurological examination:* showed slow responding, inability to recite “world” backward, word recall of 2/3, and errors on clock drawing. *Neuropsychological evaluation:* Patient and wife reported many examples of cognitive difficulties, hallucinations and nightmares during Covid-19 illness, and emotional distress. Testing results found impairment in complex attention, memory, executive functioning, and processing speed abilities as well as mild to moderate depression and anxiety. *Sleep Study:* showed Mild Obstructive Sleep Apnea. *Brain MRI w/&w/o contrast:* There was mild generalized parenchymal volume loss, without disproportionate regional volume loss; mild burden of chronic microvascular ischemic white matter changes, both slightly progressed compared to prior available MRI from 2018. Notably, there was no acute infarct, hemorrhage, or abnormal enhancement. No microhemorrhages were present to suggest sequelae of TBI. *EEG:* bitemporal cerebral dysfunction with no epileptogenic discharges or seizures. *PET/MRI:* Revealed marked disproportionate decrease in parietotemporal cortical FDG avidity involving the bilateral posterior cingulate gyri, posterior temporal convexity, and lateral occipital lobes. There was relative preservation of the bilateral hippocampi, bilateral frontal lobes, and visual cortex. Quantification using statistical parametric mapping with normal database comparison confirmed these findings. The distribution pattern was highly suspicious for Alzheimer disease with additional lateral occipital involvement raising concern for posterior cortical atrophy.

**Conclusions:** A man functioning well prior to Covid-19 infection demonstrated impaired cognition and marked cortical FDG hypometabolism typical for Alzheimer dementia after recovery. Reported history indicated mild memory lapses prior to Covid-19 infection that rapidly progressed to cognitive impairment following infection resolution. This isolated case report, limited by lack of pre-Covid neurocognitive and FDG PET/MRI evaluation, raises the possibility of Covid-19 functioning as a triggering event, unmasking nascent neurodegeneration.

Further investigations are needed to determine the range of cognitive effects and improve diagnosis and management in patients recovering from Covid-19.

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**Keywords:** dementia - Alzheimer's disease, infectious disease

**B. R. CLAWSON, A. DUPONT, Y. CERVANTES-MANZO. Long Term Effects of Anti-NMDA Receptor Encephalitis on Cognitive and Emotional Functioning: A Case Study of a Hispanic Female.**

**Objective:** Anti-NMDA receptor encephalitis has been described as a paraneoplastic disease due to its common association with a tumor that is often benign, ovarian, and a teratoma (Dalmau et al., 2008). Prevalence rates are highest among young women during their childbearing years (80% with a mean age of 23) and lowest in men (20%), the very young (age 0-10), and older individuals (>50 years) (Dalmau et al., 2008; The Anti-NMDA Receptor Encephalitis Foundation, 2020). Main symptoms include flu-like symptoms, memory difficulty, sleep disorders, speech dysfunction, confusion, hallucinations, delusional thinking, disinhibited behaviors, seizures, movement disorders, loss of consciousness and even coma, autonomic dysfunction, central hypoventilation, and impaired vision and/or hearing (Dalmau et al., 2011; The Anti-NMDA Receptor Encephalitis Foundation, 2020). The literature has revealed that 25% of patients either suffer from serious neurological deficits (i.e., brain atrophy and cognitive dysfunction) or die if not treated in the early stages of the disease (Dalmau et al., 2011). Thus, early intervention, such as the removal of a tumor if it exists, significantly increases the likelihood of a faster recovery, and decreases the likelihood of disease relapse. Given neurobehavioral changes observed, neuropsychological evaluations can help provide objective evidence of the individual's cognitive/emotional functioning at different stages of the disease process. Although there is limited data on cognition and anti-NMDA receptor encephalitis, there is even less data on the neurobehavioral presentation of Spanish-speaking individuals with diverse biopsychosocial backgrounds and limited formal education. Therefore, the case study of a Spanish-speaking female with a history of anti-NMDA receptor encephalitis is discussed.

**Participants and Methods:** We present the case of a 40-year-old monolingual Spanish-speaking Hispanic female of Mexican descent with six years of formal education. She was referred for a neuropsychological evaluation by Neurology due to subjective memory complaints within the context of resolved anti-NMDA receptor encephalitis secondary to a teratoma. Presenting complaints included declines in memory, attention, processing speed, headaches, sleep difficulty, and increased distress and anxiety related to her health and fear of a possible relapse. As a result, a comprehensive neuropsychological evaluation was conducted in Spanish by Spanish-speaking clinicians.

**Results:** The patient passed most embedded and stand-alone measures of validity thus her cognitive profile was deemed to be an accurate representation of her current cognitive functioning. Her estimated level of premorbid intellectual functioning was in the average range. Overall, her cognitive abilities were within normal limits with isolated declines on a word reading task and a novel problem-solving task that incorporates feedback. On self-report measures of emotional functioning, she endorsed minimal anxiety and mild depression, which may have been an underestimate given the level of distress observed during the clinical interview.

**Conclusions:** Overall, the patient's cognitive profile was within normal limits despite her subjective memory complaints. Recommendations focused on reassuring her of her cognitive strengths, providing compensatory strategies for subjective difficulties, and a referral to psychotherapy for distress noted secondary to ongoing health concerns. The results of this case study are consistent with the current literature. Notably, it highlights the impact emotional functioning can have on subjective long-term cognitive symptoms.

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**Keywords:** encephalitis, cognitive functioning, cross-cultural issues

### **J. PYNE, A. M. BRICKMAN. Will the Neurological and Vascular Consequences of COVID-19 Result in Increased Risk for Dementia?**

**Objective:** COVID-19 has had a dramatic effect on all aspects of society. However, certain segments of the population – those of older age, those with pre-existing cardiovascular risk factors, and communities of color – are particularly vulnerable. Emerging reports of COVID-19 suggest a wide range of neurological symptoms, systemic organ injury, and vascular complications that likely interact to increase dementia risk in late life. The purpose of this critical review is to synthesize current knowledge of the neurological and vascular impacts of COVID-19 and to propose a hypothesis about its potential longer-term impact on risk for dementia.

**Methods:** We surveyed the published literature related to COVID-19 and SARS-CoV-2 (n>200 peer-reviewed publications) and compiled the potential pathways identified that may enhance dementia risk, including pathways via direct infection risk, indirect immune-mediated response, and secondary organ mechanisms.

**Results:** SARS-CoV-2 has neuroinvasive and neurotropic characteristics with direct pathways to the brain through neural and hematogenous routes. Specifically, acute neurovirulent characteristics such as encephalitis/meningitis, astrocytic activation/injury, and neuronal injury have been reported. Chronic neurovirulent characteristics are currently unknown for SARS-CoV-2, but similar viruses have shown the ability to induce chronic cerebral inflammation. Overall, while direct infection and indirect immune-mediated responses are difficult to disentangle, COVID-19 neurological findings include white matter lesions, acute axonal injury with myelin loss, lymphohistiocytic inflammation, neuronal cell loss, and axon degeneration.

COVID-19 infection can induce vascular injury to the myocardium and endothelial cells along with systemic thromboemboli. Myocardial injury occurs in 7-25% of clinical COVID-19 patients resulting in possible cardiomyopathy, ventricular filling/contracting problems, ventricular tachycardia, atrial fibrillation, and potential cerebral hypoxia. Thromboemboli, both macro and micro within arteries and veins that deposit systemically, do not always have accompanying overt symptoms suggesting that rates of thrombosis (19%) may be currently under-reported. Endothelial cell damage has the potential to disrupt cerebral autoregulation and instigate perfusion abnormalities such as in COVID-19-induced cases of posterior reversible encephalopathy syndrome. Additionally, pulmonary, renal, and liver damage, all possible from COVID-19 infection, are prominent across patients.

Regardless of viral pathway or vascular injury considerations, an emerging report of mid-aged individuals who recovered from COVID-19 have immediate cognitive impairments, specifically in sustained attention, along with inflammatory levels (an indicator of disease severity) that correlate with reaction time.

**Conclusions:** While the true extent and risk of long-term neurological COVID-19 injury is not yet known, especially within individuals with less severe or asymptomatic infections, further study will be essential for designing preventive care, clinical care, and therapeutic strategies. The cascade of COVID-19 infection consequences, including direct neurological infection, indirect immune-mediated acute inflammation, chronic inflammation and organ injury, all play a role in the long-term progression of neurodegenerative syndromes, including dementia, and, in some cases, induce immediate cognitive impairments. Additionally, populations who are already at greater risk of dementia -- those of older age, those with pre-existing cardiovascular risk factors, and communities of color – could be disproportionately affected by exposure to COVID-19. Longitudinal study of patients recovered from the acute effects of COVID-19 is necessary to understand the longer-term effects on dementia risk.

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**Keywords:** infectious disease, vascular dementia, dementia - other cortical

**S. SHIN, M. MCARDLE, J. SLEMP, K. RUSSELL, R. BASILE. Cognitive and Psychological Effects of COVID-19 in Hospitalized Patients.**

**Objective:** Currently, over 31.4 million people worldwide have been diagnosed with COVID-19, with the number of associated deaths exceeding 967,000. Emerging research increasingly suggests that COVID-19 is associated with neurological and psychological sequelae. COVID-19 patients who require treatment in the hospital are at increased risk of physical, cognitive, and psychological symptoms that persist after surviving the illness. The purpose of this study was to identify the cognitive and psychological effects reported by COVID-19 patients in the months following discharge and its impact on daily functioning. Recommendations to address the need for a COVID-19 recovery program are offered.

**Participants and Methods:** Our sample consisted of 68 participants, over the age of 18, who were treated at Staten Island University Hospital for COVID-19. Participants were contacted by phone, two to six months post-discharge from the hospital. Screening measures were utilized to assess for Generalized Anxiety Disorder (GAD-2), depression (PHQ-2), Post-Traumatic Stress Disorder (PC-PTSD-5), and aspects of physical, mental, and social functioning (Neuro-QoL). Based on their responses, participants were referred to appropriate services including primary care, psychiatry, psychotherapy, occupational therapy, physical therapy, and speech therapy. Descriptives and frequencies of the data were conducted.

**Results:** Overall, 27.7% of participants endorsed cognitive complaints after discharge in at least one domain, including attention/concentration (20.0%), word-finding (27.7%), memory (21.5%), and speed of processing (15.3%). In terms of anxiety symptoms, 48.4% of our participants endorsed feeling nervous, anxious, or on edge, and 25.8% endorsed not being able to stop or control the worrying, for at least several days over the past two weeks. Nearly 30% endorsed at least one symptom of PTSD related to COVID-19. Specifically, 29.2% endorsed symptoms of avoidance and 21.5% endorsed nightmares or intrusive thoughts about COVID-19. Regarding depression, 28.2% endorsed anhedonia, and 18.7% endorsed feeling down, depressed or hopeless, for at least several days over the past two weeks. Based on self-report of cognitive and emotional symptoms, 25.5% participants were offered and accepted a referral for psychotherapy, 23.5% for a neuropsychology referral, and 17.6% for a psychiatry referral.

**Conclusions:** These results demonstrate the need for a comprehensive recovery program to treat cognitive decline and psychological symptoms that may emerge for COVID-19 patients.

COVID-19 recovery programs should include coordination and referral for needed services or equipment, educational resources and consultations for survivors, caregivers, and family members, and peer support groups. Future research should explore the effect of physical isolation from family during illness on patient mental health, differences in severity of symptoms among patients treated in the intensive care unit, as well as the impact of demographic factors and other medical comorbidities on the cognitive and psychological effects of COVID-19. Limitations of our study include a small sample size and the use of self-report measures.

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**Keywords:** infectious disease, cognitive functioning, mood disorders

**J. SPAT-LEMUS, A. SACKS-ZIMMERMAN, A. YI, H. A. BENDER. Neuropsychologists at the Forefront: An Innovative, Hybridized Model for Service Care Delivery Developed for COVID-19 Patients.**

**Objective:** While exact estimates of the prevalence of neurological manifestations of COVID-19 vary, it is now believed that the majority of patients diagnosed with Sars-CoV-2 exhibit neurocognitive and neuropsychiatric deficits. This public health concern has far-reaching implications for service delivery as the variability, duration, and severity of prolonged cognitive, emotional, and behavioral sequelae of COVID-19 is largely unknown. Extrapolating from available SARS and MERS studies, the persistent neurocognitive and socio-emotional ramifications of this illness may have long-lasting effects. To this end, it is essential for healthcare systems to institute a service care delivery model aimed at decreasing the potential chronicity of these symptoms and improving functional outcomes. Chronic and collaborative care models have been successfully implemented with other diagnoses, with the most effective healthcare systems addressing the needs of patients at the self-management, organization, practice, and community levels. Comprehensive, evidence-based treatment, initiated early and across the continuum of care was found to be the most efficacious. Neuropsychologists can provide a vital role in adapting and implementing a hybridized model at each stage of care that takes into account the neurocognitive and psychological factors that can affect treatment and recovery. To address the existing gaps in the literature, our objectives are to develop an innovative service delivery care model that highlights the integration of neuropsychological assessment and interventions in COVID-19 survivors.

**Methods:** An extensive literature review was conducted evaluating the use of chronic and collaborative care delivery models. Following analysis, an adapted chronic care model was created to highlight the importance of neuropsychological intervention and treatment at each stage of COVID-19 medical management within the context of an interdisciplinary team of specialists.

**Results:** The current COVID-19 care model proposes to adapt well-established attributes of chronic and collaborative care models that integrate an innovative neuropsychology paradigm which includes assessment and treatment components across phases of care. Specific elements of the proposed COVID-19 care model includes: a) Patient-centered medical management; b) Team-based collaboration; c) Evidence-based support; d) Measurement-based approach; and, e) Community integration. The neuropsychologist working within the framework of the model provides serial assessments, refines the therapeutic goals, provides interventions, and adjusts treatment plans throughout the recovery process.

**Conclusions:** COVID-19 calls for an innovative iteration of the chronic and collaborative care models that takes into account the multifactorial neurocognitive and psychological factors that can negatively interfere with patient outcomes. In this newly adapted model, neuropsychologists play an instrumental role in assessing, treating, and providing a holistic understanding of a patient's clinical and behavioral profile that can support an interdisciplinary approach to treatment. Future goals should include conducting large, multicenter 'proof of concept' studies assessing the response to and efficacy of this novel, chronic care model.

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**Keywords:** treatment outcome, cognitive functioning

**M. PERSICH, S. CLOONAN, R. A. WOODS-LUBBERT, R. SMITH, J. SKALAMERA, W. D. KILLGORE. Emotional Intelligence Training and Improvements to Emotional Regulation.**

**Objective:** Emotion regulation skills have been strongly linked to adaptive mental health outcomes, and the development of such skills is often emphasized in school, work, and therapeutic settings. One potential method of improving emotion regulation is by focusing on increasing a person's emotional intelligence (EI). EI refers to the ability to accurately perceive emotions, use emotions to facilitate thinking, understand emotions, and effectively manage the emotions of oneself and others. As such, the construct of EI encompasses many of the critical emotional capacities needed to effectively regulate emotions. The current study therefore investigates whether an EI training program can facilitate improvements to emotion regulation skills.

**Participants and Method:** In the current study, we used a comprehensive, internet-based EI training program that our lab has designed to help people develop a broad range of emotional abilities. Three hundred and twenty-six healthy adults completed this study, and were randomly assigned to participate in the EI training program ( $n = 171$ ,  $M_{age}=23.65$ ,  $SD=5.29$ ; 70.2% Female; 38.6% Non-White) or in a placebo training group ( $n = 155$ ,  $M_{age}=23.60$ ,  $SD=5.55$ ; 73.5% Female; 37.4% Non-White). To assess emotion regulation, we used the Difficulties in Emotion Regulation Scale (DERS) which assesses difficulties related to emotional non-acceptance, impulse control, impairments to goal-directed behavior, lack of emotional awareness, lack of emotional clarity, and poor emotion regulation strategies. We also administered the Emotion Regulation Questionnaire, which assesses tendencies to regulate emotions using cognitive reappraisal or expressive suppression. We conducted a 2 (EI vs placebo) by 2 (pre-training vs. post-training) mixed model ANOVA to assess changes in emotion regulation.

**Results:** Participants reported decreases in overall DERS scores after completing the EIT program, relative to participants in the placebo program,  $F(1, 322) = 8.16$ ,  $p = .005$ . Further analyses of the DERS subscales revealed that the EIT program produced significant improvements in participants' acceptance of their emotional responses,  $F(1, 323) = 5.68$ ,  $p = .018$ , emotional awareness,  $F(1, 323) = 5.57$ ,  $p = .019$ , and emotional clarity,  $F(1, 323) = 9.79$ ,  $p = .002$ , with a trend towards improvements in emotion regulation strategies,  $F(1, 323) = 3.40$ ,  $p = .066$ . Participants in the EIT program also reported less use of expressive suppression strategies relative to the placebo program,  $F(1, 323) = 4.36$ ,  $p = .038$ . However, there were no significant difference in the use of cognitive reappraisal  $F(1, 323) = 1.06$ ,  $p = .304$ .

**Conclusion:** Individuals who underwent an emotional intelligence training program showed improvements in their emotion regulation abilities, relative to those who participated in a

matched placebo program. In particular, it appeared that the program helped improve emotion regulation through awareness, clarity, acceptance, and expression, which perhaps suggests that the EIT program was most successful in helping people become comfortable with understanding and engaging in their emotional experiences.

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**Keywords:** emotional processes, social processes

### **K. I. STEWART, C. TYTLER, I. YAROSLAVSKY, M. KOVACS. Does Emotion Regulation Mediate The Association Between Frontal Alpha-Band Asymmetry and Internalizing Problems?**

**Objective:** Depression and anxiety frequently co-occur, and are believed to share common processes that contribute to the risk for both disorders. Asymmetric activity within the frontal cortex in the alpha frequency band (FAA) has been associated with the dispositional tendency to experience positive and negative affects and the risk for both disorders, which may suggest that such asymmetry indexes a common process in depression and anxiety. However, meta-analytic findings suggest that the relationships between FAA and both conditions are modest, and point to intervening mechanisms between FAA and adjustment. Emotion regulation (ER) deficits in the form of the abundant use of ineffective (maladaptive) strategies and the infrequent use of effective (adaptive) responses robustly predict risk for both disorders, and recent works suggest that resting left FAA dominance is linked to greater use of adaptive ER responses. However, it is not known whether task-related change in FAA is also tied to ER use. This study tested the mediating role of ER between FAA at rest and in response to happy and sad mood inductions and symptoms of depression and anxiety.

**Participants and Methods:** Sixty-three women (M age = 30.21 years, SD = 5.67) completed measures of depression (Beck Depression Inventory), anxiety (Beck Anxiety Inventory), and emotion regulation (Feelings and Me), as well as a physiological protocol that included a resting period (Free Breathing), and film-based sad and happy mood induction. Electroencephalography (EEG) was collected throughout the protocol at 512Hz; difference within the EEG alpha frequency band across the F3 and F4 electrodes was used to index FAA. Resting states reflect those during Free Breathing, while reactivity indexes change in FAA across the resting task and mood induction procedures.

**Results:** In contrast to expectation, neither FAA at rest or in response to mood induction predicted levels of depression and anxiety,  $F(2,60) = .40-1.49$ ,  $ps = .23 - .67$ . However, left-side FAA dominance at rest predicted the greater relative use of adaptive to maladaptive ER responses,  $b = -21.66$ ,  $p = .048$ , that, in turn, were robustly linked to depression symptoms,  $b = -.09$ ,  $p = .002$ , and to anxiety symptoms at a trend level,  $b = -.05$ ,  $p = .066$ . Importantly, the balance between adaptive and maladaptive responses mediated resting FAA asymmetry on depression symptoms (indirect effect = 1.95, 95% CI .02 - 4.60). FAA reactivity to mood induction procedures was unrelated to ER.

**Conclusions:** Our findings add to a small, but growing literature that connects resting left FAA dominance with the use of adaptive ER responses. As both constructs were measured contemporaneously, their temporal relationship cannot be discerned from this study. Therefore, it is unclear whether left FAA dominance potentiates adaptive ER use, or reflects a neural correlated of positive affectivity and well-being with which adaptive ER use is associated. Clinical implications will be discussed.

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**Keywords:** electroencephalography, emotional processes, mood disorders

**W. D. KILLGORE, J. SKALAMERA, M. OZCAN, S. CLOONAN, R. A. WOODS-LUBBERT, M. PERSICH, R. SMITH. Development and Validation of the Interpersonal Affect Regulation Test (IPART).**

**Objective:** Emotional Intelligence (EI) can be defined as the ability to accurately perceive, understand, manage, and use emotional information to solve problems. The ability to intentionally improve the emotional states of others, or inter-personal affect regulation (IPAR) ability, is often considered an important component of emotional intelligence. While multiple self-report scales have been developed to assess self-perceived behavior within this domain, there are presently no validated performance tests of IPAR ability. Therefore, we developed the Interpersonal Affect Regulation Test (IPART) as a metric of this ability and have conducted preliminary validation of the scale.

**Participants and Methods:** Study 1. 261 participants ( $M_{\text{age}} = 28.8$  years  $SD=3.7$ ; 49.2% female) read 42 scenarios and had to choose the best response to the situation that would help the individual in the story feel better about the situation. The best response option (worth 2 points) always conveyed nonjudgmental validation and then focused on constructive reappraisal and/or problem solving. The two intermediate response options (worth 1 point) were less validating, and instead focused primarily on suggesting avoidant strategies (e.g., suggestions to ignore the problem, suppress emotion, find a distraction, etc.), which tend to be less effective (especially in the long-term). Finally, the worst response option (worth 0 points) involved judgmental and/or otherwise insensitive statements that would tend to make a person feel worse. Study 2. A total of 324 individuals ( $\text{Age}=23.6$  years,  $SD=5.4$ ; 72% female) completed the IPART, and were then randomly assigned to complete one of two online training programs: 1) an Emotional Intelligence Training (EIT) program ( $n=169$ ) or 2) a placebo training program ( $n=156$ ). The IPART and other EI tests were administered 2 to 4-weeks later.

**Results:** Study 1: After identifying and removing a number of items with low item-total correlations, a 34-item version was developed with good reliability ( $\alpha = .82$ ). A principal-components analysis (PCA) demonstrated that the IPART comprised a single factor. Study 2: The IPART significantly correlated with self-perception measures of the ability to regulate the emotions of others, including the Emotion Regulation of Others and Self (EROS; Extrinsic Improving=.15,  $p=.006$ ; Intrinsic Improving=.20,  $p<.001$ ), Self-Rated Emotional Intelligence Scale (SREIS;  $r=.26$ ,  $p<.001$ ), Managing the Emotions of Others (MEOS; Enhance=.28,  $p<.001$ ; Worsen=-.21,  $p<.001$ ), and the Situational Test of Emotion Management-B (STEM-B;  $r=.52$   $p<.001$ ). EI training led to a significant improvement in scores on the IPART relative to the placebo training regardless of whether participants answered according to the “best” answer or their own “personal choice” answer (Best Choice:  $F(1,324)=7.26$ ,  $p=.007$ ; Personal Choice:  $F(1,324)=24.30$ ,  $p=.000001$ ).

**Conclusion:** The IPART demonstrates acceptable internal consistency and a single factor structure, and shows concurrent validity by correlating significantly with other measures of the ability to regulate the emotions of others and general EI tests. Further, the IPART showed significant improvement following a training program that focused on building EI skills. These findings suggest that the IPART may provide the first reliable and valid performance-based metric for assessing the ability to manage the emotions of others.

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**Keywords:** emotional processes, social processes, social cognition

**H. HEPPNER, C. CAUGHIE, G. M. MASHINCHI, E. C. HICKS, C. MCFARLAND. Emotion Suppression, Positive Affect, and Executive Function.**

**Objective:** Emotion suppression is associated with poorer performance on cognitive measures and has also been associated with the suppression of positive as well as negative affective and mood states. More specifically, emotion suppression is generally associated with poorer executive function performance, possibly because both are putatively related to prefrontal processes. However, the impact of affective and mood states has generally not been considered for this relationship, even though it can plausibly impact cognitive performance. This study aimed to replicate previous findings and show that emotion suppression is directly associated with poorer performance on executive function measures. We further aimed to extend previous research and investigate whether affect and mood states impact the relationship between emotion suppression and executive function. Other cognitive function measures were also investigated as outcome variables.

**Participants and Methods:** Data from the cognitive and neuroscience substudy of the national Midlife in the U.S. Study 2 (MIDUS 2) was used to investigate the study aim ( $n = 88$ ). Composite measures for executive function, episodic memory, and general cognitive performance were assessed via the Brief Test of Adult Cognition by Telephone (BTACT). Emotion suppression was assessed via the Emotion Regulation Questionnaire (ERQ). Mood and affect were assessed via the Mood and Symptom Questionnaire (MASQ). Linear regression and path analysis modeling was used to investigate the above relationships.

**Results:** Univariate regression modeling showed higher emotion suppression to significantly predict endorsement of lower anxious symptoms ( $p < 0.05$ ) and lower positive affect ( $p < 0.001$ ) subscales of the MASQ. Emotion suppression did not have a direct effect on any of the cognitive measures (all  $p > .05$ ). Using anxious symptoms and positive affect subscales as endogenous variables, path analysis showed no significant indirect effect of emotion suppression on any of the cognitive measures. However, item-level path analysis showed a significant indirect effect of positive affect subscale items on executive function ( $p < .05$ ).

**Conclusion:** The current study did not replicate previous findings that higher emotion suppression directly predicts poorer performance on executive function measures. No indirect relationships between emotion suppression and cognitive performance were observed. However, item-level analysis indicated that lower emotion suppression is associated with higher positive affect, which in turn predicted better performance in executive function measures. Further research should expand on the impact of positive affect as a mediating variable between emotion suppression and executive function.

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**Keywords:** executive functions, cognitive control, affective processing (normal)

**T. V. CHAPALA, M. ILICH. Study of depression in women with gastroenterological diseases.**

**Objective:** The results of numerous medical and psychological studies have confirmed a high percentage of propensity to develop depressive states among people with diseases of the gastrointestinal tract (mainly in women). The frequency of emotional-negative states among somatic patients varies from 30 to 70 %, and correlates with the severity of the disease.

The purpose of the study: to determine the depressive state in patients with diseases of the gastroenterological diseases who are on inpatient treatment using the method of psychological diagnostics.

**Participants and Methods:** The Study was conducted at the inpatient Department of gastroenterology, Tolyatti city clinical hospital No. 5, Tolyatti, Russia. The experimental sample consisted of women (N=28) with gastroenterological diseases of various clinical forms, aged from 18 to 83 years (average age M=57.24; SO = 16.01). Participants were divided into two groups: the first group consisted of middle - aged workers (N=14), the second group of non-working people – of retirement age (N=14). The Beck depression scale was used for psychological diagnosis of depression.

**Results:** A high level of major depression was detected in 28.5% of women with diseases of the gastroenterological diseases; severe stage of depression was detected in 35.7%; mild depression (subdepression) was detected in 28.5% of patients; no signs of depression were detected in 7.2% of women. The average values of the depression scale of the first group were M=21; SO = 10.79.

In middle-aged participants who work, it is determined: a high level of major depression in 14.3% of women; a pronounced stage of depression was determined in 50%; subdepression in 28.6% of sick women; no signs of depression were detected in 7.1% of women. The average values of the depression scale of the first group were M=20; SO = 10.25.

In participants of retirement age, it was revealed: a high level of major depression in 42.9% of women; a pronounced stage of depression was determined in 21.4%; subdepression in 28.6% of sick women; no signs of depression were detected in 7.1% of women. The average values of the depression scale of the first group were M=22; SO = 8.67.

According to Fischer's F-test, no significant differences were found in the level of depression between women with gastroenterological diseases who participate in labor activity and participants of retirement age  $F=0.267$ ; with  $p=0.609 > 0.05$ .

**Conclusions:** In women with diseases of the gastroenterological diseases are determined: more than half of women suffer from major depression or severe depression. Women of retirement age who do not take part in work, 42.9% were found to have major depression, while only 14.3% of working women. Which may mean that a passive lifestyle affects the psychological and emotional state of patients. However, there were no statistically significant differences between women of the first and second groups with diseases of the gastroenterological diseases.

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**Keywords:** depression, geriatric depression, emotional processes

**S. CLOONAN, M. PERSICH, R. A. WOODS-LUBBERT, R. SMITH, J. SKALAMERA, W. D. KILLGORE. Examining Changes to Perceived and Ability Emotional Intelligence Following Emotional Intelligence-Specific Training .**

**Objective:** Emotional intelligence (EI) is defined as the ability and capacity to understand, perceive, and manage one's own, as well as others', emotions. There is an ongoing debate in the EI literature as to whether EI should be conceptualized as a collection of self-perceived traits or as an ability. Critics of trait-based EI often note that self-perceptions of EI are not necessarily

reflective of actual abilities. However, these self-perceptions may be able to capture important information such as beliefs about one's self-efficacy for emotion-related abilities. Therefore, training programs designed to improve EI may want to consider the effects of the program on both actual EI ability and self-perceptions of ability. The current study explores changes in perceived and actual EI abilities before and after undergoing a training program designed to improve various aspects of EI. We predicted that the training program would benefit individuals, both by strengthening their actual EI abilities and by increasing positive self-perceptions of their EI abilities.

**Participants and Methods:** Three hundred and twenty-six healthy adults completed this study, including 171 randomly assigned to the EI training group ( $M_{\text{age}}=23.7$ ,  $SD=5.3$ ; 70.2% Female; 38.6% Non-White) and 155 assigned to the placebo training group ( $M_{\text{age}}=23.6$ ,  $SD=5.5$ ; 73.5% Female; 37.4% Non-White). The Self-Rated Emotional Intelligence Scale (SREIS) and the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) were used to assess EI traits and abilities, respectively. Assessments were collected at baseline and immediately following training. We conducted a 2 (EI vs. Placebo) by 2 (Time 1 vs. Time 2) repeated measures analysis of variance to assess changes in overall perceived and actual EI abilities before and after undergoing treatment.

**Results:** There was a significant interaction between time and program condition for total SREIS scores,  $F(1,322)=19.09$ ,  $p < .001$ . There was also a significant interaction between time and program condition for total MSCEIT scores,  $F(1,319)=5.69$ ,  $p < .018$ , showing a significant improvement in EI scores on both tests for the EI versus Placebo training.

**Conclusions:** After completing a training program targeted to improve EI skills, participants perceived themselves as more emotionally intelligent than those who completed a placebo program. Participants who completed the EI training program also performed better on an ability-based measure of EI than those who completed a placebo program. These findings reveal that individuals have a more positive perception of their emotional abilities after going through the training, and they have the actual skills to support their increased self-perception. Further, these findings suggest it is possible to both train people to be more emotionally intelligent as well as to recognize their EI abilities so that they can be better utilized. Web-based training in EI could be utilized to enhance emotional functioning in a variety of occupational settings. Future research should examine how greater perceived and actual EI abilities can impact well-being, relationships, and other related constructs.

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**Keywords:** emotional processes

### **M. MATERIA, E. HALVORSON, A. CLARK. Resilience Moderates the Impact of Adverse Childhood Experiences on Mental Health, Coping Behaviors, and Cognitive Ability.**

**Objective:** Adverse childhood experiences (ACEs) like suffering emotional/physical/sexual abuse, witnessing domestic violence or substance abuse are positively associated with depressive affect, perceived stress, and frequency of utilizing poor coping behaviors. While strong coping strategies, community support and resilience have been shown to mitigate physical health impacts of ACEs, their impacts on emotional and cognitive health have not been widely explored. In this study, we specifically focused on whether resilience, one's adaptability to adverse situations, moderates the impact of ACEs on participants' depressive affect, perceived

stress, and coping behaviors. We hypothesized that those with more numerous ACEs would report greater depressive affect, greater perceived stress, and more frequent use of poor coping strategies, but that this relationship would be moderated by higher resilience.

**Participants and Method:** Participants included 233 undergraduate students (203 females; 187 White) with an average age of 20.03 years ( $SD = 8.07$ ). They completed the ACEs Scale, Center for Epidemiological Study of Depression-Revised (CESD-R), Conner-Davidson Resilience Scale (CD-RISC), Perceived Stress Scale (PSS), and a series of questions measuring participants' utilization of alcohol, tobacco, marijuana, and/or food binges.

**Results:** The occurrence of ACEs in our sample was relatively high (mean = 2.04,  $SD = 2.82$ ). Indeed, 35.6% of the sample reported experiencing at least two ACEs during their childhood. As expected, self-reported stress on the PSS and depressive affect on the CESD-R were also high (mean = 26.93,  $SD = 8.07$ ; mean = 20.21,  $SD = 15.90$ , respectively) and ACEs was significantly correlated with both indicators ( $r = .11, p = .01$ ;  $r = .29, p < .001$ , respectively). Furthermore, those who met criteria for depression on the CESD-R reported more numerous ACEs than those who did not meet criteria,  $F(2,227) = 8.91, p < .001$ . ACEs was also significantly correlated with utilization of tobacco, marijuana, and binge eating as well as how often participants reported being sick and needing to miss classes. However, we also demonstrated that participants' resilience on the CD-RISC (mean = 67.77,  $SD = 14.19$ ) moderates the relationship between ACEs and those poor emotional and cognitive health indicators.

**Conclusions:** Undergraduate participants with higher ACEs, and particularly those with lower resilience, experience greater depressive affect, greater stress, and more frequent utilization of unhealthy coping strategies. These individuals are at high risk for chronic physical and mental health issues. Given the prevalence of high ACEs among Black, indigenous, and/or people of color, our results suggest that therapeutic interventions focusing on developing community support and psychological resilience could be an important mitigation strategy for the long-term impact of ACEs on physical, emotional, and cognitive health.

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**Keywords:** childhood maltreatment, depression, anxiety

**M. A. CORNWELL, B. CICERO, I. GRUNWALD, S. HALL, W. KRAUSE, T. MYERS, L. H. PICK, K. FINLEY, K. R. SAVAGE, J. M. SCHMIDT, J. TWAITE, V. NANCY, J. C. BOROD. Early Childhood Circumstances Predict Anger Bias in Older Adulthood.**

**Objective:** Abuse history in the first year of life predicts heightened ERP response to angry faces that, years later, differentiates them from children who did not experience maltreatment (Curtis & Cicchetti, 2011). Children with a history of physical abuse are prone to identifying neutral expressions as angry (e.g., Pollack et al., 2000) and maintain a response bias toward anger as young adults (Gibb et al., 2009), yet these error patterns have not been evaluated in healthy older adults. Sudden income loss is a specific psychosocial stressor associated with child maltreatment (Conrad-Hiebner & Byram, 2020), such as acute suffering that followed the 1929 stock market crash and the onset of the Great Depression. Further, owing to long-standing racial income disparities in the U.S. (e.g., Howard, 1992), it is possible that White families of this era were abruptly confronted by hardships to which families from marginalized groups were already inured, suggesting putative abuse-risk may have been higher for White children. The current study examined anger bias and affect perception (AP) in a diverse sample of older adults, matched in age but born during markedly different sociohistorical circumstances.

**Participants and Methods:** Anger false-positives (AFPs) and AP were evaluated in a subsample of older adults (ages 60-88,  $n = 51$ ) as part of a larger emotion study using the New York Emotion Battery (NYEB; Borod, Welkowitz, & Obler, 1992). NYEB data were collected from 1993 to 2015, affording the opportunity to compare two groups, stratified according to birth-year proximity with 1929 (i.e., Depression-era Birth Cohort [DBC; born 1924 - 1933] and Other Birth Cohorts [OBC; born 1913 - 1923, or 1934 - 1950]). The DBC and OBC groups were matched on demographic factors.

**Results:** General linear models (GLM) extended by general estimating equations (GEE) revealed, a significant interaction between birth cohort and race for predicting elevated AFPs ( $p = .000$ ), even though no significant differences in AP accuracy were detected ( $p > .05$ ). Although there was no main effect of birth cohort for predicting AFPs ( $p = .326$ ), White participants of the DBC had more AFPs than non-White participants of the DBC. In contrast, the OBC group demonstrated no interaction between birth cohort and race.

**Conclusions:** In the DBC group (i.e., birth proximal to 1929), there was a significantly elevated rate of AFPs, but only among participants who self-identified as White, despite no such differences being detected in AP accuracy. To date, the current study may be the first cross-sectional research on aging and emotion-processing to examine cohort effects that are not generally possible outside of longitudinal designs. Although these findings do not allow for any conclusive statements on the meaning of elevated AFP errors in older adults, they do raise potentially far-reaching questions about behavioral markers of earlier life experiences. Given biopsychosocial sequelae documented among adult children of parents with PTSD (e.g., Palosaari et al., 2013), addressing these questions may have particular salience in the wake of the SARS-CoV-2/COVID-19 global pandemic and its aftermath.

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**Keywords:** aging (normal), childhood maltreatment, neuropsychological outcome

### **A. CAVIASCO, J. STORBECK. Influence of Affect and Working Memory on Semantic Priming.**

**Objective:** The current study aims to clarify the mechanism by which affect influences both controlled and automatic semantic priming effects. Semantic priming effects differ between prime types that rely on controlled processing versus those that are automatically processed. Controlled processing of semantic relations is reliant on working memory (WM) and functions through expectancy generation of semantically related words in forward association (FA) prime-target pairs. In contrast, retrospective semantic matching facilitates language comprehension in backward association (BA) and symmetrical association (SYM) pairs and is automatically processed and less reliant on WM. Because affect influences both WM and semantic priming, this study sought to determine whether affect moderates semantic priming under low and high WM loads.

**Participants and Methods:** A sample of 136 undergraduate psychology students (31% male) at Queens College of the City University of New York viewed film clips to induce either a positive, neutral, or negative affective state. During the following computerized load/priming task, participants were asked to remember the placement of 4 black dots situated in a 4x4 16-square grid. Low WM and high WM load conditions were differentiated by degree of complexity of the placement pattern. A prime word was then shown, followed by a target which was either a

semantically related word or a pseudoword (e.g., dfjkr). Participants identified the word as either a word or nonword. After the fifth priming trial, participants recalled the locations of the 4 dots in a blank 4x4 grid. Priming pairs consisted of FA, BA, SYM, control, and non-words.

**Results:** Results of a Repeated Measures ANOVA revealed no significant affect by WM load interactions across FA pair, ( $p=0.74$ ), BA pair ( $p=0.47$ ), and SYM pair prime types ( $p=0.52$ ). Additionally, WM load did not significantly impact semantic priming effects in any prime type (all  $p$ -values  $> 0.46$ ). A one-sample t-test was conducted to assess the effects of affect on semantic priming directly. While neutral and negative affective states had non-significant effects on semantic priming across prime types (all  $p$ -values  $> 0.16$ ), results revealed that positive affect enhanced semantic priming across low WM load conditions for FA,  $t(43)=-2.55$ ,  $p=0.014$ , BA,  $t(43)=-2.22$ ,  $p=0.03$ , and SYM,  $t(43)=-3.58$ ,  $p<0.01$ , prime types and across high WM load conditions for BA,  $t(43)=-2.16$ ,  $p=0.04$  and SYM,  $t(43)=-2.39$ ,  $p=0.02$ , prime types, but not FA prime types,  $t(43)=-1.696$ ,  $p=0.10$ .

**Conclusions:** Positive affect enhanced semantic priming effects in low WM load conditions across prime types and BA and SYM pairs, while negative and neutral affect did not have a significant impact. The disappearance of priming effects for FA pairs in high WM load conditions indicate that WM is integral to semantic priming. This study suggests positive mood may enhance semantic priming in automatic processing observed in BA and SYM prime types, but high WM load depletes resources necessary for prospective expectancy generation that positive affect cannot overcome.

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**Keywords:** affective processing (normal), semantic processing, memory: normal

**S. B. FRANSEN, R. E. EASTER, M. WESTLUND SCHREINER, K. L. BESSETTE, A. K. DILLAHUNT, B. L. SCHUBERT, L. THOMAS, K. RYAN, R. ESTABROOK, D. MARSHALL, M. MCINNIS, S. A. LANGENECKER. Individuals with Bipolar Disorder Demonstrate Same Effects of Gender on Emotion Perception as Healthy Controls.**

**Objective:** Social cognitive deficits have been shown to predict social, occupational, and everyday functioning in bipolar disorder (BD). Unfortunately, approximately half of BD patients have long-term social functioning impairment after disease onset. This study focuses specifically on emotion perception – a key factor in BD and social functioning. In non-psychiatric samples, it has been shown that women tend to be more accurate than men at identifying emotions. Women's accuracy tends to improve when shown female-presenting faces compared to male-presenting faces, demonstrating in-group advantage – the idea that individuals can more accurately classify emotions on faces of their in-group members. We made three hypotheses: 1) women will exhibit more accurate emotion perception for negative emotions (sadness/anger) but not positive ones (happiness); 2) both genders will have higher accuracy for their own gender in-group compared to their out-group, and 3) people with BD will have weaker gender in-group advantage than healthy controls (HC).

**Participants and Methods:** 681 participants (492 BD; 189 HC) completed the Facial Emotion Perception Test (FEPT). Data was scored at the item-level using Python and the Pandas module. We conducted generalized linear effects models to examine the effects of diagnosis (HC vs BD), participant gender, facial stimulus gender, and emotion (happy vs sad; happy vs angry). Models were forward fit, with increasing levels of interactions. Participant age was included as a

covariate. Models were adjusted for the random effects of item-level and subject-level differences.

**Results:** Facial stimuli gender and emotion significantly interacted ( $b = -1.18$ ,  $SE = 0.55$ ,  $z = -0.43$ ,  $p < .001$ ), such that both genders had more difficulty correctly identifying male-presented sadness than female-presented sadness. However, this effect did not occur for happiness or anger. We also found a main effect of diagnosis ( $b = -0.18$ ,  $SE = 0.09$ ,  $z = -2.11$ ,  $p = .03$ ), in which BD participants had lower accuracy than HC. We also found a main effect of participant gender for angry faces ( $b = -0.44$ ,  $SE = .11$ ,  $z = -4.01$ ,  $p < .001$ ), in which women had higher accuracy than men.

**Conclusions:** Our findings indicate that people with BD and HC show the same effects of gender on emotion processing, and therefore the same social biases impact cognition in BD and HC. It also suggests that BD emotion perception deficits compared to HC are not accounted for by differences in gender in-group advantage. Future studies should further explore social factors that may impact emotion perception, such as the impact of race and culture.

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**Keywords:** bipolar disorder, emotional processes, computerized neuropsychological testing

### **N. C. ANDRADE, L. CARMO, A. CONTTI, A. BRANDINO. Music Emotion Recognition in Adult Life Span: a Neurodevelopmental Perspective.**

**Objective:** Music is an inherently emotional experience. Musical affective stimuli are one of the contents most recalled by subjects with neurocognitive disorders and other disorders associated with memory. The study of emotions in the course of life, specifically emotions associated with music, can be a key factor in understanding the development and rehabilitation of these conditions. A recent meta-analysis indicates a generalized decrease in the recognition of emotions in the faces in aging, with the exception of disgust. The neuropsychological hypothesis of global decline in emotion recognition postulates that older people tend to focus attention on the lower region of the face (mouth) to the detriment of the upper region (eyes). In music, a single recent study was found in which the recognition of emotions of fear and sadness was impaired in the elderly. The present study aims to evaluate the effect of aging on emotional recognition in music.

**Participants and methods:** Three hundred and twenty participants, between 18 and 72 years old, 72.5% female without hearing loss or a history of neurological diseases and psychiatric disorders, completed the experiment. Four groups were composed: young ( $N = 86$ ;  $M = 20.57$ ;  $SD = 1.75$ ); young adults ( $N = 81$ ;  $M = 27.77$ ;  $SD = 2.59$ ); middle age ( $N = 75$ ;  $M = 37.22$ ;  $SD = 3.41$ ); older adults and elderly ( $N = 78$ ;  $M = 53.79$ ;  $SD = 6.51$ ). A total of 56 musical excerpts recorded in piano tone, generated by computer with previous research on musical structure for the expression of emotions, composed two digital questionnaires. Each emotional category (tranquility, joy, fear and sadness) was evaluated through 14 music excerpts with an average duration of 12.4 seconds each. The stimuli were transmitted through individual computers to the listeners at random, preceded by two training trials.

**Results:** All groups followed the same pattern of emotion recognition trajectory. In the total sample, the emotion with the highest percentage of correct answers was joy (93%), followed by sadness (84.3%), fear (76.3%) and tranquility (64.2%). Age effect was observed in sadness recognition [ $X^2(3) = 9.21$ ;  $p = 0.27$ ], with reduced accuracy in middle age, older adults and elderly. Young people had 85.9% correct percentage in recognizing sadness while older adults

and elderly had 79.4%. However, musical excerpts that express tranquility [ $X^2(3) = 8.649$ ;  $p = 0.034$ ] were recognized most effectively by older adults and elderly (69.2%) than youngs (57.2%).

**Conclusions:** The results point to an alternative hypothesis to the global decline in the recognition of emotions during aging. In line with a previous study with music emotion recognition, our results suggested a change in the cutting bias for different affective valences. New studies on the theme are encouraged in order to deepen the state of the art, as well as to debate contextual and cultural differences in the perception of emotions in music during aging.

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**Keywords:** affective processing (normal), aging (normal), neurocognition

**W. D. KILLGORE, S. CLOONAN, R. A. WOODS-LUBBERT, J. VANUK, M. PERSICH, N. S. DAILEY, M. J. STRONG, R. J. KING, R. D. LANE, R. SMITH. Enhancing Emotional Awareness with an Online Training Program.**

**Objective:** Individuals differ in their ability to understand and conceptualize emotional responses in fine-grained ways, a construct known as Emotional Awareness (EA). A person with low EA has difficulty describing emotional responses with complexity and sophistication (e.g., “I felt bad about what happened”). In contrast, someone with high EA can conceptualize those same emotional response with subtle nuance and sophistication (e.g., “I was broken-hearted over the outcome, yet I had no regret about my role”). EA performance ability is measured using the Levels of Emotional Awareness Scale (LEAS), which scores textual descriptions of responses to various scenarios on five levels, including physical sensations, action tendencies, single emotions, blends of emotions, and blends of blends of emotions. We hypothesized that LEAS scores could improve through a multi-module training program designed to enhance emotional skills versus a placebo training program lacking emotional training content.

**Participants and Method:** We report two separate studies. Study 1: A total of 245 healthy participants (64 male; 180 female) from the general population participated in a two-month-long study. Participants ranged in age from 18 to 40 years ( $M=23.8$ ,  $SD=5.4$ ). All participants completed a baseline assessment of emotional intelligence and EA using the LEAS and were then randomly assigned to either undergo the active emotional intelligence training (EIT) program ( $n=129$ ) or a time and difficulty matched program with content focused on learning about the external natural environment (Placebo;  $n=116$ ). Two months after the initial assessment, participants returned to complete a similar assessment battery, including the LEAS. Study 2: A total of 74 Cadets from the University of Arizona Reserve Officer Training Corps (ROTC; 47 male; 27 female) ranging in age from 18 to 34 years ( $M=20.1$ ,  $SD=2.1$ ). The relevant procedures were otherwise identical to those for Study 1. Data were analyzed using a 2 (EIT vs Placebo)  $\times$  2 (pre- vs post-tx) analysis of variance.

**Results:** For the general population in Study 1, we found a significant program  $\times$  session interaction,  $F(1,243)=6.63$ ,  $p=.011$ , partial eta squared=.027. The LEAS scores did not change from pre- to post-treatment for the placebo group, but showed a significant improvement for the EIT group. Similarly, for the Cadets in Study 2, there was a significant program  $\times$  session interaction,  $F(1,71)=4.06$ ,  $p=.048$ , partial eta squared=.054. Again, the placebo group showed no significant change over time, while the EIT group improved following active online training.

**Conclusion:** First, the EIT program was effective at improving emotional skills and EA, as assessed by the LEAS. Our findings provide further validation of the EIT program and suggest its continued utility to enhance the complexity and sophistication of emotional conceptualization skills. Second, these findings support the notion that EA is a modifiable performance ability rather than an entirely stable trait, which has been suggested in the past. While there may be a (yet to be defined) limit to how trainable such skills are, these findings suggest that efforts to enhance EA are likely to be fruitful and could be a valuable approach for helping improve interpersonal relationships and emotional wellbeing.

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**Keywords:** emotional processes, social processes, awareness

**W. D. KILLGORE, S. CLOONAN, R. A. WOODS-LUBBERT, J. VANUK, M. PERSICH, N. S. DAILEY, M. J. STRONG, R. J. KING, R. D. LANE, R. SMITH. Training Interoceptive Awareness.**

**Objective:** Emotional Intelligence (EI) is a complex construct that involves accurate perception of emotional cues, understanding of the meaning of emotional information, and the ability to make good decisions and regulate behavior based on that information. Emotional experience is largely determined by an interplay of somatic/visceral responses and the individual's cognitive interpretation of those interoceptive signals. These signals communicate emotional information. Individuals who are highly attuned to interoceptive cues are going to have a greater breadth and depth of emotional information to help them in understanding emotional situations. We propose that it is possible to improve interoceptive awareness through an online training program.

**Participants and Method:** A total of 325 healthy individuals, ranging in age from 18 to 40 years ( $M=23.6$ ,  $SD=5.4$  years; 91 male; 234 female) participated. Participants underwent a baseline assessment session that included the Multidimensional Assessment of Interoceptive Awareness (MAIA). The MAIA assesses eight dimensions of interoceptive awareness, including: 1) noticing sensations, 2) not-distracting self from sensations, 3) not-worrying about sensations, 4) attention regulation (i.e., the ability to shift attentional awareness to bodily sensations at will), 5) emotional awareness, 6) self-regulation, 7) body listening, and 8) trusting bodily sensations. Participants were then randomly assigned to undergo one of two online training programs: 1) an Emotional Intelligence Training (EIT) program that focused on developing body awareness, understanding how sensations apply to various emotions, and how that could be useful in social/interpersonal contexts; or 2) a non-emotion focused Placebo Training Program (PTP) that concentrated on becoming aware of the external environment, including lessons in geography and nutrition.

**Results:** We compared scores on the MAIA at baseline and post-treatment. Overall, we found the EIT program led to a significant improvement in “not-distracting the self from bodily sensations” compared to the Placebo program,  $F(1,324)=4.37$ ,  $p=.037$ , suggesting that the program aided participants in remaining focused on interoceptive sensations. Similarly, there was a significant effect of EIT on the subscale for “emotional awareness”,  $F(1,324)=6.87$ ,  $p=.01$ , and the scale for “self-regulation”,  $F(1,324)=4.50$ ,  $p=.035$ . In contrast, EIT had no significant effect on noticing bodily sensations,  $F(1,324)=.54$ ,  $p=.464$ , “not-worrying about physical sensations”,  $F(1,324)=0.008$ ,  $p=.931$ , “attention regulation”,  $F(1,232)=1.41$ ,  $p=.235$ , “body

trusting”,  $F(1,324)=2.18$ ,  $p=.14$ , or “body listening” compared to the Placebo program,  $F(1,324)=1.36$ ,  $p=.243$ .

**Conclusion:** The EIT program successfully enhanced three of the eight dimensions of the MAIA, including Not-Distracting, Emotional Awareness, and Self-Regulation. Those who completed the EIT program improved in their ability to maintain focus on unpleasant sensations or discomfort, their understanding and awareness of the connection between bodily sensations and emotional states, and their ability to regulate feelings of distress by modulating attention to bodily sensations. Training in emotional skills with a focus on linking body and feelings was associated with improvement in several key aspects of emotional perception and understanding. Further refinement of this training approach may lead to further improvements in other aspects of interoceptive awareness. Because such training is automated and presented online, this program represents a method for rapidly developing critical emotional skills on a large scale.

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**Keywords:** emotional processes, social processes, awareness

### **W. D. KILLGORE, J. VANUK, R. A. WOODS-LUBBERT, S. CLOONAN, M. PERSICH, N. S. DAILEY, R. J. KING, M. J. STRONG, R. D. LANE, R. SMITH. Can Emotional Resilience Be Trained?**

**Objective:** With the emergence of the COVID-19 pandemic, it has become apparent that emotional resilience is a key aspect of mental health. Emotional resilience is generally conceptualized as the ability to cope effectively and recover quickly from difficulties and challenges. The U.S. military has developed a number of resilience training programs over the past two decades. For instance, the Comprehensive Soldier and Family Fitness Program attempts to train a broad set of five dimensions, including social, family, emotional, spiritual, and physical fitness. However, the demonstrated effectiveness of these programs at building meaningful emotional resilience has been limited. One possibility is that many training programs have focused too broadly and on too many facets simultaneously to have a focused impact on resilience. We therefore tested whether a program that focused instead on developing a singular set of emotional skills (i.e., Emotional Intelligence) would be effective at improving measured resilience scores in military trainees.

**Participants and Method:** We recruited 74 healthy military cadets from the Reserve Officer’s Training Corps (ROTC) program at the University of Arizona. The sample included 47 males and 27 females, ranging in age from 18 to 34 years ( $M=20.1$ ,  $SD=2.1$ ). At the beginning of the school semester, the cadets completed a baseline assessment that involved taking the Connor-Davidson Resilience Scale (CD-RISC) among other emotional questionnaires. Cadets were then randomly assigned to complete one of two different online training courses: 1) Emotional Intelligence Training (EIT; focused on developing the ability to accurately perceive, understand, manage, and use emotions effectively), or a matched Placebo Training Program (PTP; focused on awareness of the external environment such as geography) over a period of several weeks. At the end of the semester, cadets completed a follow-up assessment that included the CD-RISC.

**Results:** A 2 (pre- vs. post-training) x 2 (EIT vs. PTP) mixed analysis of variance (ANOVA) showed that cadets who completed the EIT program showed improved resilience relative to those in the placebo program,  $F(1, 69) = 4.14$ ,  $p = 0.047$ , partial  $\eta^2 = .056$ , after accounting for baseline covariates (i.e., sex, education level, and current mood state).

**Conclusion:** In a sample of military trainees, specific focused training to develop EI skills was associated with a significant improvement in measured emotional resilience scores on the current gold-standard metric of the construct. We found a medium effect size, suggesting that this program could have meaningful benefits if implemented widely. Because the program is completely administered online, these findings suggest that it could be scaled up to provide a useful method for rapidly building vital resilience skills to many different populations, including military, first-responders, or medical personnel, who are likely to encounter emotionally difficult situations. During the current pandemic, there has been a dramatic increase in mental health and emotional problems, including anxiety, depression, loneliness, and suicide. Such a training program could prove useful in bolstering the emotional resilience of wide segments of the population who are currently at risk. We encourage additional research into methods for refining and disseminating such programs.

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**Keywords:** emotional processes, social processes

**M. KAUR, M. KOTHARI, N. M. MAJEED, F. QUEK, M. NG , A. HARTANTO. Anxiety Disorders and Executive Functions: Findings from a Meta-Analysis.**

**Objective:** Anxiety disorders, one of the most common classes of psychological disorders, have been associated with deficits in executive functioning (e.g., Castaneda et al., 2008). However, the nature of this association remains a debate. For example, studies have found that, compared to controls, individuals with social anxiety disorder and general anxiety disorder performed worse on neurocognitive tasks (e.g., Fujii et al., 2013) while some have contrarily reported comparable performance between controls and individuals with anxiety disorders several executive control tasks (e.g., Airaksinen et al., 2005)

Reasons for this inconsistency could include (a) studies generalising the deficit of one or a few subdomains of executive functions as being representative of cognitive impairment or, based on the Attentional Control Theory, (b) studies measuring only performance effectiveness or only reaction time, (c) differing emotional salience of task stimuli in different studies, or (d) homogeneity of the samples used across studies which varied in comorbidity, psychotropic medication use and/or treatment, severity of anxiety disorder, age, and gender.

Therefore, this current study used a meta-analytic approach to test the conflicting hypotheses about the relationship between anxiety disorders and executive functioning and to explore the potential moderating effects of methodological discrepancies, demographic, and clinical variables this relationship.

**Participants and Methods:** A literature search was conducted in ERIC, PsycINFO, PubMed, and Web of Science, resulting in 43,736 potentially eligible records from which 45 records (N = 3,598) met all inclusion criteria and provided sufficient data to compute effect sizes. Relevant data were coded independently by two coders, where the agreement for all variables was generally good. In order to correct for positive bias when small samples were used, Hedges' standardised *g* (Hedges, 1981), was used as the effect size index.

**Results:** Overall results indicated that most anxiety disorders were significantly associated with slower reaction times in tasks assessing executive functioning, but also improved accuracy. Within anxiety disorders, both generalised anxiety disorder and complex phobia groups did worse in reaction time but displayed comparable accuracy in performance against control groups,

suggesting lower performance efficiency. Meanwhile, panic disorder was found to be connected to greater time taken and better accuracy in task completion which indicates unimpeded performance efficiency. Individuals with anxiety disorders exhibited lower performance efficiency when engaging in inhibition tasks but not shifting tasks, while they displayed enhanced performance efficiency for updating tasks. Results were robust across important demographic (i.e., age and gender) and clinical moderators (i.e., medication use, treatment status, severity of anxiety, and comorbidity).

**Conclusions:** Examining each anxiety disorder and its relationship with executive function revealed varying moderated associations. Lower performance efficiency results for those with generalised anxiety disorder and complex phobia is in line with predictions from the Attentional Control Theory. However, unimpeded performance efficiency results for those with panic disorders suggests that panic disorder may not be associated with deficits in executive functioning. Therefore, given these results, this study could provide clinicians and researchers with a personalised treatment guide for the specific anxiety disorders and pave the way for future research in this field, respectively.

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**Keywords:** anxiety, executive functions, attention

**S. SCHIFF, D. A. EGGLEFIELD, J. MOTTER, S. RUSHIA, A. GRINBERG, B. R. RUTHERFORD, J. R. SNEED. Who benefits from computerized cognitive training? Lower processing speed predicts greater cognitive improvement.**

**Objective:** Depression is a prevalent mental health disorder affecting young adults, many of whom do not receive treatment or for whom treatment does not significantly improve functioning. Computerized cognitive training (CCT) has been proposed as a novel and accessible intervention to target cognitive deficits that are associated with depression and has been found to improve depressive symptoms, cognition, and everyday functioning. The aim of the present study is to determine if baseline cognitive presentation predicts improvement in cognition from CCT, and if this improvement varies based on the type of training received.

**Participants and Methods:** Forty-six young adults with mild depressive symptoms were recruited as a part of a randomized controlled trial studying the effects of CCT on mood, cognition, and everyday functioning. Training was completed on participants' mobile devices for 15 minutes a day, 5 days/week, for 8 weeks. Clinical and neuropsychological assessments were completed at baseline and at 8 weeks.

**Results:** When comparing individuals with above and below average baseline PS scores, lower performers showed greater improvement in 3 out of 4 PS tasks (Cohen's  $d$  ranged from .60 to 1.12) and 1 out 3 EF tasks (Cohen's  $d = .69$ ). The high and low performers did not differ in change in performance in non-PS/EF tasks.

**Conclusions:** CCT has differential effects on PS and EF performance depending on participants' baseline cognitive presentation. Individuals with an initial relative PS weakness improve more from CCT than those with higher baseline functioning. This study highlights the importance of identifying individual differences in cognition that may factor into CCT response.

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**Keywords:** depression, cognitive functioning

### **S. BERG. The Relationship Between Postural Sway and Trait Anxiety While Viewing Aversive Stimuli.**

**Objective:** Some studies suggest that individuals with anxiety tend to selectively attend to threat-evoking stimuli. It has also been suggested that they have higher levels of postural sway due to hypersensitive perceptual processes, which lead to vestibular vulnerability. However, how hypersensitive perceptual processes associated with vestibular vulnerability interact with attention to threat-evoking stimuli is underexplored.

**Participants and Methods:** The present study investigated this interaction using a rollercoaster video and tracking the postural sway of participants with subclinically high and low trait anxiety, while they perceived threat-evoking images.

**Results:** The results showed that the participants with high trait anxiety did not significantly sway more towards the curves of the rollercoaster. Similarly, the participants with high trait anxiety did not significantly lean towards the threat-evoking images.

**Conclusions:** These results are not in accordance with the Attentional Control Theory, which suggests that individuals with high trait anxiety selectively pay more attention to the threat-evoking stimuli. The current study also suggests that subclinically anxious and normal adults are equally able to use cues from the curves to compensate for the anticipatory movement towards the curves, without showing vestibular vulnerability.

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**Keywords:** anxiety, attention, movement

### **J. JOHNSON, I. ANLAP, E. C. TAYLOR, L. R. VALENCIA, A. BULLOCK, N. SWIFT, C. WELLMAN, J. VANUK, W. D. KILLGORE. The Association Between Anxiety and Intelligence is Moderated by Sex.**

**Objective:** Recent studies have suggested a positive correlation between anxiety and measured intelligence, but the reasons for this association remain unclear. It is also known that women are twice as likely to experience anxiety than males and tend to score higher on standardized measures of trait anxiety. The correlation between anxiety and measured intelligence has been investigated in the past but not with the consideration of how sex differences may contribute to these associations. Based on prior research, we hypothesized that higher scores on a standardized measure of cognitive intelligence would be associated with higher trait anxiety scores. However, based on evidence that anxiety scores tend to be higher among women than men, we hypothesized that this association would be moderated by sex.

**Participants and Methods:** A sample of 118 healthy participants (Mean age = 21.59, SD age=3.01, n males=57, n females=61) completed the Wechsler Abbreviated Scale of Intelligence II (WASI-II), a measure of overall cognitive ability, and the State-Trait Anxiety Inventory (STAI), a self-report measure of both state and trait anxiety. The correlation between WASI full scale IQ (FSIQ) scores and trait-based STAI scores were examined using a bivariate correlation and stratified by sex (male, female). The Fisher's  $r$  to  $z$  Transformation was then used to compare the strength and direction of the two correlations between sexes.

**Results:** For both male and female participants, STAI scores were significantly correlated with their FSIQ scores ( $p$  male=.031,  $p$  female=.044). However, we found that the correlation was positive for males ( $r = .284$ ,  $p=.0031$ ) and negative for females ( $r = -.257$ ,  $p=.0031$ ). To compare the strength of the two correlation coefficients, we converted each coefficient to a  $z$ -score using the Fisher's  $r$  to  $z$  Transformation. The two coefficients were significantly different from one

another ( $z = 2.93$ ,  $p = .0034$ ), suggesting that the association between anxiety and intelligence is different between men and women.

**Conclusions:** We observed a positive association between measured intelligence and trait anxiety among males and a negative association for the same variables among females. The mechanisms underlying these significantly different associations are unknown. However, it appears that greater trait anxiety may be cognitively enhancing for males but disruptive for females. Given the higher level of trait anxiety normally seen in females, this finding could be interpreted within the rubric of the Yerkes-Dodson Law, which suggests that optimal cognitive performance occurs in the middle range of arousal. Males may be on the lower end of this arousal, and greater anxiety may simply enhance performance; while, females tend to be on the higher end of the curve, so increased anxiety may be detrimental. Further investigation of the relationship between anxiety and IQ and how this is impacted by gender, could provide a better understanding of how to help individuals manage anxiety to optimize cognitive performance.

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**Keywords:** anxiety, intelligence

### **K. CHRISTIANSON, Y. LIU, S. DEVINE, W. W. QIU, R. AU, R. THOMAS. Sleep Disturbances Are Related To Depression, But Not Executive Function: Framingham Offspring Study.**

**Objective:** The Ford Insomnia Response to Stress Test (FIRST) is a 9-item self-report measure of trait vulnerability to sleep reactivity and hyperarousal used to identify predisposition to insomnia. Previous analysis of the FIRST in the Framingham Heart Study (FHS) showed a relationship to age, gender, depression as measured by the Center for Epidemiological Studies Depression Scale (CES-D; score  $>16$ ), and poorer quality of life. This analysis sought to identify associations between the FIRST and executive functioning and functional outcomes in older adults given the link between sleep disturbances and vascular related pathology.

**Participants and Methods:** The study sample included 1635 FHS participants from the Generation 2 and Omni 1 cohorts who were administered both the FIRST and neuropsychological testing between 2011-2018. Descriptive statistics were conducted to determine the mean, median, standard deviation and range of the FIRST. Two groups, a “high” and a “low” group, were established based on the median FIRST score. T-tests were conducted to assess the differences between the two groups for Executive Function (Controlled Word Association Test (FAS), Category Verbal Fluency (Animals), Halstad-Reitan Trailmaking Trails B–Trails A, Digit Span Backward (DS-B)), actual sleep time, Epworth Sleepiness Scale, age, CES-D, Katz Activities of Daily Living (ADL). Chi-square tests were used to compare these two groups using dichotomized variables (e.g., yes/no for Cardiovascular Disease (CVD), CES-D  $>16$  as depression, diabetes, education (high school did not graduate, high school graduate, some college, college graduate), hypertension, and sex (male, female). Separate general linear models were also constructed to compare the FIRST as the continuous (independent) variable against Trails B–Trails A, FAS, Animals, and DS-B as dependent variables adjusted for age, sex, education, CVD, diabetes, and days between administration of the FIRST and neuropsychological testing.

**Results:** Among all 1635 participants, the average FIRST score was 8.39 (SD=5.88) and a median score of 8 differentiated participants in the “low” and “high” groups. The average FIRST score in the “low” group was 3.63 (SD=2.36), and 13.04 (SD=4.37) in the “high” group.

Between-group analysis indicated the “high” FIRST group was significantly associated with less time actually sleeping ( $p=.0005$ ), higher sleepiness ( $p<.0001$ ), younger age ( $p=.0006$ ), sex (women > men,  $p<.0001$ ), diabetes ( $p=.001$ ), and depression ( $p<.0001$  with CES-D as continuous variable and  $p<.0001$  as a categorical). No significant between-group differences were observed across any measure of executive function or the Katz ADL. Additionally, no significant associations were observed within the general linear models that included neuropsychological tests as dependent variables and the FIRST as a continuous, independent variable.

**Conclusions:** This study provides insights into sleep reactivity and its relationship with affective and executive outcomes. Important differences associated with sleeping less, younger age, gender, and depression. Cognitive measures of executive function, functional outcomes, and key health-related measures were unrelated to sleep reactivity in older adults. These results suggest that sleep reactivity and insomnia may be related to emotional reactivity and depression, but not vascular mediated cognitive disorders.

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**Keywords:** sleep, executive functions, depression

**M. W. MENKES, C. M. ANDREWS, D. MARSHALL, H. J. BURGESS, I. CARLEY, S. A. LANGENECKER, M. MCINNIS, P. J. DELDIN, K. RYAN. Sleep Quality and Neuropsychological Functioning in Euthymic Bipolar I Disorder.**

**Objective:** Sleep disturbance and neuropsychological impairments are both observed in individuals with bipolar I disorder (BD-I) during acute mood episodes and persisting into the euthymic phase, suggesting they are trait-level features of the illness. Poor sleep adversely affects learning, memory, and executive functioning in healthy individuals; however, little is known about the role of poor sleep in neuropsychological functioning in BD-I. The current study examines sleep disturbance in the euthymic phase of BD-I, relative to healthy control participants (HC), and compares the effect of sleep quality on verbal learning, verbal and visual episodic memory, and executive functioning between BD-I and HC.

**Participants and Methods:** As part of their enrollment into the Prechter Longitudinal Study of Bipolar Disorder, 150 participants in the euthymic phase of BD-I and 206 HC (aged 18–65) completed the Pittsburgh Sleep Quality Index (PSQI), a neuropsychological testing battery, and clinician-administered mood measures. The BD-I and HC samples were both subdivided into “good” and “poor” sleepers based on global PSQI score. ANCOVA analyses were conducted to examine effects of both diagnosis (BD-I, HC) and sleep quality (good, poor) on neuropsychological functioning, while controlling for demographic variables.

**Results:** Relative to HC, BD-I showed significantly poorer sleep quality and poorer neuropsychological functioning in verbal learning, verbal and visual memory, processing speed, psychomotor speed, inhibitory control, and selective attention. Poor sleep quality was significantly associated with poorer verbal learning, verbal fluency, processing speed, and interference control. No significant interactions between diagnosis and sleep quality were observed.

**Conclusion:** Results were consistent with trait-level sleep disturbances and neuropsychological impairments in BD-I. Further, results indicated additive effects of a BD-I diagnosis and poor sleep quality on verbal learning and processing speed. The observed effects of poor sleep on neuropsychological functioning were similar between BD-I and HC groups. The current findings

provide evidence that those with BD-I experiencing poor sleep that persists into affective remission may also be more vulnerable to impairments in verbal learning and executive functioning, or vice versa. These findings suggest persistent sleep disturbance as a potential area for intervention to improve neuropsychological functioning, which has implications for facilitating functional and psychosocial recovery in BD-I. However, longitudinal research is needed to understand the directionality of this relationship and better inform intervention.

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**Keywords:** bipolar disorder, sleep, neurocognition

### **H. R. BOGOIAN, Z. TAIWO, V. DOTSON. Vascular Depression in Older African Americans: A Systematic Review and Preliminary Evidence of Cognitive Dysfunction.**

**Objective:** Decreased white matter integrity as a result of vascular burden is associated with a form of late-life depression, known as vascular depression (VaDep), which is marked by chronic vascular risk, apathy, executive dysfunction, and high levels of functional disability. Older African Americans represent a vulnerable population at risk of developing VaDep due to higher prevalence of vascular risk factors and greater cerebrovascular disease burden compared to European Americans. However, the literature examining VaDep in older African Americans is sparse.

**Participants and Methods:** A systematic review was conducted of all peer-reviewed research to date in which the impact of vascular risk factors on depression was examined in older African-American samples. Studies were considered eligible for inclusion if samples comprised primarily African Americans aged 50 and older or if race-specific analyses regarding African Americans were conducted within multi-racial samples, and if an outcome measure of depression was present ( $N = 15$ ). To address gaps in the literature identified by the systematic review, preliminary analyses were performed on a subset of the National Alzheimer's Coordinating Center (NACC) data to investigate the impact of subthreshold VaDep on cognition and functional ability in older African Americans. The NACC sample included 77 African-American adults aged 66 to 89 years ( $M = 77.34 \pm 5.61$ ) who received MRI scans and completed the 15-item Geriatric Depression Scale, cognitive measures of processing speed and executive function (Trail Making Test and WAIS-R Digit Symbol), and the Functional Abilities Questionnaire. Individuals who reported any depressive symptoms and had total white matter hyperintensity volume above the 50<sup>th</sup> percentile were classified as having subthreshold VaDep ( $n = 21$ ). General linear models were used to compare the subthreshold VaDep group to the rest of the sample on cognitive measures and functional ability when controlling for age, sex, and education.

**Results:** Results from the systematic review provided evidence for the validity of the VaDep hypothesis in older African Americans. There was preliminary support for VaDep-related cognitive and functional deficits, and there were mixed findings regarding the question of racial disparities in prevalence of VaDep. Analyses of NACC data revealed that the subthreshold VaDep group performed more poorly compared to the rest of the sample on Trail Making Test Part B and Digit Symbol, but did not differ on Trail Making Part A or FAQ.

**Conclusions:** Systematic review findings supported the importance of research on VaDep in older African Americans. Preliminary analyses from a subset of the NACC database indicated that even at a subthreshold level, VaDep is associated with poorer executive functioning and slower processing speed in this group. Further neuroimaging, neuropsychological, and

longitudinal research is required to better characterize the clinical profile of VaDep in older African Americans, a group at risk for this form of late-life depression.

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**Keywords:** depression, cognitive functioning, multiculturalism

**E. RHODES, P. INSEL, M. BUTTERS, R. MORIN, D. BICKFORD, D. TOSUN, H. ROSEN, P. AISEN, R. RAMAN, S. M. LANDAU, A. SAYKIN, A. TOGA, C. R. JACK, M. WEINER, C. NELSON, S. MACKIN. The Impact of Amyloid Burden and APOE on Rates of Cognitive Impairment in Late Life Depression.**

**Objective:** To evaluate cognitive dysfunction in late life depression (LLD) relative to a sample of nondepressed (ND) older adults with matched levels of memory impairment and amyloid- $\beta$  (A $\beta$ ) burden.

**Participants and Methods:** Participants included 120 LLD and 240 ND participants matched on age, education, sex, MMSE, MCI diagnosis, and PET A $\beta$  burden. Cognitive performance was evaluated using measures of global cognition, episodic memory, attention/processing speed/executive functioning, and language adjusted for demographics using regression-based norms.

**Results:** LLD showed higher rates of impairment relative to ND with 54.6% of the LLD sample demonstrating impairment in at least one cognitive domain compared to 42.9% of controls ( $H = 7.13$ ,  $p = .008$ ). LLD had significantly poorer performance and higher rates of impairment on AVLT learning and memory trials compared to controls. In the overall sample, A $\beta$  positivity was associated with worse performance on Logical Memory I ( $p = .044$ ), Logical Memory II ( $p = .011$ ) and Trail Making Test – B ( $p = .032$ ), and APOE e4 genotype was associated with worse performance on Logical Memory I ( $p = .022$ ); these relationships did not differ between LLD and ND.

**Conclusions:** The LLD group showed higher rates of CI driven by focal deficits in verbal learning and memory. Alzheimer's disease biomarkers were associated with worse performance on timed set-shifting and story learning and memory, and these relationships were not impacted by depression status. These findings suggest that AD may account for a portion of previously reported multi-domain cognitive impairment in LLD and highlight the potential for AD to confound studies of cognition in LLD.

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**Keywords:** geriatric depression, aging disorders, mild cognitive impairment

**H. MOOSATH, M. RANGASWAMY. Decision making in Depression: Differential Performance on the Iowa Gambling Task and Balloon Analog Risk Task.**

Depression is one of the most prevalent psychiatric disorders characterized by an array of affective, behavioural and cognitive symptoms.

**Objectives:** The current study aimed to explore value based decision-making patterns using two tasks across three groups - individuals diagnosed with mild to moderate depression, a healthy matched control group and a mood induction group.

**Participants and Methods:** Participants in the experimental group consisted of 40 drug and therapy naïve individuals diagnosed with first episode of mild to moderate depression using the Beck's Depression Inventory-II. Participants in the control group consisted of 40 healthy

individuals matched on age, gender and education, and those in the negative mood group consisted of 40 healthy individuals with no current, past or family history of any psychiatric conditions. All participants were right-handed, had normal or corrected vision and audition, and were not familiar with the tests used in the current study. The Iowa Gambling Task (IGT) and the Balloon Analog Risk Task (BART) were used to measure value-based decision making. On the IGT the following variables were measured and explored- Total money obtained, Long Term Learning of Consequences, Infrequent Loss Bias, reward and punishment sensitivity (big and small losses). On the BART, Average adjusted pumps, total explosions, reward and punishment sensitivity were considered.

**Results:** Data was not normal and group differences were analysed with the Kruskal Wallis test. Analysis suggested that individuals with depression showed heightened punishment sensitivity on both the IGT and the BART measures; and also performed poorly on the more complex IGT task indicating poor and slow learning. A similar, less severe, pattern was seen in individuals with negative mood induction. On the BART, individuals with depression, showed lower risk-taking tendencies as compared to the other two groups.

**Conclusions:** Our study shows individuals with depression make poorer choices in the more complex IGT and demonstrated a lower risk-taking propensity on the BART, consistent with the initial hypothesis and existing literature. They also showed a heightened sensitivity to punishment, and not for reward. The study also demonstrates how a negative affective state, induced in a normal control, has a similar but less severe pattern, suggestive of impaired decision making. This study implicates an affective influence on representation of the decision problem, the valuation of the outcomes and also the learning process that influences decision making in depression.

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**Keywords:** decision-making, depression, mood disorders

### **J. VANUK, A. BULLOCK, B. FORBECK, N. S. DAILEY, W. D. KILLGORE. Severity of PTSD Symptoms is Associated with Greater Levels of Depression and Deficits in Short-Term Memory.**

**Objective:** Cognitive deficits and negative affect are some of the most commonly reported symptoms by individuals that are suffering from post-traumatic stress disorder (PTSD). Of interest, decrements in memory, specifically, are consistently shown within this patient population. Individuals with PTSD often demonstrate a deficit in the ability to recall extinction memories to previously feared stimuli, a phenomenon considered to be a hallmark feature of the disorder, and postulated to drive the prevalence of hyperarousal symptoms and resurgence of behavioral responses when an individual experiences a “triggering” event. An inability to consolidate safety learning results in a vicious cycle that likely contributes to the failure to habituate under conditions of repeated exposure to fear-provoking contexts/stimuli under non-threatening conditions. However, the relationship between PTSD, affect, and cognitive deficits remain unclear; and more so when considering previously demonstrated decrements in attention and memory associated with negative affect and depression. We addressed this issue by examining how PTSD severity is associated with cognitive abilities and levels of depression in a community sample of individuals diagnosed with current PTSD. We hypothesized that individuals who experienced higher levels of PTSD symptom severity would have decrements in memory, that were mediated by higher levels of self-reported depressive symptoms.

**Participants and Methods:** Eighty-five patients meeting DSM-5 criteria for PTSD (29 male; Age=31.2, SD=8.8) completed the *Clinician-Administered PTSD Scale for DSM-5* (CAPS-5), a diagnostic instrument that quantifies PTSD symptom prevalence and severity, along with the *Repeatable Battery for the Assessment of Neuropsychological Status* (RBANS), a brief cognitive battery which assesses cognitive abilities across 5 domains, as well as the *Beck Depression Inventory Second Edition* (BDI-II).

**Results:** We found a significant negative association between PTSD symptom severity and the RBANS total score ( $\beta=-.32$ ), independently driven by scores in immediate memory ( $\beta=-.38$ ). We also found significant positive associations between scores on the BDI-II ( $\beta=.47$ ), in conjunction with negative associations in immediate memory ( $\beta=-.28$ ), when incorporating depression into the model. However, depressive symptoms did not mediate the observed relationship between PTSD symptom severity and immediate memory ( $\beta=-.12$ ). Effect sizes were minimally affected by the inclusion of gender or IQ in the model, as well.

**Conclusions:** As hypothesized, greater PTSD symptom severity was related to lower levels of immediate memory ability and greater levels of depression. However, our hypothesis that depression mediates the relationship between deficits in memory and PTSD symptom severity was not supported. Our findings suggest that the decrements in memory capacity observed in individuals with PTSD are not independently driven by deficits in attention and memory impairments that are often observed in individuals suffering from depression. Further research work is necessary to examine whether treatments incorporating exposure and targeting improvements in affect would benefit from conjunctive interventions aimed at enhancing immediate memory capacities, as a means of facilitating subsequent declines in trauma-related symptom severity.

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**Keywords:** post-traumatic stress disorder, memory: normal, depression

### **Z. SALLING, L. MINTO, V. DOTSON. Effect of Aerobic Exercise on Anterior Cingulate Thickness and Depressive Symptoms in Late Life: A Pilot Study.**

**Objective:** Recent studies have emphasized the importance of aerobic exercise on mood in older adults. The cingulate cortex (CC), a primary brain region involved in mood regulation and cognition, has generally shown more pronounced cortical thickness in the caudal anterior cingulate (CAC) and rostral anterior cingulate (RAC) in nondepressed older adults than in depressed older adults. However, the relationship between the effect of aerobic exercise on the CC and depression in older adults is unclear. Therefore, the present study examined the relationship between aerobic exercise, CAC and RAC thickness, and depression in older adults.

**Participants and Methods:** Beck Depression Inventory (BDI) scores, CAC and RAC thickness measurements by magnetic resonance imaging (MRI) were collected from eight participants (mean age = 66.25, 63% female) before and after an aerobic exercise intervention at the University of Florida Center for Exercise Science. Race was controlled for and participants had an average of 15 years of formal education. Age was included as a covariate in a regression in which left and right CAC and RAC thickness predicted BDI scores.

**Results:** Post-aerobic exercise intervention, there was a significant relationship between decrease in BDI score and increase in thickness of the right RAC ( $p < .01$ ) after controlling for

age. Participants BDI score inversely correlated with changes in cortical thickness in the CAC and RAC. No significant differences were found for age variance.

**Conclusion:** This data supports recent studies highlighting the importance of aerobic exercise in older adult to improve mood. The data further suggests that exercise can be helpful in targeting some neurobiological mechanism underlying depression by promoting increase in cortical thickness.

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**Keywords:** depression, neurophysiology, aging (normal)

**K. I. STEWART, C. TYTLER, I. YAROSLAVSKY, M. KOVACS. Brain or Heart: A Test of Central and Peripheral Nervous System Indices in Predicting Children's Internalizing and Externalizing Problems .**

**Objective:** Internalizing and externalizing problems (i.e., anxiety and depression, and oppositional defiant disorder and conduct disorder, respectively) during childhood increase the risk for functional impairment in adolescence and adulthood. Growing evidence points to affected parasympathetic nervous system (PNS) activity and frontal neural asymmetry, an index of emotionality, predicts adjustment in children. However, few studies investigate the unique contribution of the two physiological indices towards predicting emotional and behavioral problems. This study tests contemporaneous and prospective ties between neural asymmetry and PNS activity at rest and in response to hedonic and dysphoric mood induction procedures among children at high and low risk for internalizing and externalizing problems by virtue of their familial depression histories.

**Participants and Methods:** One-hundred and fifty-eight children (54% male, M age=6.47 years, range=4–12, 67% high risk) and their parents completed survey measures of internalizing and externalizing problems (Child Behavior Checklist, CBCL). Children also completed an experimental protocol that included a resting period (Free Breathing) and two film-based mood induction procedures; sad and happy moods via validated film clips. Electrocardiography (ECG) and EEG signals were collected throughout the protocol at 512Hz; difference within the EEG alpha frequency band across the F3 and F4 electrodes was used to index neural asymmetry, while high frequency heart rate variability (HF-HRV) indexed PNS activity. Resting states reflect those during Free Breathing, while reactivity indexes change in asymmetry and HF-HRV across the resting task and mood induction procedures. HF-HRV withdrawal reflects task-related reduction in levels relative to resting state, while augmentation indexes their increase. Parents also completed the CBCL at follow-up that occurred M=.98 years (SD=.29) after the laboratory visit (range=.54–2.27 years).

**Results:** Neural asymmetry indices were not significantly correlated with their HF-HRV counterparts. As expected, familial depression history predicted elevated levels of internalizing and externalizing problems at study entry ( $b=7.16-8.25$ ,  $p < .001$ ) and increasing internalizing symptoms across follow-up ( $b=8.02$ ,  $p < .001$ ); externalizing problems were predicted at a trend level ( $b=2.98$ ,  $p = .081$ ). Importantly, HF-HRV augmentation to the Sad Film predicted externalizing problems contemporaneously ( $b=2.69$ ,  $p = .021$ ) and across follow-up ( $b=1.53$ ,  $p=.012$ ), while HF-HRV withdrawal to the Happy Film prognosticated internalizing problems at study entry ( $b=-2.53$ ,  $p=.047$ ). Of the neural asymmetry indices, only reactivity to the Happy Film emerged as a significant predictor: increased right hemispheric dominance predicted a reduction in internalizing problems across follow-up ( $b=-21.70$ ,  $p=.002$ ).

**Conclusions:** Consistent with the extant literature, our results suggest that the neural asymmetry and PNS indices reflect non-redundant processes that are implicated in well-being. However, though conceptually linked, our results and those of others raise questions concerning the coherence between such processes, given the non-significant associations between asymmetry and HF-HRV measures. It is notable that HF-HRV emerged as a more consistent predictor of adjustment than neural asymmetry, given the low cost of collecting ECG relative to EEG data. Indeed, the relationship between HF-HRV augmentation in response to sadness and externalizing problems, noted by others and posited to reflect low empathy and callousness, suggests that further study of HF-HRV as a diagnostic tool is warranted.

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**Keywords:** electroencephalography, mood disorders, emotional processes

### **C. TYTLER, K. I. STEWART, I. YAROSLAVSKY, M. KOVACS. Alpha-Band EEG Asymmetry to Reward and Disappointment Predict Depression Trajectories Across Childhood..**

**Objective:** Depressive symptoms during childhood, when enduring, are associated with psychopathology and functional impairment in adulthood. Right fronto-temporal dominance in neural activity has been linked to protracted dysphoria and depression, and therefore may be a key predictor of depression symptom trajectories. However, it remains unclear whether an asymmetric neural response to emotion elicitors predicts depression trajectories incrementally to asymmetry at rest, nor whether the elicitor's valence is important in predicting psychopathology. This study tested the contribution of neural asymmetry, ascertained via electroencephalography (EEG), at rest and in response to positive and negative valenced tasks in predicting change across the early and late childhood years in a sample of youths at high- and low-risk for familial depression.

**Participants and Methods:** One-hundred and thirty-one children (25% male, M age = 6.48 years, range = 4-12) completed survey measures of depression symptoms (Child Depression Inventory) and an experimental protocol that included a resting period (Free Breathing Task) and positive (receiving a desired toy prize) and negative (receiving a broken toy prize) mood inductions. EEG signals were collected throughout the protocol at 512Hz, and their difference across the F3 and F4 electrodes within the alpha frequency band (8-13Hz) was used to index asymmetry. Resting asymmetry reflects EEG activity during the resting task, while reactivity indexes change in asymmetry across the resting task and mood induction procedures.

**Results:** Neither sex, nor familial depression risk status were related to neural asymmetry at rest nor in response to mood induction procedures. Independent of demographic characteristics and familial depression histories, incongruent fronto-temporal dominance in response to both mood inductions predicted depression levels across childhood. Specifically, right dominance in response to the positive mood induction predicted elevated depression levels that, while declining over time, remained higher than those of their left-dominant peers (intercept at age 12 = 2.66,  $p < .001$ , slope = -1.03,  $p = .005$ ), while an inverse pattern emerged for reactivity to the negative mood induction (intercept at age 12 = -1.99,  $p = .012$ , slope = 1.04,  $p = .004$ ): a shift towards left fronto-temporal dominance predicted elevated depression levels. Resting asymmetry was unrelated to depression symptom trajectories.

**Conclusions:** Consistent with the extant literature, our results support the relationship between right fronto-temporal asymmetry and depression. Importantly, these findings suggest that EEG

asymmetry, a predictor of depression symptom trajectories, presents differently across positive and negative emotion elicitors. While right fronto-temporal dominance predicts elevated depression levels during positive emotion elicitors, left dominance indicated more depression symptom trajectories for negative emotion elicitors. This pattern of findings suggests the need to consider context when evaluating the adaptive value of frontotemporal asymmetry. Indeed, the significant effects of both indices, independent of familial depression histories, a well-known risk factor, underscore the potential clinical utility of neural asymmetry for understanding risk for this mood disorder.

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**Keywords:** electroencephalography, mood disorders, emotional processes

### **C. PEREIRA, E. BRICKELL. Relationship between Bipolar Disorder and neuropsychiatric symptoms in dementia.**

**Objective:** There is limited data exploring the relationship between Bipolar Disorder (BD), the development of dementia, and the behavioral presentation of that dementia. Here, we aim to assess this relationship by comparing conversion characteristics and rates of neuropsychiatric symptoms in dementia subjects with BD, depression, and no psychiatric history.

**Participants and Methods:** Cross sectional data from National Alzheimer's Coordinating Center (NACC)\* Uniform Data Set (UDS) were used. Enrollees were diagnosed with Alzheimer's disease, Frontotemporal dementia (FTD), or mild cognitive impairment (MCI) (N=9,161). Of those, subjects were further divided by psychiatric status: BD (N=89), Major Depressive Disorder (MDD; N=2,975), and a control group with no psychiatric history (N=6,097). Patients with neurodevelopmental conditions or neurological diagnoses that impair cognitive function were excluded. Regressions and Chi-Squared procedures were used to compare groups on outcome variables, which included Neuropsychiatric Inventory Questionnaire (NPIQ) Total and Severity scores, age of initial cognitive decline, and likelihood of progression to dementia.

**Results:** The BD group was significantly younger (M=67.9, SD=9,  $p<0.05$ ) and more educated (M=15.8, SD=3,  $p<0.001$ ) than the rest of the sample. No significant differences were identified between groups for dementia severity (measured by CDR Sum), dependence level, or degree of cardiovascular burden between groups. For those with dementia, the BD group had a significantly higher NPIQ Total Scores compared to those with no mood disorder ( $p<0.001$ ), but not when compared to the MDD group ( $p=0.064$ ). NPIQ Severity Scores were higher for BD in comparison to controls ( $p<0.001$ ) and MDD ( $p=0.005$ ). The age of initial cognitive decline was found to be significantly lower for the BD subjects (M=62, SD=10.6) in comparison to other groups (M=67, SD=10 for MDD; M=69, SD=9.7 for controls;  $p<0.001$ ). BD subjects were also three times more likely to be diagnosed with behavioral variant of FTD (BvFTD) than their group counterparts ( $p<0.001$ ). Finally, the BD group with MCI had a higher chance of progressing to dementia when compared to MDD participants or controls with MCI ( $p=0.10$ ).

**Conclusions:** BD appears to be related to increased behavioral symptoms, earlier cognitive decline, higher probability of conversion to dementia, and more frequent diagnosis of BvFTD when compared to MDD or no psychiatric diagnosis. These findings are consistent with the literature and bolster the neuroprogression hypothesis, particularly as the pattern holds even in this young and highly educated BD sample. It also suggests that BD impacts dementia characteristics beyond what can be explained by MDD. Limitations of this study include sample

size of BD group and reliability of patient-reported data. Thorough analysis of BD cases is recommended in clinical practice to avoid underdiagnosis of dementia via misattribution of behavioral symptoms, or subtype misdiagnosis that may alter the course of treatment. Future studies are needed to characterize the phenotype of behavioral symptoms that may differ in BD and identify progression moderators.

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**Keywords:** bipolar disorder, dementia - Alzheimer's disease, dementia - other cortical

**T. LAI, M. S. SHAH, M. FRANDO, J. LAI, L. V. TASTARD, G. BRITZ, M. DULAY.  
Executive Functioning, Verbal Memory and Depressed Mood After Cerebrovascular Accident.**

**Objective:** Research has repeatedly shown that focal cognitive difficulties occur after a unilateral cerebrovascular accident (CVA), including verbal memory difficulties after left-temporal lobe CVA and phonemic fluency difficulties after left-frontal lobe CVA. Besides the frontal lobe, executive difficulties are associated with damage to other areas of the brain including the pons, thalamus, basal ganglia, and cerebellum. Previous studies have also demonstrated that depressed patients perform more poorly on measures of memory and executive functioning than non-depressed patients. This study evaluated the contribution of side of stroke and post-stroke depression (PSD) to memory and executive difficulties after a unilateral CVA.

**Participants and Methods:** Three-hundred and seven consecutive patients (mean age 58.9 years, 14.6 years of education, 49.2% female, and 59.9% Caucasian) underwent standardized neuropsychological and psychological testing an average of seven months after a unilateral focal stroke (156 left hemisphere and 151 right hemisphere; largest groups were 75 patients with frontal lobe stroke, 73 MCA, 41 cerebellar) since 2009 at Houston Methodist hospital as part of an IRB approved study. An additional 182 patients were excluded from analyses if strokes were bi-hemispheric, patients had a Mini Mental Status Exam score below 20 or comprehension difficulties, or if patients had comorbid neurologic diagnoses. Impairments in verbal memory or executive functioning were made categorical for analytic purposes because different cognitive tasks were administered over the 11 years of data collection (e.g., RBANS, HVLT-R and CVLT-II for verbal memory). Groups consisted of depressed patients with a left-sided CVA (N=48), non-depressed patients with a left-sided CVA (N=108), depressed patients with a right-sided CVA (N=44), and non-depressed patients with a right-sided CVA (N=107). Impairment on neuropsychological tasks was defined as z-scores < -1.32.

**Results:** Overall, 33% of patients were depressed seven months after a stroke. Chi-square analyses indicated significant group differences (Pearson chi-square 27.74,  $p < 0.001$ ) with the highest percentage of verbal memory difficulties for left-CVA depressed patients compared to other groups (75% of depressed left-sided CVA patients had verbal memory impairment). Non-depressed left-CVA patients had the second highest percentage of verbal memory impairment at 53%. For executive functioning, chi-square analyses indicated significant group differences (Pearson chi-square 8.68,  $p = 0.034$ ) such that there was a lower percentage of executive difficulties for the right-CVA non-depressed patients (42% of patients with executive difficulties) compared to all other groups (between 70-75% of executive impairments for all other groups).

**Conclusions:** Post-stroke depression and side of stroke were found to be important factors in verbal memory impairment after CVA. Patients who sustained a right-sided CVA and were not depressed were less likely to experience executive difficulties. Results highlight the importance of considering patient mood state and side of stroke when evaluating memory and executive abilities.

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**Keywords:** executive functions, cerebrovascular injury, mood disorders

**L. R. VALENCIA, A. BULLOCK, M. MILLER, J. JOHNSON, W. D. KILLGORE. Incorporation of Cardio Exercise is Associated to Increased Levels of Gratitude Among PTSD Patients.**

**Background:** Engaging in exercise among individuals with post-traumatic stress disorder (PTSD), alleviates symptoms such as depression and anxiety. Cardiovascular (CV) exercise is defined as sustained movement for a period that keeps an individual's heart rate to at least 50 percent of its maximum level. Examples of CV exercise includes swimming, running, and cycling. Other forms of exercise include strength training, and light training including exercises such as yoga, and walking. Additionally, the practice of gratitude has been found to improve mental health and to reduce the severity of symptoms experienced by individuals with (PTSD). Given the relationship between exercise and the trait gratitude, we investigated whether gratitude would be increased among people with PTSD who incorporated CV exercise into their regular routine.

**Participants and Methods:** : Eighty-one participants (Age: M =31.1, SD =8.84) with a clinical diagnosis of PTSD based on the Structured Clinical Interview for DSM-5, completed the Day of Scan Questionnaire, DSIQ, a general health survey. Participants indicated if they exercised regularly (n = 45; Age: M =31.1, SD =8.6), and recorded the percentage of time during exercise sessions that involved CV, strength training, and light training activity. The forty-five participants who exercised regularly completed the Gratitude Questionnaire-6 as a measure of trait gratitude. Three separate tests for percent CV, strength and light training exercise were correlated with scores on the trait gratitude using a bivariate Pearson correlation (1-tail) in SPSS. Participants recorded in the DSIQ how many days per week they exercised and the duration of their exercise sessions in minutes. These data were used to estimate the mean number of minutes of exercise per week.

**Results:** : Of eighty-one participants that answered if they exercise regularly in the DSIQ, forty-five recorded "yes" and thirty-six recorded "no" (Age: M =31.1, SD =9.3). For the forty-five participants that exercised regularly, incorporation of cardio exercise was positively correlated with trait gratitude ( $r=.284$ ,  $p=.036$ ), incorporation of strength exercise was negatively correlated with trait gratitude ( $r=-.284$ ,  $p=.036$ ), and incorporation of light exercise was not significant in correlation with trait gratitude ( $r=-.087$ ,  $p=.295$ ). On average those who exercised regularly, worked out for 52.8 minutes per session (Minutes SD=35.2) and 3.9 days per week (Days: M=3.9, SD=1.3), including 44.2 percent (Percentage: SD=32.4) cardio.

**Conclusions:** Among individuals with PTSD, we found that greater time spent in CV exercise per week was positively correlated with greater trait gratitude. Although an association between strength training and gratitude was found, the negative relationship suggests that more time spent in strength training exercise per week is associated with lower trait gratitude. This may be due to a trade-off that decreases the opportunity for CV exercise. These findings identify incorporation

of CV exercise as a potential intervention for increasing gratitude in individuals with PTSD. However, because these data are cross-sectional and correlational, we cannot infer directional causality. As practicing gratitude is known to reduce symptom severity among individuals with PTSD, future investigation into the relationship of incorporation of CV exercise and gratitude in effect to PTSD symptoms may contribute to non-pharmacological treatments

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**Keywords:** post-traumatic stress disorder, neuropsychiatry, quality of life

### **C. TRASK, N. S. KOVEN, R. ROTH. Schizotypal Personality Traits are Unrelated to Delay Discounting in a Nonclinical Sample.**

**Objective:** The ability to weigh appropriately the benefits of immediate versus future reward is an important component of effective decision-making. The tendency to discount a reward that is temporally distant in favor of a more immediate reward, as a function of the temporal distance, is known as delay discounting. Previous research has found that individuals with schizophrenia and first episode psychosis discount future rewards to a greater extent than healthy comparison subjects. Furthermore, this discounting has been associated with symptom subtypes, such that more severe negative symptoms are related to more “normal” delay discounting in schizophrenia (i.e., lower impulsive decision making). However, few studies have examined delay discounting in individuals with schizotypal personality (STP) traits, and findings have been equivocal. The present study therefore aimed to clarify the nature of the association between STP and delay discounting in a sample of college students.

**Participants and Methods:** Participants included 123 undergraduate students (mean age = 18.54 years; 71.5% female). STP was assessed using the Schizotypal Personality Questionnaire – Brief Version (SPQ-B), a 22-item self-report questionnaire. The SPQ-B generates a total score, as well as three factor scores for cognitive-perceptual deficits, interpersonal deficits, and disorganization. Additionally, participants completed the Delay Discounting Questionnaire, which consists of 30 questions regarding preferences for smaller immediate versus delayed larger hypothetical monetary rewards (e.g., “would you prefer \$15 today or \$60 in three weeks?”). Geometric mean ( $k$ ) was used to estimate a participant’s discount rate based on his or her preference for rewards sooner or later in time. A smaller  $k$  value is associated with preference for delayed but higher rewards and is indicative of more normal delay discounting.

**Results:**  $k$  was not significantly correlated with total SPQ-B score, nor with any of the three subscales. Furthermore, univariate ANOVA comparing students classified into high and low schizotypal subgroups (upper and lower quartile of SPQ-B Total scores, respectively) did not reveal a group difference.

**Conclusions:** The lack of significant association between schizotypal traits and delay discounting suggests that impulsive decision-making, at least as reflected in delay discounting, may develop nearer or after the onset of psychosis. This is consistent with prior research indicating that unaffected first-degree relatives of patients with schizophrenia and other individuals at high-risk for psychosis do not evidence abnormal delay discounting.

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**Keywords:** psychosis, decision-making

**M. BECKER, A. AHMED, S. BENNING, K. BARCHARD, S. E. JOHN, D. ALLEN. Bifactor Structure of Cognition in Schizophrenia.**

**Objective:** Some research suggests that cognition in SZ is best characterized by a unitary factor representing a general neurocognitive deficit, whereas other research contends that models incorporating specific cognitive domains are more appropriate. Studies of cognitive heterogeneity in SZ identify groups with uniform normal or impaired performance, consistent with a unitary factor, and groups with differentiated cognitive profiles, consistent with specific cognitive domains. Multidimensional models (hierarchical, bifactor) may more accurately reflect the latent structure of cognition in SZ because they incorporate both general and specific factors, a possibility that was examined in this investigation.

**Participants and Methods:** Participants included 813 people with SZ from the Clinical Antipsychotic Trials of Intervention effectiveness (CATIE) baseline dataset (age = 38.7 years, education = 11.7 years, % male = 75.3, and % Caucasian = 62.9). They were randomly split into calibration and cross-validation samples. Cognitive test scores were conceptualized to measure Processing Speed, Verbal Memory, Working Memory, Reasoning, and Vigilance (Keefe et al., 2006). Hierarchical and bifactor models included a general cognitive factor in addition to these domains. Also examined were six- and seven-factor models that separated Verbal Fluency measures from Processing Speed, and further differentiated between phonemic and semantic fluency. All models were estimated using confirmatory factor analysis (CFA) in *Mplus*.

**Results:** Calibration sample CFA results indicated a bifactor seven-factor model provided excellent fit to the data. Comparative fit for the bifactor seven-factor model indicated it was better than all other models examined. The bifactor seven-factor model also provided excellent fit to the data in the cross-validation sample. For both samples, WAIS-IV Digit Symbol, Letter-Number Sequencing, and WISC-III Mazes had higher loadings on the general factor (.52 to .75) with low loadings on their respective specific factors. Loadings for other tests across the specific factors ranged from -.21 to .94 (median=.57).

**Conclusions:** A bifactor model with seven specific factors best characterized the latent structure of cognitive abilities in SZ, providing a more nuanced understanding of cognition consistent with unitary and specific ability conceptualizations. Factor loadings on the general factor suggest that test scores may encompass contributions from multiple domains or may represent overlapping deficits in SZ, such as lower-level deficits resulting in impairments in higher-level functions.

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**Keywords:** schizophrenia, neurocognition, psychometric constructs

**E. PARRISH, S. KAMARSU, T. F. FILIP, P. HARVEY, E. GRANHOLM, S. CHALKER, R. C. MOORE, A. PINKHAM, C. A. DEPP. Ecological Momentary Facial Emotion Recognition in Psychotic Disorders.**

**Objective:** Cognitive tasks delivered during ecological momentary assessment (EMA) may elucidate the short-term dynamics and contextual influences on cognition and judgements of performance. This paper provides initial validation of a smartphone task of facial emotion recognition in serious mental illness, called the Mobile Ecological Test of Emotion Recognition (METER).

**Participants and Methods:** A total of 86 participants with psychosis (diagnoses included schizophrenia, schizoaffective disorder, bipolar disorder, and depression), aged 19-65, were administered in-lab “gold standard” affect recognition (Penn Emotion Recognition Task [ER-40]; Bell Lysaker Emotion Recognition Task [BLERT]), neurocognition, and symptom assessments (e.g., Positive and Negative Syndrome Scale [PANSS]). They subsequently completed 10 days of the mobile facial emotion recognition task, assessing both accuracy and self-assessed performance, along with concurrent EMA of psychotic symptoms and mood. Validation focused on task adherence and predictors of adherence, gold standard convergent validity, and symptom and diagnostic group variation.

**Results:** The mean rate of adherence to the task was 79%; no demographic or clinical variables predicted adherence. Convergent validity was observed with in-lab measures of facial emotion recognition (ER-40:  $\rho=.46$ ,  $p<.001$ ; BLERT:  $\rho=.59$ ,  $p<.001$ ). The METER had a similar correlation with the PANSS ( $\rho=-.323$ ,  $p=.002$ ) as the BLERT had with the PANSS ( $\rho=-.353$ ,  $p=.001$ ), but the METER had a stronger association than the ER40 had with the PANSS ( $\rho=-.133$ ,  $p=.221$ ). In terms of potential practice effects, performance was negatively associated with protocol day, with slight declines in performance over time ( $estimate=-0.07$ ,  $S.E.=0.23$ ,  $t=-2.98$ ,  $p=.003$ ). In time-varying models, more severe voices ( $estimate=-0.21$ ,  $S.E.=0.04$ ,  $t=-5.07$ ,  $p<.001$ ) and sadness ( $estimate=-0.11$ ,  $S.E.=0.03$ ,  $t=-3.14$ ,  $p=.002$ ) predicted performance. Voices ( $estimate=-0.11$ ,  $S.E.=0.05$ ,  $t=-2.10$ ,  $p=.036$ ) and sadness ( $estimate=-0.24$ ,  $S.E.=0.04$ ,  $t=-5.74$ ,  $p<.001$ ) also predicted self-assessed performance for participants with schizophrenia. Participants with schizophrenia were almost twice as likely to overestimate their performance compared to people with mood disorders,  $F(2,694)=2.8$ ,  $p=0.059$  (contrast:  $estimate=0.25$ ,  $S.E.=0.9$ ,  $t=2.6$ ,  $p=0.027$ ).

**Conclusions:** The mobile facial emotion recognition task was tolerated and demonstrated convergent validity with in-lab measures of the same construct among persons with psychosis. Biased judgement of social cognitive performance, previously shown to predict functioning, can be evaluated in real-time in naturalistic environments.

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**Keywords:** test validity, social cognition, psychosis

## Y. KOLAHI, C. A. BRENNER. Theory of Mind and Neurocognition as Predictors of Social Functioning in Schizophrenia.

**Objective:** One of the core features in schizophrenia is a deficit in social functioning as expressed through difficulties in the ability to work, engage in social relationships, attend to self-care, and participate in recreational and community activities. Due to the profound impact of social functioning deficits on illness prognosis and overall quality of life, research has investigated possible underlying mechanisms. Candidates include elements of neurocognition (especially verbal memory, flexible problems solving, and vigilance) and social cognition. Theory of Mind (ToM) is an area of social cognition with widely researched links to social

functioning. ToM involves making inferences regarding other's mental states, knowledge, beliefs, and intentions. This study aimed to explore ToM and the specific domains of neurocognition that predict social functioning in schizophrenia.

**Participants and Methods:** This study used 24 patients (11 female) with schizophrenia recruited from the community in Vancouver, Canada, as part of a larger study on cognitive remediation. Participants were administered the MATRICS Consensus Cognitive Battery (MCCB), the Hinting Task, and the Social Functioning Scale.

**Results:** A regression analysis showed that verbal learning (HVLT-R) and Theory of Mind are significant predictors of recreation activities and prosocial behaviors ( $R^2_{adj} = .327$ ,  $F(2, 14) = 4.89$ ,  $p < .05$ ;  $R^2_{adj} = .457$ ,  $F(2, 14) = 6.88$ ,  $p < .05$ ). Additionally, executive functioning (NAB Mazes) and Theory of Mind were shown to be predictors of interpersonal communication and prosocial behaviors ( $R^2_{adj} = .327$ ,  $F(2, 14) = 4.89$ ,  $p < .05$ ;  $R^2_{adj} = .457$ ,  $F(2, 14) = 6.88$ ,  $p < .05$ ).

**Conclusions:** ToM is a category of social cognition that plays a complex and important role in social functioning for those with schizophrenia. It seems that verbal memory, executive functioning, and the psychosocial skill of mental perspective taking influences aspects of functioning that involve social interaction, such as the frequency of engagement in recreational and community activities. The findings of this study have important implications for the implementation of Theory of Mind interventions in both Cognitive Remediation and Social Skills Training for schizophrenia.

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**Keywords:** theory of mind, neurocognition, schizophrenia

### **I. RUIZ, W. G. MACFIE, G. P. STRAUSS. Why do People with Schizophrenia Fail Effort Tests: Poor Cognition or Low Motivation?**

**Objective:** A recent meta-analysis indicated that people with psychotic disorders fail a neuropsychological effort test at a rate of 18%. However, the reasons for effort test failure are currently unclear. It is possible that effort test failure results from genuine cognitive impairment, low motivation, or a combination of the two. The current study examined whether effort failure rates could be reduced in SZ by using a modified version of the digit span task that presented participants with monetary incentives for accurate performance and a traditional version without incentives. **Participants and Methods:** The reliable digit span (RDS) index was calculated to assess effort test failure on each version. Participants included 33 patients with schizophrenia (SZ) and 27 healthy controls (CN). **Results:** Results indicated that people with SZ were more likely to fail the RDS on the non-incentivized version compared to controls (Failure rate: CN = 31%, SZ = 50%). On the incentivized version, there were no group differences in the RDS failure rate (CN = 21%, SZ = 25%). Reward incentives therefore increase the performance validity on both groups, with a disproportionately greater effect on people with SZ. **Conclusions:** The increase in pass rate on the reward incentivized condition may suggest that people with SZ fail effort test due to low intrinsic motivation to perform well on neuropsychological testing. The findings have implications for cognitive rehabilitation programs in SZ in which the manipulation of external reward incentives may be useful for maximizing cognitive effort exertion during training.

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**Keywords:** effort, schizophrenia, attention

**N. A. HOPKINS, J. MAIETTA, L. N. MAIETTA, H. C. KUWABARA, G. J. GOODWIN, T. F. KINSORA, S. R. ROSS, D. ALLEN. Differences in Baseline Symptom Reporting in Athletes with Psychiatric Treatment History.**

**Objective:** The ImPACT is a commonly utilized assessment that measures cognitive abilities pre- and post-concussion. Current literature examines symptom reporting on the ImPACT Post-Concussion Symptom Scale (PCSS) and indicates that females tend to report more symptoms at baseline and post-concussion than males. Additionally, those with pre-concussion psychiatric history report more symptoms post-concussion. Currently there is limited research that investigates the interaction between gender and psychiatric history on symptom reporting in athletes, which was the focus of this investigation. We hypothesized that there would be an interaction between gender and psychiatric treatment history (PSYCH) on baseline symptom reporting. Specifically, females and those with psychiatric history would report more symptoms on the Cognitive/Sensory, Sleep/Arousal, and Affective domains.

**Participants and Methods:** Participants were selected from a larger database of high athletes who completed baseline ImPACT from 2008-2016 (mean age=15.1, SD=1.1; mean education=9.0; SD=1.5; 68.1% female). Self-reported psychiatric history was obtained from ImPACT demographics section. A case-control approach was used to randomly select age- and sex-matched healthy controls, which yielded a sample of 1,098 (HC n=549 and PSYCH n=549). A mixed-model ANOVA was conducted to compare PCSS domains on two between-groups factors (gender and clinical group) with one within-group factor (PCSS domain). PCSS domains were summed based on Kontos et al., (2012) factor structure and include: Cognitive/Sensory, Sleep/Arousal, Vestibular/Somatic, and Affective. Due to non-normality of PCSS domains, ranked scores were utilized in analysis

**Results:** Results indicated no main effect for PCSS, but there were main effects for gender and clinical group with females and the PSYCH group reporting more symptoms overall. There was no Gender x PCSS interaction, suggesting that PCSS domain did not differ by gender. However, there was a Clinical Group x PCSS interaction, such that the PSYCH group reported significantly more symptoms on all PCSS domains with the Affective and Sleep/Arousal domains demonstrating large effects compared to the Vestibular/Somatic and Cognitive/Sensory domains (small to medium effects). There was no additional three-way interaction between Gender x Clinical Group x PCSS suggesting that there were no gender differences in PCSS reporting between clinical groups.

**Conclusions:** Athletes with psychiatric treatment history reported more baseline symptoms across PCSS domains with the largest differences in Sleep/Arousal and Affective domains. Previous literature has demonstrated that those with psychiatric history also report more symptoms after concussion and our results indicate that, even at baseline, those with psychiatric treatment history report greater symptom severity. Based on these findings, it is possible that increased post-concussion symptom reporting may be due to premorbid baseline differences.

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**Keywords:** self-report

**A. FISHER, L. M. CAMPBELL, N. SUN-SUSLOW, M. KOHLI, B. TANG, E. E. LEE, A. HEATON, R. C. MOORE. Intra-Individual Variability in Objectively-Measured Sleep**

**Quality is Associated with Worse Cognition in Middle-Aged and Older Adults with and without HIV.**

**Objective:** Poor sleep quality is related to worse cognition. In older adults, greater intra-individual variability (IIV) in objectively-measured sleep quality has also been associated with worse cognition; however, this relationship has been less-studied in persons with HIV (PWH), a group with increased prevalence of sleep problems and cognitive impairment compared to older adults without HIV. Therefore, this study examined the association between cognition and IIV in sleep quality among adults aging with and without HIV.

**Participants and Methods:** Sixty-one PWH ( $M_{age}=59.1$ ,  $SD_{age}=6.6$ ; 82% Male) and 32 HIV-adults ( $M_{age}=59.2$ ,  $SD_{age}=6.2$ ; 58% Male) completed comprehensive neuropsychological evaluations. Global and domain-specific demographically-adjusted T-scores were generated. Three objective sleep quality parameters (total sleep time [minutes], efficiency, and sleep fragmentation) were obtained via wrist actigraphy over 5–14 nights. Standard deviations of the objective sleep parameters were calculated to represent IIV for each participant. Subjective sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). Independent samples *t*-tests were used to compare sleep variables by HIV status. Spearman's rho correlations were used to examine the relationship between subjective sleep quality, average objective sleep, and IIV in objective sleep. Linear regressions, which included an HIV by IIV in sleep interaction and adjusted for use of sleep medication (yes/no), number of nights of sleep data, and hypertension, were used to examine the association between IIV in sleep and global cognition and examine if this relationship differed by HIV status. For significant findings, follow-up analyses examined which cognitive domains were driving this association.

**Results:** Total sleep time, efficiency, and sleep fragmentation did not differ significantly by HIV status ( $p$ 's>0.05). PWH had greater IIV in total sleep time than the HIV- group (PWH:  $M=69.4$ , HIV-:  $M=55.3$ ,  $p=0.03$ ); IIV in efficiency and IIV in sleep fragmentation did not differ by HIV status. Average total sleep time, efficiency, and sleep fragmentation were not associated with subjective sleep quality. Likewise, IIV in efficiency and IIV in sleep fragmentation were not associated with subjective sleep quality; however, greater IIV in total sleep time was associated with worse subjective sleep quality ( $\rho=0.33$ ,  $p<0.01$ ). All HIV by IIV interactions were not significant ( $p$ 's>.50) and were thus removed from the linear regressions. Adjusting for covariates found greater IIV in total sleep time was associated with worse global cognition ( $\beta=-0.23$ ,  $p=0.039$ ); this effect was driven by executive function ( $\beta=-0.36$ ,  $p<0.001$ ). IIV in efficiency ( $\beta=-0.20$ ,  $p=0.058$ ) and IIV in sleep fragmentation ( $\beta=-0.07$ ,  $p=0.48$ ) were not associated with global or domain-specific cognition.

**Conclusions:** We found that IIV, but not mean objective sleep measures, differed by HIV status; therefore, IIV is an important measure to include with overall sleep measures when assessing sleep's association with cognition. While we found IIV in total sleep time was related to worse global cognition and executive functioning in middle-aged and older adults with and without HIV, longitudinal studies are needed to determine the directionality of this relationship. These data also highlight the usefulness of actigraphy in assessing hard-to-measure sleep variables that are related to cognition such as IIV in sleep quality.

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**Keywords:** sleep, cognitive functioning, HIV/AIDS

**A. CARLEW, J. R. LIVINGSTONE, A. PARKER, L. H. LACRITZ. Patient Satisfaction and Utilization of Teleneuropsychology Feedback Visits.**

**Objective:** Teleneuropsychology (TeleNP) research and clinical utilization rapidly expanded in 2020 with the COVID-19 pandemic. With temporary flexibility from insurance companies for TeleNP reimbursement, neuropsychologists have the opportunity to explore alternative modalities of service that may increase access to and utilization of services by reducing common barriers (e.g., distance, transportation, etc.). Currently, very limited data exists on patient perspectives of virtual services. Therefore, the current study aims to examine patient satisfaction and utilization of TeleNP feedback visits.

**Participants and Methods:** 67 patients ( $M_{age}=63.2$ , range=28-85, 55.2% male) who completed in-person testing and TeleNP feedback between May 2020 and July 2020 were contacted and asked to complete a survey regarding their satisfaction with their TeleNP visits as part of an IRB-approved quality-improvement project at a large academic medical center. The group was highly educated ( $M=14.7$  years, range = 4-20) and predominantly white (89.6%). Descriptive and frequency statistics were used to analyze satisfaction data, and chi square analyses were run to check for differences in satisfaction data based on age ( $\leq 64/65+$ ), education ( $\leq 12$  years/ $13+$  years), race (white/non-white), or sex. Of those who completed the survey, 12 primarily utilized the telephone due to difficulty with videoconference technology. As a follow-up investigation, electronic medical record data was pulled for patient utilization of feedback services from September 2019 – February 2020 (pre-COVID) and May 2020 – July 2020 (mid-COVID).

**Results:** There were no group differences in satisfaction based on demographic factors or TeleNP modality (videoconference vs. telephone). In the overall sample, 96% reported feeling “Satisfied” or “Very Satisfied” with the visit (out of the choices Very Satisfied, Satisfied, Somewhat Satisfied, and Not Satisfied). Main advantages of virtual visits endorsed were “flexibility/convenience” (81%) and “avoid potential exposure to illness” (57%). Main disadvantages endorsed were “feel less connected to doctor than if seen in person” (31%) and “harder to communicate” (21%), though 54% of patients endorsed “no disadvantages to virtual visit.” During the post-COVID timeframe, a significantly higher proportion of patients utilized feedback visits via TeleNP 156/250 (62.4%), compared to the 343/657 (52.2%) who returned for in-person feedback visits during the pre-COVID timeframe ( $\chi^2[1, N=205] = 10.42, p=.001$ ).

**Conclusions:** Overall, provision of feedback through TeleNP is feasible and well received by patients. Results indicate a largely positive patient response in terms of overall satisfaction, which appears to be mostly related to increased flexibility and convenience. Common concerns were related to greater difficulty feeling connected with and ability to communicate with their provider, which could be ameliorated with certain strategies (e.g., extra time for rapport building, making eye contact with the camera). Furthermore, preliminary data suggests an increase in feedback visit utilization with TeleNP. Overall, results support continued use of TeleNP for providing feedback, which may provide patients more options to review results and recommendations, and in turn could have a positive impact on patient outcomes.

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**Keywords:** assessment

**A. PARKER, A. CARLEW, J. R. LIVINGSTONE, M. CULLUM, L. H. LACRITZ. Patient Satisfaction with Teleneuropsychological Assessment and Feedback Across Home and Clinic Settings.**

**Objective:** To safely provide services during the COVID-19 pandemic, many clinicians have implemented teleneuropsychology (TeleNP). Different models of TeleNP exist, with some conducting part or all of the visit virtually with patients in their homes, while others use hybrid models with in-clinic TeleNP. Existing literature generally supports the validity of TeleNP; however, evidence is limited regarding patient satisfaction, preferences, and responses to these different TeleNP models. To this end, we examined patients' satisfaction with TeleNP following different types of visits (assessment only, feedback only, and assessment + feedback), and further examined differences in satisfaction between locations (in-home vs. virtual in-clinic).

**Participants and Methods:** Patients (N=123) who received TeleNP services (M age = 63.17, range 19-85; M educ = 15.13, range 4-20; 48% female; 85.2% white) completed a survey (by phone/survey link 2-8 weeks following their visit) regarding their level of satisfaction with the visit as part of an IRB approved quality improvement project. Across all visit types, 98 were in-home, 22 were assessed virtually in-clinic, and three were excluded as visits were conducted in another location. Twenty-six had a video-based TeleNP assessment only, 67 had a TeleNP feedback only, and 30 had assessment + feedback via TeleNP. Survey responses were examined qualitatively, descriptive statistics were utilized to examine item level survey data, and chi-square analyses compared satisfaction across visit types.

**Results:** Ninety-six percent of all respondents were "Satisfied" or "Very Satisfied" with their visit(s) overall and 95% reported the visit did a "Good" or "Very Good" job of meeting their needs. Chi square analyses did not indicate significant differences between visit types in terms of level of satisfaction ( $\chi^2=6.9, p=.3$ ) or how well the visit met their needs ( $\chi^2=2.6, p=.9$ ). There were also no significant differences in visit satisfaction ( $\chi^2=1.7, p=.6$ ) or needs met ( $\chi^2=.1, p=.7$ ) across locations (in-home vs. virtual in-clinic). Qualitatively, 10% of patients (n=10) who completed in-home assessment endorsed difficulty concentrating as a potential disadvantage compared to 0% whose virtual visit was in-clinic. More patients who completed in-home visits (79%; n=78) endorsed flexibility/convenience and avoiding exposure to illness (52%; n=51) as advantages to TeleNP than virtual in-clinic respondents (Flexibility/Convenience: 40%, n=9; Avoiding Exposure 22%, n=5). Ninety-four percent (n=92) in-home and 90% (n=20) virtual in-clinic patients expressed interest in another TeleNP visit.

**Conclusions:** Overall, clinical patients in this sample responded well to TeleNP with high levels of satisfaction that did not differ between types of visits or locations. Furthermore, patients felt their TeleNP visit(s) met their needs regardless of visit type or location in which the service was conducted, and the majority of patients across locations expressed interest in another TeleNP visit. Given these findings, clinicians may expect overall good satisfaction when providing TeleNP services and patients may prefer the flexibility and decreased exposure to illness associated with home-based visits. Additional research is needed to examine satisfaction with TeleNP in more diverse samples and to further examine outcomes following TeleNP assessment. Correspondence: Allison Parker, University of Texas Southwestern Medical Center, Dallas, TX, 75235, United States. Email: [allison.parker@utsouthwestern.edu](mailto:allison.parker@utsouthwestern.edu)

**Keywords:** neuropsychological assessment

## **B. HONSEY, K. NAMAN, J. STEWART-WILLIS, Z. PROCTOR-WEBER. Neuropsychological Assessment and the Impact on Rehabilitation Outcomes.**

**Objective:** The literature places the prevalence rate of dementia and/or cognitive impairment among persons with lower extremity amputations at greater than 10%, which is greater than the general population rates of 5-10% in those aged 65 years and above (Coffey, O'Keefe,

Gallagher, Desmond, Lombard-Vance, 2012). Additionally, studies have found that individuals with lower limb amputation secondary to cerebrovascular disease are at greater risk for cognitive impairment (Coffey et al., 2012). As such, emphasis has been placed on neuropsychological assessment and its impact on rehabilitation outcomes for veterans who present with lower extremity amputations. The current pilot study examined a sample of veterans with a history of amputation. It was hypothesized that individuals with more severe cognitive impairment as indicated by diagnosis of cognitive status (no cognitive impairment, mild cognitive impairment, dementia) would have a higher frequency of discharge requiring assistance post-rehabilitation.

**Participants and Methods:** Participants (n = 12; 100% males) underwent neuropsychological evaluations in a VA CIIRP. The average age was 67 years old (range: 54-76 years), education level was 12.9 years, and 11 of the participants were Caucasian. The assessment covered domains of memory (HVLt-R, CVLT-II, BVMt-R), attention/processing speed (WAIS-IV Digit Span, SDMT), executive functioning (TMT, WCST) visual spatial functioning (RCFT), language (BNT, ANT, COWAT), and mood. Frequencies and distributions were examined using SPSS, followed by nonparametric chi-squared analyses.

**Results:** Preliminary analysis revealed that 83% of the sample had a below the knee amputation (BKA) and 17% had an above the knee amputation (AKA). Of the sample, 33% were diagnosed with a major neurocognitive disorder (ND), 50% had a mild ND, and 16% were normal. However, this higher rate of cognitive impairment that is found in the literature may be related to selection bias, with individuals demonstrating cognitive challenges prompting evaluation sooner than those who do not. The proportion of participants who discharged home vs. home with assistance vs. an assisted living facility (e.g., ALF, SNF) did not differ by diagnosis  $\chi^2(4, N = 12) = 6.00, p = .199$  or type of amputation  $\chi^2(2, N = 12) = 2.400, p = .301$ . Interestingly, post hoc analyses revealed a significant relationship; those administered the CVLT instead of the HVLt were more likely to be diagnosed with a major neurocognitive  $\chi^2(2, N = 11) = 6.375, p = .041$ .

**Conclusions:** Early evidence suggests diagnosis is impacted by the measures used, as the CVLT-II classified individuals as having more severe levels of impairment. Based on the preliminary data, further examination of the specific cognitive variables that predict outcomes are needed. The current pilot data is promising, and as data collection is still ongoing, cross-validation of the results will be necessary (to be presented at INS). The goal of this research is the continued refining of the neuropsychological evaluation (i.e., cognitive strengths and weaknesses, learning styles, and degree of cognitive impairment) of patients with below BKAs and AKAs to inform the course of rehabilitation treatment and improve functional outcomes (progression to prosthetic training, use of prosthetic, and ambulation status).

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**Keywords:** neuropsychological assessment, outcome

## H. A. CLARK, S. LAVIGNE, K. A. MARTINEZ, P. MARTIN, M. MACALUSO, R. W. SCHROEDER. How Might Neuropsychologists Target Educational Programs for Medical Residents to Promote Future Referrals?

**Objective:** Neuropsychologists receive most of their patient referrals from neurologists, psychiatrists, and primary care physicians (Sweet et al., 2015). It is consequently important to understand how to facilitate these providers' continued engagement with neuropsychology. The current study explores differences in neuropsychology-related education and attitudes between

medical residents who do and do not intend to refer to neuropsychologists during independent practice, with the goal of informing how educational programs can be targeted to promote future referrals.

**Participants and Methods:** Participants consisted of 416 residents in accredited family medicine (33.7%), internal medicine (31.0%), psychiatry (23.3%), and neurology (12.0%) training programs from across the United States. Residents completed a survey that used Likert scales (strongly disagree, disagree, agree, strongly agree) to assess if residents: 1) are aware of local neuropsychological services, 2) understand neuropsychology, 3) think neuropsychological services could benefit their patients, and 4) are likely to refer to neuropsychologists during independent practice. Residents were also asked to identify sources of exposure to neuropsychology during medical training (e.g., lectures, clinical rotations) and about perceived barriers to making referrals. Residents were separated into 2 groups: those who agreed/strongly agreed that they are likely to refer and those who disagreed/strongly disagreed. Tests of independence (chi-square or Fisher's exact test) were used to explore associations between referral intentions and awareness, understanding, and perceived benefits. Fisher's exact test was also utilized to assess the relationship between referral intentions and exposure to neuropsychology. An independent samples t-test was used to explore differences regarding diversity of educational experiences. Qualitative responses about barriers were explored for common themes.

**Results:** Most residents (86.1%;  $n=358$ ) agreed/strongly agreed that they are likely to refer to neuropsychologists during independent practice. Only 58 residents (13.9%) disagreed/strongly disagreed (21.7%, 14.3%, 12.0%, and 4.1% of internal medicine, family medicine, neurology, and psychiatry residents, respectively). Referral intentions were significantly associated ( $p<.001$ ) with awareness, understanding, and perceived benefits, with fewer unlikely-to-refer residents endorsing awareness of local neuropsychological services (15.8%), understanding neuropsychology (22.4%), and perceiving neuropsychological services as beneficial to their patients (68.4%) than likely-to-refer residents (56.0%, 59.9%, and 98.9%, respectively). Referral intentions were also significantly associated ( $p=.016$ ) with exposure to neuropsychology during medical training; 17.2% of unlikely-to-refer residents reported having no exposure, compared to only 6.7% of likely-to-refer residents. Additionally, unlikely-to-refer residents endorsed experiencing significantly lower ( $p<.001$ ) diversity of neuropsychology-related educational experiences (mean=1.74 types of exposure) than likely-to-refer residents (mean=3.35). The most common barriers to making referrals reported by unlikely-to-refer residents were not having access to neuropsychologists, lack of awareness of local neuropsychological services, and not understanding neuropsychology.

**Conclusions:** Results suggest that useful targets for the education of medical residents include sharing information about local neuropsychological services and instructing residents about the field of neuropsychology, including how neuropsychological services can benefit their patients. It would likely also be useful to provide education about neuropsychology as a routine part of medical training, preferably in several different forms (e.g., both academic and clinical experiences). Implementing these strategies might increase the likelihood of future referrals from the next generation of medical providers.

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**Keywords:** transdisciplinary research, self-report

**K. H. CHANG, S. JETT, N. WOLF, A. ISKHAKOV, A. FERDINAND, A. BOOK, J. GOLDBLATT, G. KOKKINOS, A. BRAND, C. PYTTE. Administration of Human CD34+ Cells Mitigates Cognitive Decline in a Mouse Model of Healthy Aging.**

**Objective:** Circulating CD34+ cells have been used therapeutically in rodent models of injury with neuroprotective and neuro-regenerative effects, such as increased neurogenesis, decreased inflammation, and decreased activated microglia. However, little is known about the therapeutic effects of exogenous CD34+ cells on cognition in a healthy aging model. The present study sought to determine whether a peripheral supplement of  $5 \times 10^5$  human cord blood CD34+ cells, injected either in one or two installments, would mitigate cognitive decline or improve cognitive function in a mouse model of healthy aging.

**Participants and Methods:** Young adult and middle-aged mice underwent a battery of behavioral tests (Y-maze, elevated plus maze, Barnes maze, novel object recognition, and Morris water maze) before and after treatment with human cord blood CD34+ cells to assess hippocampal-dependent learning and memory. Learning and memory performance was compared between CD34+-treated mice and control mice, pre- and post-treatment.

**Results:** In novelty-motivated tests (Y-maze and novel object recognition), CD34+-treated mice spent significantly more time exploring the novel arm or object than the familiar arm or object ( $p < 0.05$ , paired t-test) after treatment, whereas the control mice showed no preference for the novel arm or object.

**Conclusions:** CD34+-treated mice demonstrated better memory ability post-treatment on novelty-motivated tests. The effect of CD34+ treatment on memory stability and improvement was distributed across the majority of CD34+-treated mice. Our findings suggest that a supplement of CD34+ cells may mitigate cognitive decline of memory performance in a mouse model of healthy aging.

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**Keywords:** aging (normal), cognitive neuroscience, treatment outcome

**H. GEORGE, M. LANCA. Cognitive Stabilization Intervention During the COVID-19 Pandemic.**

**Objective:** With the emergence of the COVID-19 pandemic, traditional neuropsychological assessment and associated services were halted due to physical distancing restrictions. In response to these necessary restrictions, neuropsychologists expanded their delivery of services. Cognitive Stabilization Intervention (CSI) is a novel, telehealth treatment that seeks to stabilize patients' cognitive symptoms in advance or in lieu of neuropsychological testing due to the delay for in-person neuropsychological assessment. We describe this modality of treatment and highlight its applicability with a case presentation.

**Participants and Methods:** CSI is characterized as an admixture of psychological and neuropsychological interventions to help patients stabilize their cognitive symptoms. These interventions are dependent on the evaluation of individualized cognitive symptoms and presumed etiologies of the presenting symptoms. They are founded on empirically validated behavioral intervention techniques that can include cognitive remediation, medication adherence training, improved sleep regulation, study skills, implementation of exercise regimes, and meditation and mindfulness. A motivational interviewing (MI) framework is used to help the patient move from inaction to implementation as needed. A case will be presented of a patient

with memory symptoms who was referred for a neuropsychological assessment but whose appointment was deferred due to the state Emergency Declaration period of the COVID-19 pandemic, which resulted in the clinic having temporarily halted its neuropsychological assessments.

**Results:** Preliminary analyses of pre/post self-report measures indicate that CSI was an effective neuropsychological intervention provided on a virtual platform to reduce reported memory symptoms.

**Conclusions:** Prior to the COVID-19 pandemic, neuropsychological evaluation and interventions were predominantly in-person services. The pandemic has required neuropsychologists to modify and expand services to provide telehealth options. CSI was developed as a low-risk telehealth-based treatment to stabilize cognitive symptoms. The clinical case described highlights how CSI treatment resulted in improvements of day-to-day functioning and reduction of cognitive symptoms. Future research can examine the extent of stabilization in a group of patients undergoing CSI versus a control group.

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**Keywords:** cognitive rehabilitation, treatment outcome

#### **A. NEHRA. Brain Behaviour Relationship Uncovered From Assessment & Rehabilitation Perspective: Sharing Experiences of Low Resource Setting.**

Clinical Neuropsychology (CNP) is a super-specialization which is grounded in the neurosciences with a strong focus on evidence-based practice including diagnostics (using standardized tests), prognostics and interventions for various neurological conditions.

**Objective:** To discuss & unravel (1) the role and importance of neuropsychological assessment in neurological conditions and challenges in low resource settings.

**Participants and Methods:** At Clinical Neuropsychology, AIIMS, New Delhi, India, we are using evidence based assessment and rehabilitation techniques (using A-B-A format) based on national & international literature. The neuropsychological rehabilitation procedure where restorative & compensatory techniques using an eclectic approach are used, depending upon patient's strengths & weaknesses, at home-based and hospital based level to help a patient acquire the knowledge and skills needed for optimal physical, psychological, vocational, cognitive and social functioning.

**Conclusions:** The paper will highlight our experience and challenges to carry out Neuropsychological Interventions (on chronic neurological conditions) focusing on the need to strengthen the interdisciplinary approach in the healthcare sector lending a better and improved quality of life of patient populations, worldwide.

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**Keywords:** cognitive rehabilitation, neuropsychological outcome, neuropsychological assessment

#### **A. ALBIZU, R. FANG, A. INDAHLASTARI, A. O'SHEA, S. E. STOLTE, K. B. SEE, E. M. BOUTZOUKAS, J. N. KRAFT, N. NISSIM, A. J. WOODS. Individualized Machine-Learning Derived Transcranial Electrical Stimulation Optimization for Working Memory Improvement in Older Adults.**

**Objective:** Transcranial electrical stimulation (tES) is widely investigated as a family of therapeutic tools for enhancing cognitive function in older adults with and without neurodegenerative disease. Prior research demonstrates that direction and intensity of electrical current are essential features for producing favorable outcomes of stimulation. While these features are directly related to electrode placement and injected current, they vary extensively with differences in individual anatomy. A method to target these features while accounting for individual anatomical differences provides a pathway to personalized dosage delivery for optimized functional gains. This pilot study used machine learning and MRI-derived computational models of tES to define a personalized medicine application of transcranial electrical stimulation.

**Participants and Methods:** Fourteen healthy older adults (age 65-87) received 20 min of 2mA tES stimulation (F3-F4) during a two-week cognitive training intervention. Participants performed an N-back working memory task pre-/post-intervention. Computational models of tES current density were generated from T1-weighted MRI images to estimate the intensity and direction of the tES electric field. Constructed models were normalized to the University of Florida Aging Brain-587 template. Normalized maps were passed through a binary support vector machine-learning algorithm (SVM) to identify the critical features for producing tES-based working memory improvements. Weighted, gaussian mixture model (GMM) optimization was used to determine the optimal electrode placement and injected current by maximizing the relative likelihood estimate of treatment response. An adversarial network was established by passing the optimized current density estimates back into the deployed SVM model for reclassification to assess the performance of the GMM.

**Results:** Optimization via GMM reduced inter-individual electric field direction and intensity variability. GMM also produced an average relative likelihood estimate of 0.98 for producing treatment response in optimized brains. The optimized models successfully converted 100% of non-responder predictions to responders within the adversarial network.

**Conclusions:** Clinical applications of tES have grown exponentially, yet reproducibility of these studies remains a challenge. At present, the optimal stimulation parameters remain unknown, making it difficult to ensure optimal treatment response on an individual basis. Findings from this study clearly demonstrate the advantages of employing optimized stimulation parameters in tES protocols for patient specific dosing. The current study provides a method for building personalized medicine models for a variety of therapeutic tES applications.

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**Keywords:** neuromodulation, working memory, aging (normal)

**A. A. DESPOTI, E. KARATZANOS, D. TZOUMI, I. PATSAKI, N. LEVENTAKIS, A. PAPATHANASIOU, G. ROUSSOU, S. NANAS, N. DIMITRIADI. Immersive Virtual Reality in Neuropsychological Rehabilitation: A Systematic Review.**

**Objective:** There has been increasing interest on the employment of Virtual Reality (VR) in cognitive rehabilitation. Most of the studies in cognitive rehabilitation, use semi or non-immersive environments. High levels of immersion provide a high sense of presence in the virtual world. The aim of this study is to investigate the effects of *immersive VR as a rehabilitation approach of cognitive functions. Safety and reliability will be also examined.*

**Participants and Methods:** A systematic literature review was conducted from 1998 since March of 2020 in the electronic databases of PubMed, Cochrane, OTseeker and PsycINFO. The

main search terms were "immersive virtual reality," "and cognitive rehabilitation". The research was strictly limited in immersive technologies and adult patients suffering from neurological disorder or a traumatic injury. The criteria of defining a VR technology as immersive were: stereoscopic projection (e.g. Head Mount Displays), use of real-time three-dimensional graphics and interaction interfaces (e.g. motion sensing input devices).

**Results:** Totally, 12 out of 465 citations reviewed. Most of the studies were RCTs (N=5) and three feasibility and one reliability study. There was some low-level evidence, including two case studies and two non-randomized controlled trials. There have been developed VR systems to train patients with traumatic brain injury (TBI) (N=5), elderly (N=4), stroke (N=1), Alzheimer's disease (N=1), and mild cognitive impairment (N=1). The studies demonstrated improvement in attention (4 out of 4), executive functions (3 out of 3), in memory (3 out of 3) and in navigation skills (1 out of 1). One study referred to stress relief in older adults with various kind of cognitive abilities. The comparison group in RCTs performed either traditional, face to face training such as physical and cognitive rehabilitation or music therapy (N=2) either non-immersive VR training (N=2) either computerized cognitive training (N=1). Two studies compared immersive with non-immersive rehabilitation training, in which immersive intervention was found to have greater improvement and significantly higher galvanic skin response, namely higher sense of presence. All three feasibility and one reliability studies conclude that VR is a safe, feasible, usable and engaging system for cognitive rehabilitation. Most of the studies did not include long-term impact of interventions on cognitive functions.

**Conclusions:** Even though there is limited data, immersive VR environments seem to be feasible and safe and to have a positive impact in cognitive functions in the dynamic process of rehabilitation. Further research is warranted in large-scale longitudinal clinical trials in various patients' groups to explore the different effects of immersive VR interventions. Larger sample sizes and more Randomized Control Trial designs should also be implemented.

**Keywords:** immersive, virtual reality, cognitive rehabilitation, safety, feasibility

This review has been conducted as part of the "REACT" ("Virtual Reality Medical Rehabilitation") project implemented by NKUA, NOUS VR Ltd and STRATIS Ltd in the framework of the RESEARCH-CREATE-INNOVATE Action and co-financed by European Regional Development Fund and national resources through the Operational Program Competitiveness, Entrepreneurship & Innovation.

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**Keywords:** activities of daily living, neuropsychological outcome

## **R. WEBER, N. MOTAMED YEGANEH, A. WALLACE, R. MCCLURE, A. BRIDGER, R. KING, S. PACEY-SMITH. Initial Outcomes of an Executive Functioning Coaching Intervention with Postsecondary Students.**

**Objective:** Executive functions (EFs) are a set of mental processes that direct and control goal-oriented cognitive, behavioral, and emotional functioning (Logue & Gould, 2014). Reviewed research indicates that students who have a unique cognitive profile that involves difficulties in EFs struggle with planning, problem-solving, organization, and time management. Therefore, EF is frequently a target of neuropsychologists for cognitive rehabilitation interventions. The executive functioning coaching intervention in this study combined Goal Management Training

(GMT; Levine et al., 2011), a didactic approach emphasizing meta-cognition and present-mindedness, with the Dynamic Coaching approach (Kennedy, 2017), which utilizes motivational interviewing, goal-setting, and strategy evaluation, to provide personalized cognitive remediation for university student with EF difficulties. The purpose of the present study is to evaluate the initial outcomes of this neuropsychological intervention with postsecondary students.

**Participants and Methods:** A total of 8 post-secondary students with self-reported executive difficulties consented to research data collection. The Behaviour Rating Inventory of Executive Functioning (BRIEF-A) was administered pre and post intervention. Intervention was provided for 10 weeks, with each week consisting of a group session and individual session, for a total of 20 sessions. The intervention was delivered by doctoral interns and supervised by a registered psychologist. BRIEF-A index and subscale scores were analyzed using paired samples *t*-tests.

**Results:** The paired samples *t*-test yielded indicated significant improvements on the Metacognitive Index ( $t(7) = 2.40, p < .05, d = .85$ ) and on the Task Monitoring Subscale ( $t(7) = 2.94, p < .05, d = 1.04$ ). All pre- and post-intervention mean comparisons indicated lower *T*-scores on BRIEF-A subscales and indexes following the intervention.

**Conclusions:** This initial outcome evaluation suggests positive results in intervention participants. Additional research is needed, with a smaller participant sample and control group, to further evaluate this interventions use with this population and in its current form. While GMT is an established EF intervention, Dynamic Coaching has not been sufficiently evaluated on its own, nor has the combination of these two approaches been empirically validated. In addition, the use of GMT with young adults in university is novel.

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**Keywords:** executive functions

### **K. L. GRIFFIN, Y. KOLAH, C. HOWARD, M. STEED. Cognitive Remediation Among Psychiatric Inpatients.**

**Objective:** The objective of this study was to evaluate the changes in cognitive functioning following a cognitive remediation (cog rem) curriculum combined with computer training in an in-patient setting. Extant literature indicates that cog rem is associated with improved cognitive functioning in schizophrenia, depressive disorder, bipolar disorders, and attention-deficit/hyperactivity disorder. Research also suggests that clinical stability and baseline performance on cognitive measures are associated with more improvement.

**Participants and Methods:** Participants included 20 inpatient adults. Eighty percent of participants were identified for psychosis-specific treatment. Patients participated in a 12-session cognitive remediation instruction (Compensatory Cognitive Training, Twamley, 2011) adapted for an inpatient psychiatric hospital setting and computer skills training (BrainHQ, Posit Science, 2020). Cognitive performance was assessed pre and post the 12-session curriculum using the Neuropsychological Assessment Battery-Screener Forms 1 and 2, respectively (NAB). Statistical analysis evaluated index scores in domains of attention, language, memory, and executive functioning.

**Results:** A Wilcoxon Signed-Ranks Test indicated Language performance post-intervention was significantly lower than performance pre-intervention ( $Z = 36, p = 0.002$ ). Index scores were not significantly different between pre/post performance in attention, memory, or executive functioning.

**Conclusions:** The decrease in language performance is consistent with literature which suggests that declines in language are expected in Schizophrenia. Given that 80% of our sample was part of the psychosis treatment track, it is possible that the decline in language functioning was typical. Additional research would benefit from comparing this treatment to a control group to evaluate if Cognitive Remediation slows language decline compared to psychiatric intervention alone.

The results of this study are inconsistent with some existing literature which suggests that cognitive remediation is associated with improvements in attention. However, our results are consistent with other studies which did not report positive results of cognitive remediation. One reason for the discrepancy in positive results for this study may be the small sample size. Additionally, other factors such as engagement and baseline performance moderate treatment outcomes. The results of this study contribute to the ongoing discussion regarding the utility of cognitive remediation in in-patient settings.

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**Keywords:** cognitive rehabilitation, psychosis, language

**S. LALL, M. L. TURMAN, S. JACOBS, T. BROWN, K. LYNCH, I. GOSNELL, H. A. BENDER, J. SPAT-LEMUS, A. SACKS-ZIMMERMAN. Cognitive and Psychiatric Sequelae of Mild to Moderate COVID-19 Infection: Treatment Implications for Integrated Cognitive Remediation (CR)/Cognitive Behavioral Treatment (CBT).**

**Objective:** Studies on previous coronaviruses have shown neuropsychiatric sequelae occur in a significant proportion of patients. While most studies have examined severe forms of COVID-19 (per CDC guidelines), the majority of COVID-19 cases are considered to be mild to moderate (approximately 80% CDC, September 2020). However, even non-severe forms of COVID-19 may lead to prolonged neuropsychiatric symptomatology, specifically the interplay of depression, anxiety, persistent fatigue and cognitive functions, that remains past the resolution of primary respiratory symptoms. Previous studies regarding psychological treatment of prolonged neuropsychiatric sequelae in disease processes with similar pathognomonic features to COVID-19 have been shown to be efficacious. Psychological treatment in these patient populations have utilized psychotherapy and cognitive remediation (CR) techniques as independent treatment modalities, yet an integrated approach (cognitive behavioral therapy (CBT) and CR) is necessary to simultaneously address cognitive and emotional symptomatology to facilitate return to optimal functioning. We review existing research to characterize the neuropsychiatric symptoms related to mild to moderate forms of COVID-19 and to describe the manifestations of these factors in three case studies, as well as the application of integrated CR and CBT strategies to facilitate return to vocational and daily activities.

**Participants and Methods:** Existing literature were reviewed, including research on neuropsychiatric sequelae of COVID-19 and related syndromes. Three clinical cases of mild to moderate COVID-19 disease, between the ages of 40 and 50, referred for neuropsychological treatment for persistent neuropsychiatric sequelae approximately 3 months post-COVID-19 diagnosis. Each patient underwent intake and reported self-perceived cognitive and emotional difficulties and related impact on occupational and adaptive functioning. The integrated CR and CBT techniques utilized with these three cases will be outlined.

**Results:** Consistent with the literature, these three cases presented with neuropsychiatric symptomatology including low mood, anxiety, fatigue and attention/working memory difficulties

that resulted in diminished functioning. Treatment of each case consisted of integrated CR/CBT where attention enhancing exercises were utilized to increase attentional capacity as well as awareness of impact of distraction on information processing. Additionally, CBT techniques of thought awareness and modification as well as behavioral activation were utilized to address impact of anxiety and low mood on functioning. Self-reported increase in occupational and adaptive functioning were described following 3 sessions of this integrated approach. Follow-up sessions will be implemented to support the maintenance of gains.

**Conclusions:** Taken together, evidence from the literature and clinical cases illustrates a matrix of prolonged neuropsychiatric sequelae that may occur after mild to moderate cases of COVID-19 infection. Clinicians should consider the impact of anxiety, depression, and medical stressors on the cognitive functioning of recovered COVID-19 patients with mild to moderate clinical courses of the disease. The interplay of emotion, fatigue and diminished attention/working memory associated with persistent diminished functioning in COVID-19 patients highlight the need for integrated CR/CBT psychotherapy. Given the likely growth in the number of patients with mild to moderate COVID-19 persistent neuropsychiatric sequelae, RCTs should be conducted to assess the efficacy of neuropsychological treatments in this population. This can facilitate establishment of practice guidelines for this population.

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**Keywords:** cognitive rehabilitation, infectious disease, neuropsychiatry

### **D. S. HAYDUKE, K. CODDAIRE, J. POWELL, T. VIRDEN. Outcomes of Neurocognitive Rehabilitation Targeting Working Memory Deficits Subsequent to Pediatric Sickle Cell Disease.**

**Objective:** Children diagnosed with Sickle Cell Disease (SCD) with and without subsequent infarct commonly experience neurocognitive deficits, specifically in memory and learning, among other areas. In turn, these neurological sequelae often negatively impact academic performance. The aim of the current study was to determine evidence of association between diagnosis of SCD in children and feasibility of cognitive neurorehabilitation programming addressing working memory deficits.

**Participants and Methods:** The current study conducted a systematic review and meta-analysis using data derived from four studies since 2007. A search was conducted on EBSCO Host, Wiley, and PsycArticles in June 2020, using the terms SCD, cognitive rehabilitation, working memory, efficacy, learning, neurocognitive, neurorehabilitation, and programming. Salient selection criteria included: standardized pre- and post-treatment measures, randomized groups, and data that permitted calculations of effect sizes. Data were obtained from 105 pediatric participants diagnosed with SCD who had completed cognitive neurorehabilitation programming targeting working memory deficits. Exclusion criteria included bias represented and incomplete data due to participant attrition. Higgins  $I^2$  with  $p < 0.05$  was taken to demonstrate heterogeneity. Because the current research involves particularly small study samples, Hedges'  $g$  was used to determine effect sizes.

**Results:** Postintervention, there was an overall significant effect favoring cognitive neurorehabilitation intervention for working memory performance (SMD = 0.279; 95% CI [0.082-0.477];  $p = 0.006$ ). This effect was of small magnitude but with substantial heterogeneity ( $I^2 = 47\%$ ), indicating cognitive neurorehabilitation was effective in improving working memory when comparing pre- and post-intervention scores. Noticeably, the effects of cognitive

rehabilitation on working memory and psychosocial functioning were significantly stronger in studies that provided adjunctive psychotherapy aimed at improving adherence than in those that provided cognitive neurorehabilitation alone.

**Conclusions:** The current study demonstrated a modest but clear association regarding the impact of cognitive neurorehabilitation on working memory for pediatric patients with SCD. One notable consideration involves the substantially small amount of studies available for review. However, these findings encourage future research to explore the use of neurocognitive treatment to improve patient quality of life, especially regarding the impact of SCD-related neurological sequelae on academic functioning. Due to focus on such a specific patient subset, future studies are essential to better meet the neurocognitive needs of this unique population.

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**Keywords:** sickle cell disease, pediatric neuropsychology, working memory

### **B. CRUZ-NARCISO, G. YÁÑEZ-TÉLLEZ, A. N. SEUBERT-RAVELO. Effectiveness of a Neuropsychological Intervention Program in Cognitive Improvement and Independence in Everyday Activities and Self-Care in a Patient Surviving Aneurysmal Subarachnoid Hemorrhage.**

**Objective:** Survivors of subarachnoid hemorrhage (SAH) due to ruptured anterior communicating artery aneurysm (ACoAA) may present cognitive sequelae, mainly in executive functions, attention and memory, as well as emotional and behavioral alterations that generate the affectation of the quality of life of the patient and family. This work aimed to test the efficacy of a neuropsychological intervention program (psychoeducation, cognitive rehabilitation and behavioral modification) for a surviving patient SAH aneurysm rupture.

**Participants and Methods:** We worked with a 36-year-old male patient, whose main symptoms were failures in attention, memory, and executive functioning, which had progressed towards greater deterioration between 3 and 8 months after SAH. He also showed problems to independently carry out self-care and daily life activities. An ABA design was used in which a neuropsychological battery and specific executive function tests were applied (verbal fluency, d2 test, SCWT, WSCT, TOL) as well as scales of functionality, quality of life, neuropsychiatric symptoms and overload (T-ADLQ, ECVI-38, INC and Zarit Scale). In phase A (evaluation), the aforementioned instruments were applied; In phase B (intervention), the cognitive area was worked with pencil and paper tasks and emotional and behavioral management through role playing and modeling, during 24 weekly sessions of 90 minutes each; In the second phase A (post-intervention evaluation), the same instruments were applied as in the first phase.

**Results:** a) The use of memorization strategies favored their immediate recall (RCI = 2.02), b) the use of strategies, the response latency and the time to solve a problem increased, but their effectiveness in the solution improved, c) began to independently carry out activities such as bathing, dressing, cooperating with household chores, leaving the house (RCI = -2.79), d) also expressing the initiative to carry out activities that could generate some economic remuneration and their quality of life were favored (RCI = -2.26).

**Conclusions:** The intervention program favored the independence of the patient in carrying out activities of daily living and self-care, as well as improvement in cognitive domains such as attention, memory and executive functioning. These findings contrast with what is reported in the literature on the natural evolution of the disease, where it is highlighted that these patients

remain with significant deficits throughout their lives, demonstrating that the intervention can very favorably change the prognosis of patients with sequelae of aneurysmal SAH.

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**Keywords:** cognitive rehabilitation, anterior communicating artery aneurysm, cerebrovascular disease

**M. E. MCLAREN, A. J. WOODS, A. O'SHEA, V. DOTSON. Functional Neural Correlates of Apathy and Anhedonia in Older Adults: A Pilot Study.**

**Objectives:** Apathy and anhedonia are common mood symptoms in older adults associated with multiple negative outcomes. Subcomponents of both symptoms have been proposed in the literature, including cognitive, behavioral and emotional apathy, and anticipatory and consummatory anhedonia. While both constructs appear to relate to dysfunction within the reward network, few studies have examined the functional neural correlates of the subcomponents of these affective symptoms in otherwise healthy older adults. This pilot study expands on the preexisting apathy and anhedonia literature by examining functional neural correlates of subcomponents of both apathy and anhedonia in healthy older adults. It was hypothesized that cognitive apathy and anticipatory anhedonia would both be associated with decreased BOLD signal in the anterior cingulate cortex, increased activity in thalamic regions, and altered activity in the nucleus accumbens and prefrontal regions during reward anticipation. It was further hypothesized that emotional apathy and consummatory anhedonia would be associated with decreased activity in the amygdala and altered activity in the ventral pallidum and nucleus accumbens during reward receipt.

**Participants and Methods:** Fifteen healthy older adults (age 60-80 years) completed the Apathy Evaluation Scale (AES) and the Temporal Experience of Pleasure Scale (TEPS) to assess apathy and anhedonia symptoms, respectively. Participants then underwent 3T functional magnetic resonance imaging while completing the Effort Expenditure for Reward Task (EEfRT), a reward-based decision-making task. Subcomponent scores for cognitive, behavioral and emotional apathy and anticipatory and consummatory anhedonia were calculated for each participant. fMRI data were preprocessed using CONN software and functional activity during reward anticipation and reward receipt portions of the EEfRT task were isolated. Separate multiple regression analyses were conducted examining whether apathy or anhedonia subscales were associated with brain activity during reward anticipation or reward receipt. An FDR correction at  $p = 0.05$  and cluster threshold of five voxels was used to decreased the likelihood of spurious findings.

**Results:** One subject was removed from analyses due to excessive movement. Contrary to the hypothesis, no subcomponents of apathy or anhedonia were associated with BOLD signal during reward anticipation. As hypothesized, emotional apathy was positively associated with BOLD response in multiple regions including portions of the bilateral pallidum, caudate head, and nucleus accumbens. Contrary to our hypothesis, emotional apathy was positively associated with BOLD response in portions of the right amygdala. Consummatory anhedonia was correlated with BOLD signal during reward receipt, though not in anticipated regions. Behavioral apathy was also correlated with BOLD signal, while anticipatory anhedonia and cognitive apathy were not.

**Conclusions:** Results suggest, in older adults, specific subcomponents of apathy and anhedonia may uniquely relate to BOLD signal during the receipt of a reward. This adds to existing

literature highlighting the importance of examining subcomponents of mood symptoms. Future research may benefit from exploring the association between specific apathy and anhedonia subcomponents.

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**Keywords:** neuroimaging: functional, apathy

**L. M. JENKINS, A. A. HEYWOOD, J. BAE, M. WESTLUND SCHREINER, R. SHEPARD, J. STANGE, A. LEOW, L. WANG, S. A. LANGENECKER. Cortical Thickness Associated with Past-Year Mood Episode in Major Depressive and Bipolar Disorders.**

**Objective:** Major depressive disorder (MDD) and bipolar disorder (BD) are distressing mood disorders with high lifetime prevalences (16.6 and 3.9% in the U.S.), and very high rates of recurrence that increase with each successive episode, even with optimal therapy. We sought to identify neuroimaging biomarkers of recurrence.

**Participants and Methods:** 30 young adults aged 19-38 (mean 26, SD= 5) with a lifetime diagnosis of MDD (n=21) or BD (n=9) underwent T1-weighted and T2-weighted structural MRI and completed the Hamilton Rating Scale for Depression (HAM-D) and Young Mania Rating Scale. Clinical diagnosis by trained raters was based on the SCID. Participants also completed the semi-structured Longitudinal Interval Follow-up Evaluation (LIFE) for the previous year. Participants were classified into the Past-Year Mood Episode (PYME) group (n=18, 10 MDD, 8 BD) if they met full criteria or initiated treatment for a major depressive or manic episode in the year prior to the MRI, or no-PYME group (n=12, 11 MDD, 1 BD) if they did not. Data were preprocessed using the Human Connectome Project's Pre/FreeSurfer/PostFreeSurfer Minimal Preprocessing Pipelines and `wb_command` tools. No smoothing was applied. Statistical maps were calculated using FSL's Permutation Analysis of Linear Models (PALM, n= 10,000), with  $p < .025$  (uncorrected).

**Results:** The PYME group scored higher on the HAM-D (mean=11.0, SD= 7.9) than the no-PYME group (mean=5.3, SD= 4.0),  $p = .014$ . A two-group unpaired t-test, covarying diagnosis, sex and age, compared cortical thickness between groups. The PYME group showed greater cortical thickness than the no-PYME group in the bilateral primary visual cortex, and left parahippocampal gyrus, paracentral lobule and posterior gyrus rectus ( $p = .025$ , uncorrected). The no-PYME group had greater thickness than the PYME group in the right supramarginal gyrus. Linear regressions of HAM-D score were calculated separately for each group, covarying diagnosis, sex and age. For the PYME group, greater HAM-D was associated with increased cortical thickness in the bilateral medial and ventromedial prefrontal cortex and left precuneus. Greater HAM-D was also associated with reduced cortical thickness in left lateral occipital cortex. In the no-PYME group, greater HAM-D score was associated with small areas of increased cortical thickness in the left paracentral lobule and decreased cortical thickness left posterior gyrus rectus and right dorsolateral prefrontal cortex, orbitofrontal cortex, anterior temporal lobe, and anterior insula.

**Conclusions:** The PYME group showed increased cortical thickness, particularly in primary visual cortices, compared to those who were episode-free during the prior year. Current depression severity in the PYME group was associated with increased cortical thickness in bilateral areas of the default mode network. In the no-PYME group, increased HAM-D showed far less extensive associations, including decreased cortical thickness in regions of the salience

and cognitive control networks. Increased cortical thickness could reflect compensatory inflammatory responses leading to astrocyte activation and hypertrophy, or other illness-related physiological hyperfunction, particularly in individuals in the early stage of illness. Our results suggest that cortical thickness of the default mode network may be a biomarker of recent mood episode

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**Keywords:** bipolar disorder, depression, neuroimaging: structural

**S. M. MCCLINTOCK, E. ERHARDT, Z. DENG, D. QUINN, A. GREGG, C. ABBOTT. A Possible New Assessment Method to Inform Acute Electroconvulsive Therapy Cognitive Adverse Effects in Older Adults with Major Depressive Disorder.**

**Objective:** Research has consistently demonstrated that electroconvulsive therapy (ECT) induces transient cognitive adverse effects that can persist for up to and beyond six-months. The United States Food and Drug Administration recommended that ECT clinical practice would benefit from including neurocognitive assessment. However, research is needed to inform how to efficiently assess neurocognitive function during the ECT course. The purpose of this study was to evaluate the utility and sensitivity of dot counting as an index of ECT-induced cognitive adverse effects.

**Participants and Methods:** 62 older adults (age:  $M=65.6$ ,  $SD=8.4$ ) diagnosed with major depressive disorder (MDD) were randomized in a double-masked study to one of three ECT pulse amplitude-titrated (600, 700, or 800mA) treatment conditions. Participants completed clinical and neuropsychological measures at baseline, mid-way through the ECT course, and at the end of the course. The primary neuropsychological measure for this analysis was the Dot Counting Test. Clinical and demographic variables were evaluated with chi-square or ANOVA models. Longitudinal unstructured repeated measures covariance matrix analyses were computed to assess pre-post changes on the Dot Counting Test variables.

**Results:** Across all participants, structured ( $p=0.99$ ) and unstructured ( $p=0.45$ ) dot counting time remained relatively stable from baseline to end. For the structured dot counting procedure, there were no significant effects ( $ps$  range from: 0.30 to 0.83) of amplitude condition. For the unstructured dot counting procedure, there were no significant differences from baseline to end in the 600 ( $p=0.89$ ) and 700mA ( $p=0.92$ ) conditions, but there was a trend for worsened performance in the 800mA condition ( $p=0.07$ ). Also, we computed a likelihood ratio test to compare the variability in responses of the structured and unstructured dot counting. The responses were explained by models without versus with progress variables that showed a significant relationship with progress ( $p$ -values = 0.0270 and 0.0363 for structured and unstructured)."

**Conclusions:** To our knowledge, this is the first study to examine the effects of ECT on Dot Counting Test performance. Overall, the study found that only the unstructured dot counting procedure may have some sensitivity to ECT associated cognitive adverse effects when it is administered at 800mA. Although typically used as a performance validity and effort measure, these results suggest the Dot Counting Test, particularly the unstructured dot counting, may have some utility to measure acute cognitive effects in ECT clinical practice. Further research in populations across the adult lifespan as well as different ECT conditions are warranted to determine its utility and sensitivity.

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**Keywords:** neurostimulation, test development, depression

**S. BOTTARI, D. LAMB, E. S. PORGES, A. MURPHY, A. TRAN, R. FERRI, M. JAFFEE, S. HARTMANN, M. BAUMERT, J. WILLIAMSON. Preliminary evidence of transcutaneous vagal nerve stimulation effects on sleep microstructure in veterans with PTSD.**

**Objective:** Subjective sleep disturbance is considered a hallmark feature of posttraumatic stress disorder (PTSD) and is associated with a wide range of negative sequelae. However, first-line treatments for PTSD often do not improve sleep problems. Transcutaneous vagal nerve stimulation (tVNS) is a non-invasive technique that impacts the central nervous system through stimulation of vagal afferents. tVNS may impact autonomic correlates of hyperarousal. Given that hyperarousal symptoms are associated with sleep disturbance in patients with PTSD, reducing hyperarousal symptoms may improve sleep quality. The current pilot study examined the effect of one hour of tVNS administered at “lights out” on sleep macro- and microstructure in veterans with PTSD.

**Participants and Methods:** Using a within-subjects crossover design, 12 participants aged 28-73 ( $M=44.6$ ,  $SD = 11.4$ ) completed two nights of sleep studies: one with active tVNS (administered at the tragus), and one with sham tVNS (administered at the earlobe). Polysomnography data was acquired using 14 EEG surface electrodes over 6 scalp locations. Spectral EEG analyses across 5 frequency bands and automated cyclic alternating pattern (CAP) analyses were conducted to characterize sleep stability.

**Results:** Paired t-tests showed a significant increase in sigma power during REM sleep on nights with active tVNS versus sham stimulation ( $t[9] = 2.94$ ,  $p = 0.02$ , Cohen’s  $d = 0.93$ ). Although non-significant, there was also a moderate effect size for an increase in other high frequency bands, including alpha ( $t[9] = 1.86$ ,  $p = 0.09$ , Cohen’s  $d = 0.587$ ) and beta ( $t[9] = 1.59$ ,  $p = 0.15$ , Cohen’s  $d = 0.502$ ). However, there was no significant effect on the low frequency delta band ( $t[9] = 1.46$ ,  $p = 0.18$ , Cohen’s  $d = 0.46$ ). With regard to NREM sleep, paired t-tests showed a significant reduction in overall CAP rate ( $t[11] = -2.24$ ,  $p = 0.046$ , Cohen’s  $d = 0.648$ ), particularly in the A1 index ( $t[11] = -2.57$ ,  $p = 0.03$ , Cohen’s  $d = 0.742$ ). There were no significant changes in sleep macrostructure.

**Conclusions:** In this pilot study, we found no significant effect of tVNS on sleep macrostructure; however, we did find some preliminary evidence for a potential positive effect of tVNS on sleep microstructure. Specifically, we found that tVNS increased high frequency band power during REM sleep, which could be beneficial given previous findings of a reduction in high frequency power during REM sleep in individuals with PTSD. Furthermore, we also found that tVNS improved NREM sleep stability, as indicated by the reduction in CAP rate, which has previously been shown to be associated with nightmare occurrence. It will be important to replicate these findings in a larger sample in the future and to investigate whether these changes in sleep microstructure translate to meaningful improvements in PTSD symptoms and quality of life.

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**Keywords:** post-traumatic stress disorder, sleep, neuromodulation

**K. SAGAR, M. K. DAHLGREN, R. T. SMITH, A. M. LAMBROS, C. EL-ABBOUD, S. A. GRUBER. Veterans Demonstrate Improved Performance on Measures of Executive Function Following Six Weeks of Treatment with A Cannabidiol Product.**

**Objective:** Reports indicate high rates of cannabis use among veterans, who often view cannabis as lower-risk or safer than other substances. Many veterans use cannabis specifically for medical purposes to address symptoms related to combat exposure or service-related conditions, including PTSD, anxiety, pain, depression, and sleep disturbance. However, there is a paucity of data examining the impact of medical cannabis (MC) use on cognition, particularly among veterans. Although a large body of research suggests that chronic, heavy *recreational* cannabis use is associated with cognitive decrements, particularly on measures of executive function, recreational users often exhibit distinct patterns of use from MC patients. These patterns are often dictated by different goals use; accordingly, many who use cannabis medically often choose products containing non-intoxicating cannabinoids, including cannabidiol (CBD), which is known for its therapeutic properties. Given these important distinctions and the potential therapeutic benefits that MC may offer to some veterans, it is imperative to directly assess the impact of MC use on cognition in this population.

**Participants and Methods:** As part of an observational, longitudinal study, veterans who chose to begin using a hemp-derived, high-CBD sublingual product were enrolled. The high-CBD product was provided at no cost from the product manufacturer (Charlotte's Web) as part of a veterans support program. Study participants were divided into two cohorts based on whether or not they were using other cannabinoid-based products at baseline. Prior to initiating use of the Charlotte's Web product, all participants completed a baseline study visit, and later returned after 6 weeks of daily use. At each visit, veterans completed a neurocognitive battery consisting of several frontal/executive measures, including the Trail Making Test, Stroop Color-Word Test, Digit Span, and the computerized Wisconsin Card Sorting Test (WCST).

**Results:** Following 6 weeks of daily high-CBD product use, veterans in both groups demonstrated improvements on the Trail Making Test, Stroop, and the WCST relative to baseline. Specifically, participants exhibited significantly faster times on Trails B as well as on the color naming and interference conditions of the Stroop. Significantly increased accuracy was also observed for these Stroop conditions. On the WCST, veterans demonstrated significantly more correct responses and fewer total errors following 6 weeks of CBD use. Digit Span performance remained stable, with no significant changes over time.

**Conclusions:** Overall, veterans demonstrated improved performance on measures of executive function following 6 weeks of use of a high-CBD product. These data provide an important contrast to previous studies of recreational cannabis users, which often report decrements on measures of executive function. Larger study samples will also facilitate comparison between veterans who were already using cannabinoids at baseline vs those who were not, and help clarify the potential interaction between therapeutic effects associated with MC use and observed changes in cognition. Future studies should assess whether varying types of MC regimens (high-CBD vs other cannabis products) produce distinct outcomes, examine whether patterns persist with larger study samples, and utilize clinical trial models to evaluate the efficacy of MC.

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**Keywords:** cannabis, executive functions

**N. E. MENDOZA ESTRADA , D. MOOK, L. SOTELO, J. RAZANI. Psychiatric Symptoms Impact Daily Functional Ability in Cognitively Impaired Individuals.**

**Objective:** The purpose of this study is to investigate psychiatric symptoms and symptom severity of cognitively impaired individuals as rated by their caregivers and functional ability of patients as observed on a performance-based task.

**Participants and Methods:** As part of a larger study, 39 patients diagnosed with dementia and cognitive impairment were administered the Direct Assessment of Functional Status (DAFS), a performance-based daily activities task designed to assess areas of orientation, communication, financial ability, transportation knowledge and shopping skills, administered to patients. The patients' next-of-kin caregivers were administered the Neuropsychiatric Inventory Questionnaire (NPI). Caregivers indicated whether the patient presented with symptoms of specific psychiatric illnesses and rated the severity of those illnesses. For the purposes of this study the NPI symptoms of delusions, apathy and agitation were assessed.

**Results:** Several One-way analysis of variances (ANOVAs) were conducted to compare the effect of the presence and severity of psychiatric symptoms reported by the caregiver on participant's DAFS observed performance. The results for NPI revealed that those with delusions performed worse than those without delusions on the DAFS total score,  $F(1, 36) = 3.97, p < .05$ , DAFS Financial,  $F(1, 36) = 6.59, p < .05$ , and DAFS Transportation,  $F(1, 36) = 3.85, p < .05$ . Results of NPI Apathy revealed that patients with apathy performed worse on DAFS total score,  $F(1, 36) = 7.57, p < .05$ , DAFS Financial,  $F(1, 36) = 17.67, p < .05$ , DAFS Transportation,  $F(1, 36) = 3.98, p < .05$ , relative to those without apathy. Finally, patients with NPI Agitation performed worse on DAFS total score than those without,  $F(1, 36) = 5.31, p < .05$ , DAFS Communication,  $F(1, 36) = 9.70, p < .05$  and DAFS Financial,  $F(1, 36) = 8.38, p < .05$ . In addition, Pearson correlations found associations between severity scores of NPI Agitation and DAFS total score,  $r(30) = -.405$ , Communication,  $r(36) = .461$ , and Financial,  $r(36) = .435$  ( $p$  values  $< .05$ ). Similarly, the severity of NPI Apathy correlated with DAFS total score,  $r(32) = -.451$ , Communication,  $r(36) = .448, p < .05$ , Financial,  $r(36) = .574$  and NPI Apathy on Transportation,  $r(36) = .316, (p$  values  $< .05)$ . Lastly, the severity of NPI Delusions correlated with DAFS total score,  $r(36) = .315$ , Financial,  $r(36) = .394$ , and Transportation,  $r(36) = .311, (p$  values  $< .05)$ .

**Discussion:** These results indicate that psychiatric symptoms are related to behavior disturbances and clearly affect functional ability. The NPI psychiatric symptoms selected for this study are consistent with disturbances observed in patients with frontal lobe and systems disorders. Thus, it is not surprising to find that functional tasks requiring executive functioning were disturbed in these groups in those with these psychiatric symptoms.

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**Keywords:** activities of daily living, aging disorders, executive functions

**J. KIDWAI, S. SHARMA, M. PEPPER, J. BRUMBERG. A Review of Novel Technology used in Aphasia Rehabilitation.**

**Purpose:** Recent advances in aphasia rehabilitation involve using technology adjuvant to speech-language therapy to aid recovery to pre-stroke language ability. The use of technology like high-tech augmentative and alternative communication (AAC) and non-invasive brain stimulation (NIBS) for individuals with aphasia (IWA) incorporate external devices to alter brain excitability for relearning language-based communication.

Research associated with suitability of high-tech AAC has shown ‘smart’ mobile devices to improve communicative outcomes. Individuals with aphasia (IWAs) in a controlled clinical environment can successfully navigate a speech generating device for conversing with their clinician and caregiver. High-tech AAC treatment has shown larger treatment effects and greater leftward lateralization of language during aphasia recovery. Language is leftward lateralized in healthy brains and post-morbid recruitment of right hemisphere homotopic areas leads to generally worse outcomes.

Similarly, non-invasive brain stimulation comprising of transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS) has been increasingly researched as a possible tool altering brain plasticity for improving communicative outcomes in aphasia. The TMS and tDCS placement is based on the site of lesion and targeted model of neuroplasticity in aphasia. Both TMS and tDCS have shown improvement in picture naming task outcomes with TMS improvements at both acute and chronic stages while tDCS thus far has been limited to chronic aphasia. The improved communicative outcomes with NIBS are maintained over varying periods of time post-treatment.

After several years of growth as a research tool, these novel technologies are gradually being accepted as clinical rehabilitative tools. In this systematic review, we will discuss the current state of knowledge, methods and the physiologic basis of using high-tech communication supports and NIBS for aphasia rehabilitation by identifying the a) methods of access and the model of neuroplasticity underlying aphasia recovery for rehabilitative technology, b) the transition of technology from acute to chronic stages of aphasia recovery, and c) the relation of the technological intervention with the outcome assessment measure.

**Method:** The review was initiated by a thorough search of the databases using the PICO framework. Selected studies were uploaded into CADIMA software where two reviewers independently screened titles and abstracts against inclusion and exclusion criteria. The database search identified 5042 studies that met the search terms and were reduced to 3611 after removal of duplicates. A total of 228 articles were included in the title/abstract review. Full texts of included articles were obtained and reviewed to determine eligibility and sort the studies in a customized data extraction table for answering the research questions. Following the review of 228 full text articles, 126 articles were identified for inclusion in the data extraction table.

**Results:** The methods of access for high-tech AAC largely leaned towards direct selection through keyboard or touch screen. The model of neuroplasticity for NIBS focused on recruitment of left perilesional areas for language recovery. The use of technology like high-tech AAC and NIBS was seen to be more prevalent in chronic stages of aphasia recovery. Neuropsychologically sensitive standardized test materials were generally used as outcome assessment measure for assessing efficiency of technological intervention.

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**Keywords:** aphasia, language, neurostimulation

**R. E. WONG, M. FLINT, J. POWELL, T. VIRDEN, M. MALEK-AHMADI. The Influence of Perceived Control, Depression, and Anxiety on Subjective Memory Complaints.**

**Objective:** Subjective memory complaints (SMCs) are complaints made by individuals without clear cognitive impairments on psychometric testing. Researchers have investigated the relationship between SMCs and Perceived Control (PC), which is the perception that one can

influence what happens in life. Currently, the relationship between PC and SMCs remains limited in older populations who report more SMCs and a lower sense of PC compared to younger populations. This study investigated the association between PC and SMC in a sample of individuals aged 85+. It was hypothesized that increased PC would be negatively associated with SMCs (i.e., fewer complaints). Additionally, this study examined the role of depression and anxiety in the relationship between PC and SMCs. It was hypothesized that there would be a significant indirect effect exerted by PC on SMCs by anxiety and depression.

**Participants and Methods:** The present study used archival data drawn from the Longevity Study: Learning from Our Elders, at Banner Sun Health Research Institute. Inclusions criteria included participants of the Longevity Study who were aged 85+, and who completed the following scales in the year of 2019: Everyday Cognition Scale, Perceived Control Index, Center for Epidemiological Study for Depression-10 Scale, and the Penn State Worry- Abbreviated Questionnaire ( $N= 108$ ). Individuals who obtained a score of  $<24$  on the Montreal-Cognitive Assessment were excluded, in order to eliminate those who had objective cognitive impairments.

**Results:** A bivariate Pearson Correlation found a significant negative correlation between PC and SMCs, ( $r= -.268, p= 0.005, r^2= .0718$ ), with 7.2% of the variance in SMCs explained by PC. A path analysis was subsequently conducted to determine the casual effects among the variables of depression, anxiety, PC, and SMCs. Results yielded a non-significant trend between PC and SMCs, ( $\beta=0.190, p= 0.053$ ), suggesting that PC may have influence on SMCs. Depression directly influenced PC, ( $\beta=0.304, p= 0.002$ ), as well as SMCs, ( $\beta = .216, p= 0.034$ ), but anxiety did not directly or indirectly influence PC, ( $\beta = -.049, p= 0.613$ ), or SMCs, ( $\beta = 0.070, p= 0.446$ ). Notably, this model explained approximately 10.3% of the variance of PC and 12.6% of the variance of SMCs.

**Conclusion:** Overall, this study found a significant correlation between PC and SMCs in individuals aged 85+. Findings also demonstrated that depression directly influenced PC and SMCs, such that individuals with higher levels of depression had a lower sense of PC and reported more SMCs. These results further suggested depression may indirectly influence SMCs through PC. In contrast, anxiety did not significantly influence PC or SMCs. Despite PC being a significant predictor of SMCs in younger populations, it appears it may not hold the same role in the oldest-old populations (i.e., 85+). However, it is possible that this study lacked robustness due to the homogeneity and small sample size. Future studies should continue to investigate the variables that influence SMCs, as this could guide research for early identification of memory changes in the rapidly growing older population.

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**Keywords:** memory complaints, depression, anxiety

### **G. VITALE, A. D. TAYLOR, K. A. LEHOCKEY. C-Log and O-Log Discrepancies in a Rehabilitation Sample.**

**Objective:** Inpatient rehabilitation hospitals often administer brief orientation assessments to determine whether patients are capable of further cognitive assessment. The literature supports this approach and has found that orientation scores are almost universally higher than other cognitive domains (e.g., memory, attention, visuospatial processing) in these settings, and are indeed a good “rough estimate” of whether further assessment is appropriate. Previous research has found cardiac rehabilitation patients score similarly to stroke rehabilitation patients on gross cognition with more subtle differences associated with stroke patients, such that stroke patients

score lower on executive functioning tasks. However, to date, there is no published research quantifying the gap between pure orientation and general cognitive functioning in the inpatient rehabilitation setting.

**Participants and Method:** Data were obtained from 169 adult inpatients ( $M_{\text{age}}=65.2$ , 63.3% male) at the MedStar National Rehabilitation Hospital (NRH). Inpatients were grouped by primary diagnosis on admission: 116 cardiac (68.6% of sample;  $M_{\text{age}}=64.8$ ) and 53 stroke (31.4% of sample;  $M_{\text{age}}=66.0$ ). Patients were administered the UAB Spain Rehabilitation Center Cognitive Log (C-Log) and Orientation Log (O-Log) within one week of their admission to NRH as part of their initial neuropsychological evaluation. Data were transformed to produce a mean difference factor for the groups ( $M_{\text{diff}} = M_{\text{O-Log}} - M_{\text{C-Log}}$ ).

**Results:** An independent samples t-test was run to compare the  $M_{\text{diff}}$  between the cardiac and stroke groups. The analysis found statistical significance ( $t[167]=2.6$ ,  $p=.009$ ) such that the  $M_{\text{diffSTROKE}}$  ( $M=6.9$ ,  $SD=3.1$ ) was markedly higher than the  $M_{\text{diffCARDIAC}}$  ( $M=5.6$ ,  $SD=3.2$ ). This difference was found to be statistically significant even though the groups were found to score statistically similar on the O-Log ( $t[167]=1.4$ ,  $p=.16$ ;  $M_{\text{O-LogCARDIAC}}=29.0$ ,  $M_{\text{O-LogSTROKE}}=28.68$ ). However, their performance on the C-Log, was statistically different ( $t[167]=2.7$ ,  $p=.008$ ;  $M_{\text{C-LogCARDIAC}}=23.5$ ,  $M_{\text{C-LogSTROKE}}=21.7$ ) such that cardiac patients scored higher.

**Conclusions:** The findings suggest the importance of further examining these populations beyond a measure of orientation. The data also suggest that if a stroke patient and cardiac patient were to score the same on the O-Log, one may expect the stroke patient's C-Log score to be about 1.3 points worse than the cardiac patient's C-Log score. The findings also suggests that on average, a cardiac patient might expect to score about 5.6 points less on the C-Log vs. the O-Log, and that a stroke patient might expect to score about 6.9 points less. Previous findings with this sample indicated that C-Log scores were trending towards statistical significance between these groups ( $p=.06$ ), and that executive functioning was the domain that showed more impairment in the stroke group vs. the cardiac group. With just a slightly larger sample size (11 more), the total C-Log score group comparison now shows significance. Further directions include investigating changes in scores over the course of the hospital stay.

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**Keywords:** cardiovascular disease, cognitive screening, stroke recovery

### **E. NOYES, C. SEAMAN , N. ALEXANDER, R. HOGIKYAN, A. ROCHETTE, L. MANDERINO, J. STELMOKAS. Relationship of MoCA and FIM Cognitive Subscale to Increased Level of Care Needs Following Post-Acute Care Rehabilitation.**

**Objective:** Cognitive function is a strong predictor of functional improvement in post-acute care (PAC) inpatient settings (Seematter-Bagnoud et al., 2013) and related to healthcare utilization and costs (e.g., discharge to higher level of care, length of stay, rehospitalizations; Seematter-Bagnoud, Martin, & Bula, 2012; Stelmokas et al., 2020). Mental status screens, like the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005), and functionally-derived cognitive measures such as the Functional Independence Measure-Cognitive Subscale (FIM-Cog; Hamilton et al., 1987) are commonly administered by Neuropsychology and Occupational Therapy services, respectively, to inform rehabilitation treatment needs. Despite high frequency of use of these measures in clinical practice, the extent to which these measures both independently and simultaneously predict level of care (LOC) needs remains unclear. The

current study explores the relationship between the FIM-Cog and MoCA upon PAC rehabilitation admission and the relative values in predicting LOC needs post-discharge.

**Participants and Methods:** Medical record review included older Veterans (>50 years) admitted to a Community Living Center (CLC) PAC unit. Participants were predominately male (94.9%) and white (87.9%). Common admission reasons included wound/antibiotic treatment (37.4%), cardio/pulmonary conditions (17.2%), and orthopedic conditions (14.1%). The MoCA was administered by Neuropsychology Service and the FIM-Cog was completed separately by Occupational Therapy Service during the first week of PAC admission. Increased LOC was defined as difference between discharge disposition and pre-admission living setting. Correlations between level of care, FIM-Cog, MoCA and demographic variables were examined. Logistic regression was used to examine the relationships between FIM-Cog, MoCA, and increased LOC while controlling for age.

**Results:** Of the total sample (N = 99), 24 participants (32%) required increased LOC. Age and education were associated with increased LOC. Bivariate correlations demonstrated that the FIM-Cog and MoCA were positively associated ( $r = .410$ ,  $p < .01$ ). The full logistic regression model containing all predictors (i.e., age, FIM-Cog, MoCA) was statistically significant,  $X^2(3, N = 99) = 8.513$ ,  $p < .05$ , indicating that the model distinguished between those who did and did not require a higher LOC. Results of the logistic regression demonstrated that only the MoCA made a unique statistically significant contribution to the model ( $B = -.144$ ,  $S.E. = .055$ , Odds Ratio = .866,  $p < .01$ ), indicating that for every point increase in the MoCA, there was a reduced likelihood of higher LOC. The FIM-Cog was not significantly associated with LOC ( $B = .023$ ,  $S.E. = .065$ ,  $p = .720$ ). **Conclusions:** Despite conceptual overlap and utility of the MoCA and FIM-Cog in PAC rehabilitation, results indicate that the MoCA uniquely contributes to predicting select rehabilitation outcomes (i.e., level of care needs) and highlight important differences between these measures. While the MoCA focuses primarily on cognition and involves little physical output, the FIM-Cog captures the impact of physical impairment on functional cognition as it relates to activities of daily living. Further investigation is warranted to explore how differences between commonly used cognitive measures (e.g., assessment method, construct validity, standardized scoring, psychometric properties) may contribute to relative utility in predicting PAC rehabilitation.

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**Keywords:** cognitive screening

**A. ROCHETTE, L. MANDERINO, R. SPENCER, A. SCIAKY, B. M. HAMPSTEAD, R. HOGIKYAN, N. ALEXANDER, J. STELMOKAS. Psychometric Evaluation of the Hopkins Rehabilitation Engagement Rating Scale in Older Veterans Admitted for Post-Acute Rehabilitation.**

**Objective:** Poor rehabilitative engagement is routinely encountered in clinical practice and is related to several adverse outcomes (e.g., longer hospital stay, reduced functional gain). The Hopkins Rehabilitation Engagement Rating Scale (HRERS) is a promising outcome tool that has been shown to demonstrate a unidimensional construct in acute settings; however, the HRERS has yet to be evaluated in post-acute care (PAC) settings and has only been examined cross-sectionally at time of discharge. Adapting the scale for use throughout the rehabilitation stay could help to inform interventions. The aim of the current study was to extend previous work by assessing internal consistency, confirming a unidimensional factor structure in a PAC setting,

and examining temporal stability with a test-retest design to detect change over time in PAC rehabilitation. We hypothesized that the HRERS would have adequate internal consistency and temporal stability and present a unidimensional construct of engagement.

**Participants and Methods:** Retrospective medical chart review was completed for patients with two HRERS administrations (at CLC-PAC admission and at 30-day follow-up or discharge) between 2016-2017. Key demographic, medical, functional, and outcome data were extracted. Individuals were included if they were age 50 or older with specific rehabilitation goals upon admission and excluded for PAC stay less than 7 days or for conditions (e.g., delirium, motor impairment) that precluded engagement in PT services. The HRERS was completed by a physical therapist and/or assistant. A total of 107 individuals met study criteria ( $M_{age}=70.7$ , 98.1% male, 86.9% Caucasian, 65.4% retired).

**Results:** *Factor Analysis:* Factor analysis of the HRERS at baseline revealed a single factor structure accounting for 52.4% of the variance (Chronbach's  $\alpha=0.76$ ). Item-total correlations for individual items ranged from 0.57 to 0.85 (Median=0.73) and corrected item-total correlations ranged from 0.35 to 0.74 (Median=0.56), with item 5 obtaining the highest values. A second factor analysis of the HRERS at time 2 also revealed a single factor structure accounting for 67.7% of the variance (Chronbach's  $\alpha=0.88$ ). Item-total correlations ranged from 0.73 to 0.87 (Median=0.80) and corrected item-total correlations ranged from 0.51 to 0.83 (Median=0.73), with item 3 obtaining the highest values. *Temporal Stability:* Wilcoxon Signed Ranks Test revealed significantly higher total scale scores at time 2 (Median=26) compared to time 1 (Median=24;  $z=-2.23$ ,  $p<0.05$ ), with a small effect size ( $r=0.22$ ). Items 2 ( $z=-2.22$ ,  $p<0.05$ ) and 4 ( $z=-2.97$ ,  $p<0.01$ ) were also significantly higher at time 2 compared to time 1. Total scores across time points correlated at  $r_s = 0.55$  ( $p<0.001$ ), with individual items correlated between 0.36 and 0.51.

**Discussion:** These findings extend the utility of the HRERS to an older Veteran sample within PAC rehabilitation and across multiple time-points. Higher consistency and item convergence at follow-up could suggest that patient familiarity could influence ratings and are consistent with the dynamic nature of engagement noted over time. Changes in scores may also be influenced by resolving factors, such as medical acuity or pain.

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**Keywords:** psychometrics, assessment

**M. KOHLI, A. FISHER, N. SUN-SUSLOW, A. HEATON, M. DAWSON, D. R. FRANKLIN, J. E. IUDICELLO, R. K. HEATON, D. J. MOORE. Evidence of the Feasibility of Video-Based Neuropsychological Evaluations Among Persons With and Without HIV.**

**Objective:** The use of telehealth to provide remote health care services is rapidly growing especially during the COVID-19 pandemic. Available evidence suggests that video-based neuropsychological assessments (VBA) are feasible compared to traditional in-person assessments (IPA); however, we are unaware of any study that has examined the reliability of VBA among persons with HIV (PWH). Considering PWH can be immunosuppressed and may be at-risk for contracting COVID-19, the aim of the current investigation is to determine the reliability and feasibility of remotely-administered VBA compared to IPA among PWH.

**Participants and Methods:** In our first 40 participants assessed with VBA during the COVID-19 pandemic (March-June 2020), 30 of whom were PWH ( $M_{age}=59.7$ ,  $SD_{age}=10.7$ ) and 10

( $M_{age}=69.7$ ,  $SD_{age}=14.2$ ) were HIV- adults. Participants completed two comprehensive neuropsychological IPA at the HIV Neurobehavioral Research Program at the University of California, San Diego (time between IPA1 and IPA2:  $Mdn = 375$ ,  $IQR = [229-526]$ ) prior to one VBA (time between IPA2 and VBA:  $Mdn = 361$ ,  $IQR = [214-421]$ ) during the COVID-19 pandemic. Neuropsychological assessments included in analyses were: Hopkins Verbal Learning Test-Revised (HVLT-R), Controlled Oral Word Fluency Test (COWAT) FAS, Wechsler Adult Intelligence Scale 3<sup>rd</sup> Edition (WAIS-III) Symbol Search and Letter Number Sequencing, Stroop Color and Word Test, Paced Auditory Serial Addition Test (Channel 1), and Boston Naming Test. Total raw scores and sub-scores for each assessment were used in analyses. Spearman's rho correlations and paired  $t$ -tests were used to assess test-retest reliability and performance-level differences between 1) the two consecutive IPA (i.e., IPA1 and IPA2), and 2) IPA2 and remote VBA.

**Results:** Results indicate moderate to strong test-retest correlations between the IPA1 and IPA2 evaluations ( $\sigma = 0.66-0.93$ ,  $ps < .05$ ), and between IPA2 and remote VBA ( $\sigma = 0.72-0.95$ ,  $ps < .05$ ). Furthermore, performance levels on 12 of the 14 neuropsychological tests and sub-tests were comparable across test visits regardless of administration format. There were significant mean differences in raw scores between the two IPA on the Stroop Color Test (IPA1 = 61.9 seconds, IPA2 = 59.0 seconds;  $t(39) = -2.8$ ,  $p = .007$ ), such that participants had higher scores on IPA1 compared to IPA2. Results show significant mean differences in raw scores between the IPA2 and remote VBA only on the HVLT-R Total Recall (IPA2 visit = 22.2 words, VBA visit = 20.6 words,  $t(39) = -2.2$ ,  $p = .036$ ) such that participants had lower scores on the HVLT-R VBA.

**Conclusions:** Among our sample of persons with and without HIV, we provided evidence of test-retest reliability and performance-level comparability of our IPA and those administered in the VBA format. Considering the current COVID-19 pandemic, there is an immediate need for reliable neuropsychological assessments that can be administered remotely especially for PWH. Video-based neuropsychological evaluation shows promise as a way to improve access to neuropsychological services in vulnerable populations and amidst the COVID-19 pandemic, and to maintain consistent neuropsychological test batteries in ongoing research studies.

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**Keywords:** neuropsychological assessment, HIV/AIDS, test reliability

**L. MANDERINO, A. ROCHETTE, R. SPENCER, A. SCI AKY, B. M. HAMPSTEAD, R. HOGIKYAN, N. ALEXANDER, J. STELMOKAS. Validating the Hopkins Rehabilitation Engagement Rating Scale in an Older Veteran Post-Acute Rehabilitation Sample.**

**Objective:** Poor rehabilitative engagement is routinely encountered and related to several undesirable outcomes (e.g., increased length of stay, reduced functional gain). The Hopkins Rehabilitation Engagement Rating Scale (HRERS) is a measure of engagement that can be utilized by physical therapists but has yet to be evaluated in post-acute care (PAC) rehabilitation. We examined the validity of the HRERS in a sample of older adult PAC veterans and correlations to key behavioral health variables (i.e., pain, depression, cognitive impairment) and outcomes (e.g., PT attendance, medical complexity, length of stay).

**Participants and Methods:** Retrospective medical review of consecutive admissions between 2016-2017 of key demographic, medical (mental status screening, subjective report of pain, depressive symptoms), functional and outcome data. The HRERS was completed by a physical therapists and/or assistants at one week of admission (Time 1) and 30-day follow-up (Time 2).

**Results:** With regards to construct validity, increased pain ( $r=-.309$ ,  $p=.005$ ) and depression ( $-.287$ ,  $p=.006$ ) at admission correlate with Time 2 but not Time 1 HRERS scores, such that higher pain and greater depressive symptoms upon admission correlated with poorer engagement at follow-up. HRERS total score at Time 1 correlated with transfers to a bed/chair or commode ( $r=.29$ ,  $p<.01$ ), and there were no significant relationships with rehabilitative effectiveness. Regarding criterion validity, HRERS Time 1 Total correlated with number of PAC consults ( $r=.44$ ;  $p<0.001$ ). HRERS PT attendance correlated with percentage of missed PT sessions at Time 1 (Q1  $r=-.399$ ,  $p<.001$ ) and Time 2 (Q1  $r=-.547$ ,  $p<.001$ ), and overall HRERS score at Time 2 was statistically different across high(1), medium(2), and low (3) physical therapy attendance groups ( $\chi^2(2, 107)=18.522$ ,  $p<.01$ , with those in Group 3 recording a lower median Total HRERS (Md=24) compared to Group 1 (Md=28) and Group 2 (Md=27).

**Conclusions:** Administration of HRERS throughout rehabilitation stay appears to provide valid assessment of PAC physical therapy engagement and correlates with select criteria of medical complexity and physical therapy attendance. HRERS scores at Time 2 appeared to be more indicative of engagement, which may be explained by acute medical factors taking precedence and interfering with rehabilitation activities upon admission. As we would not expect behavioral health intervention to improve such factors, referral for behavioral health intervention for low

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**Keywords:** psychometrics, test validity

#### **D. M. WHITESIDE, V. OLEYNICK, E. HOLKER, E. WALDRON, J. PORTER, M. KASPRZAK. Neuropsychological Deficits in Three Patients with COVID-19 Infection in Post-Acute Physical Rehabilitation: A Case Series.**

**Objective:** Recently, much attention has focused on the widespread severe acute respiratory syndrome coronavirus 2 (SARS-Cov2 or COVID-19), which is a new coronavirus that causes a variety of symptoms ranging up to life threatening multiple organ complications. There is increasing literature to support that COVID-19 in some patients causes neurological issues (Fotuhi et al., 2020) including anosmia, seizures, stroke, confusion, encephalopathy, and paralysis (Mao et al., 2020) and psychiatric conditions such as depression, obsessive compulsive disorder, and psychosis (Nath, 2020). Recent research indicates increased frequency of delirium in severe COVID-19 infections (McLoughlin et al., 2020). However, no neuropsychological studies investing the short term and long-term neurocognitive deficits associated with COVID-19 have been completed.

**Participants and Methods:** This study begins to address this gap by studying 3 English speaking COVID-19 positive inpatients with severe symptoms, intubation, and long term intensive care unit (ICU) treatment who were subsequently transferred to an acute physical rehabilitation unit. The inpatients were referred for telehealth neuropsychological evaluation by the attending psychiatrist to evaluate their cognitive deficits and make recommendations for treatment and discharge planning. Per records, all patients had a premorbid history of hypertension and hyperlipidemia and experienced severe COVID-19 symptoms with prolonged ventilator treatment, no recall of their acute hospitalization, delirium, and hypoxemia. Patient 1 is

a 62 year old male with 15 years of education with additional premorbid history of obstructive sleep apnea and type 2 diabetes with hospital course complicated by acute kidney injury. Patient 2 is a 73 year old female with 12 years of education with an additional premorbid medical history for alcohol use disorder and Guillain-Barre syndrome whose hospital course was complicated by a urinary tract infection. Finally, patient 3 is a 75 year old male with 14 years of education and no other premorbid medical history. None of the patients had a premorbid psychiatric history and all the patients were in long-term marriages with strong social support systems.

**Results:** The 3 patients all demonstrated similar deficits on formal neuropsychological testing, the most noteworthy being deficits in encoding of new verbal information and verbal fluency. Interestingly, encoding improved for each patient on a more structured story memory task compared to a less-structured verbal list learning task, suggesting executive dysfunction impacted learning. None of the patients demonstrated rapid forgetting of previously learned information. Patient 1 demonstrated the most significant attention deficits and had an unusual impairment in vocabulary which was likely a decline compared to premorbid estimated levels. Patients 1 and 2 also endorsed new onset of significant depressive and/or anxiety symptoms.

**Conclusions:** The results suggest evidence for neurocognitive deficits after severe COVID-19 infection, particularly in encoding, verbal fluency and some aspects of executive functioning but no evidence for stroke. The specific mechanism that caused these cognitive deficits in these individuals remains unclear. Directions for further research on cognitive functioning in COVID-19 patient includes careful systematic study of all domains in diverse populations, but particular emphasis on memory and executive functioning is suggested by this case series.

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**Keywords:** cognitive functioning, infectious disease

### **J. PASSLER, A. ARENIVAS, L. HARIK. Neuropsychological Functioning Post-COVID-19 Recovery in Acute Inpatient Rehabilitation: A Case Series.**

**Objective:** To report the case history, treatment and recovery course, and neuropsychological test findings for six adults admitted to acute inpatient rehabilitation to address functional decline following COVID-19 infection.

**Participants and Methods:** Retrospective chart review was conducted as approved by the site's Institutional Review Board to identify patients admitted to the area inpatient rehabilitation network between March and July 2020 with acute hospital admissions due to COVID-19 infection. Eighteen patients were identified with six having received brief neuropsychological assessment, the latter group being the focus of this report. While not all patients completed the same brief screening battery, there was overlap between measures used and domains including attention, processing speed, executive functioning, language, visuospatial skills, memory, and mood were objectively assessed across all patients. Results for all cognitive measures are reported as standard scores and percentiles; mood questionnaires are reported as raw scores.

**Results:** Processing speed deficits were the most pronounced, evidenced in five of six patients and ranging from 1 to 2 standard deviations below respective normative sample means. Two patients demonstrated deficits in processing speed only, three patients demonstrated processing speed deficits alongside attention/working memory, visuo-construction, verbal fluency, learning (which impacted recall), and executive functioning deficits, and one patient demonstrated performance largely within premorbid expectation. Motor functioning was not formally assessed

but all patients had some level of generalized weakness, neuropathy, and/or myopathy. None of the six patients in this case series endorsed significant symptoms of depression or anxiety, though two patients reported adjustment difficulties as related to functional changes and social isolation. It is important to note that the patients in this case series are not representative of all post-COVID-19 presentations. For example, three of the eighteen patients identified for this report experienced one or more cerebrovascular accidents (CVA) secondary to COVID-19 resulting in significant functional impairment (e.g., global aphasia; profound debility).

**Conclusions:** Processing speed, visuo-construction, and verbal fluency deficits are consistent with post-intensive care syndrome (PICS). Risk factors for PICS associated cognitive impairment included duration of delirium in intensive care, acute brain dysfunction, acute respiratory distress syndrome/hypoxia, hypotension, glucose dysregulation, respiratory failure requiring prolonged mechanical ventilation, use of renal replacement therapy, sepsis, and premorbid factors (i.e., older age, prior cognitive impairment, premorbid health conditions). Duration of delirium may be especially important when considering long-term cognitive consequences.

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**Keywords:** assessment, cognitive functioning, treatment outcome

### **J. C. WERTHEIMER, A. L. WONG, P. ROBERTS. Identification of Functional Limitations and Discharge Destination in COVID-19 Patients.**

**Objective:** The objectives of this study were to identify functional limitations in COVID-19 patients admitted to an acute care hospital, to evaluate functional limitations by demographic, medical and encounter characteristics, and to examine functional limitations (physical, cognitive, psychological, and sensory) in relation to discharge destination.

**Participants and Methods:** This is a cross sectional, retrospective study of adult patients with COVID-19 who were discharged from two different types of hospitals (academic medical center and a community hospital) within one healthcare system between January 1 and April 30, 2020. Patients were identified from the Cedars-Sinai COVID-19 data registry who had a new onset positive test for SARS-CoV-2. A total of 273 cases were identified, which included 230 cases that were discharged alive and 43 patients who expired and were excluded from the study sample.

**Results:** In a propensity-score matched cohort based on age and comorbidity, 88.2% had functional physical health deficits, 72.5% had functional neuropsychological health deficits, and 17.6% experienced sensory deficits. In the matched cohort, individuals discharged to an institution experienced greater physical (62.7% vs. 25.5%,  $p < .001$ ) and cognitive and psychological health (49.0% vs. 23.5%,  $p = .006$ ) deficits than patients who were discharged home. Marital status (married/domestic partner versus single/divorced/widowed; OR 3.17, 95% CI: need,  $p = .011$ ) and physical function deficits (OR 3.63, 95% CI: need,  $p = 0.025$ ) were associated with an increase odds ratio of discharge to an institution.

**Conclusions:** This research highlights that physical health and neuropsychological status are strong predictors for discharge destination to an institution for COVID-19 patients. Patients who were older, in the acute care hospital longer and with comorbidities were more like to be discharged to an institution. Rehabilitation is a significant aspect of the healthcare system for these vulnerable patients. The challenges of adjusting the role of neuropsychologists and systems during the pandemic needs further exploration. Moreover, additional research is needed

to look more closely at the many facets and timing of cognitive and psychological needs, to shed light in utilization of neuropsychological and rehabilitation services, and to guide providers and healthcare systems in facilitating optimal recovery and patient outcomes.

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**Keywords:** infectious disease, medical disorders/illness

**A. Z. CHESTER, P. LUNIA, E. GRACIAN , S. FLOOD , X. E. CAGIGAS. Preserved Bilingual Language Functioning and Decline in Visuospatial Reasoning and Memory in Persistent Dissociative Amnesia: A Bilingual Case Study .**

**Objective:** Dissociative amnesia (DA) is characterized by retrograde memory loss in the absence of detectable structural brain damage (Bidzan, 2017; Tramoni et al., 2009). The mechanism is unknown, but researchers postulate that stress hormones are released during traumatic events, and excessive secretion can lead to complex hyperarousal that disturbs frontal-limbic-subcortical networks and produces amnesia by obstructing or misdirecting access to memory networks (Bidzan, 2017). Neuropsychological weaknesses in visual reasoning and visual memory have been reported in patients with persistent DA and this pattern of performance has been linked to hypometabolism in the right temporo-mesial region as measured by FDG-PET (Hennig-Fast et al., 2008). Notably, Glisky and colleagues (2004) reported that a native German, bilingual patient (English/German) with DA had to relearn his native German language. For our work, we obtained two neuropsychological time points that occurred before and after DA onset which provided a unique opportunity to compare persistent effects to a premorbid baseline. Importantly, to our knowledge, this is the first reported bilingual, English-and-Spanish-speaking case of persistent DA with preserved language functioning.

**Participants and Methods:** FY is a 38-year-old, right-handed, bilingual (Spanish and English), Hispanic male with a history of DA beginning in 2018 after a breakthrough session of cognitive processing therapy. He also has a past medical history of PTSD, TBI, migraine headaches, generalized anxiety disorder, hypertension, sleep apnea, and completed a brief neuropsychological screener in 2018 before he was diagnosed with DA that will be used as a baseline comparison. An EEG from 2019 was reportedly normal, and an MRI from 7/26/2018 revealed several small foci of FLAIR hyperintensity in the cerebral white matter are nonspecific that may be related to his history of chronic migraine headaches. FY completed a full standardized neuropsychological battery and results were compared to his findings from 2018.

**Results:** FY evidenced a frontal-subcortical neuropsychological pattern of wavering attention and information processing speed that is stable from 2018. Significantly, his neurocognitive profile lateralized to the dominant hemisphere as evidenced by his stable, well-preserved language functioning and significant decline in visuospatial reasoning and visual memory since the 2018 evaluation. Verbal memory also evidenced executive inefficiencies and a subtle decline since 2018 which is consistent with his medical history of cardiovascular risk factors and PTSD.

**Conclusions:** FY's neurocognitive findings are consistent with the neurocognitive theory of DA. Specifically, his visuospatial reasoning and memory abilities declined since 2018, which is consistent with the existing literature on DA, and has been related to hypometabolism in the right fronto-parietal networks. His language functioning is well-preserved possibly because he is typically organized with verbal abilities represented in the left hemisphere. Thus, our neuropsychological findings add convergent evidence to the literature that right hemispheric weaknesses are probable in persistent DA.

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**Keywords:** amnesia, bilingualism, post-traumatic stress disorder

### **J. KOAY, A. VAN METER. The Effect of Emotion Regulation on Executive Function.**

**Objective:** Both emotion regulation (ER) and executive function (EF) utilize the prefrontal cortex network (Deveney & Pizzagalli, 2008) and some EF processes – set-shifting, response inhibition, and working memory – are implicated in ER (Schmeichel & Tang; 2015). For instance, higher working memory capacity is associated with more effective application of ER strategies (Hendricks & Buchanan, 2016). Conversely, there is also evidence that ER influences an individual's EF. Specifically, maladaptive ER has been linked to impaired EF while adaptive ER is associated with enhanced EF (D'Avanzato et al., 2013; Gross, 2002). Although an association between ER and EF clearly exists, most studies have employed a correlational approach preventing inferences about the specific direction of the relationship.

We aim to address this gap by measuring how engaging in ER impacts EF performance; healthy adult participants completed a computer-based EF task both in a control condition and while engaging in a series of ER conditions. We hypothesized that participants would have the best EF performance when engaging in a relatively easy ER task (maintaining positive mood) and that EF performance would decline with increased ER burden (reducing negative mood, maintaining negative mood).

**Participants and Methods:** Participants ( $N=31$ , mean age=31.3, 43% female) were recruited and screened out if they met criteria for current substance use or other psychiatric disorder. Eligible participants completed a computerized task-switching test (CTST; Stoet et al., 2013). Following a baseline trial to establish typical performance, they completed the CTST under three randomized ER conditions: Positive Mood Maintain (PMM), Negative Mood Reduce (NMR), Negative Mood Maintain (NMM). In each ER condition, mood was induced with a short video after which participants were given an ER goal (maintain or reduce). CTST performance was evaluated with set-shifting response time (RT), set-shifting error rate (ErR), inhibition RT, and inhibition ErR.

**Results:** Negative mood inductions were successful in both NMR ( $t=-6.89, p<.001$ ) and NMM ( $t=-6.08, p<.001$ ). The positive mood induction reduced negative mood ( $t(20)=2.38, p=.027$ ), but did not increase positive mood. Set-shifting RT was faster in both PMM ( $B=-62.38, p=.028$ ) and NMR ( $B=-66.56, p=.02$ ) relative to baseline. Set-shifting ErR was lower across conditions relative to baseline (PMM [ $B=-4.01, p=.004$ ], NMR [ $B=-2.85, p=.037$ ], NMM [ $B=-2.96, p=.032$ ]). Inhibition RT and inhibition ErR were equivalent across all conditions.

**Conclusions:** Our results indicate that engaging in ER influences EF performance. Relative to baseline, participants demonstrated *better* set-shifting performance across mood conditions, suggesting that performance improved with repeated trials. In contrast, inhibition did not improve. This suggests that inhibitory control may have been more heavily recruited during ER process, resulting in a decrement in performance, whereas set-shifting remained intact. Consistent with Process Model of Emotion, in which different regulatory processes are recruited at different points, inhibitory control might play a larger role in ER when participants try to *control* their emotions, whereas set-shifting may be employed primarily when they *generate* emotions in response to the mood-induction videos. Future experiments to study ER and EF should investigate how mood valence, specific ER strategies, and the nature of the EF task impact the association between these two processes.

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**Keywords:** emotional processes, executive functions, cognitive processing

**E. ESPINAL, A. MISHRA, A. MEHTA, S. BICKEL. Electrical Stimulation in Lateral Orbitofrontal Cortex Evokes Retrieval of Complex Memories.**

**Objective:** Used clinically to map brain areas involved with motor, language, and sensory processing, electrical brain stimulation (EBS) occasionally provides unexpected insight into more elusive, involute cognitive processes (i.e., memory). Evocation of complex memories is among the rarest reported phenomena resulting from EBS. In the current study we explore two rare cases of EBS evoked complex memory reactivation at orbitofrontal cortex (OFC) sites. We provide detailed patient accounts, anatomical reconstruction, evidence for the role of OFC in memory, and the first evidence of potential biomarkers (sharp wave ripples) of episodic memory network activation and retrieval through analysis of intracranial electroencephalography (iEEG) data following EBS evoked complex memory retrieval.

**Participants and Methods:** We delivered high-frequency bursts (50Hz, bi-phasic, 0.2msec/phase, square-wave pulses) up to 2 seconds, at amplitudes between 2-5mA, through depth electrodes implanted in the lateral OFC and neighboring white matter. Patients were asked to report their subjective experiences. The anatomical locations of electrodes were determined using post-op CT and MRI and coordinates co-registered to the preimplantation MRI. We performed an additional hippocampal segmentation using Freesurfer to identify electrodes in the CA1 and subiculum subfields used for sharp wave ripple (SWR) analysis. Due to technical limitations during recording, we were unable to analyze neural data for patient 1. We split iEEG data from the EBS session into 3 conditions for SWR analysis: experimental stimulation (patient reported evoked memory), control stimulation (no reported evoked memory), and resting (no stimulation applied). We bandpass filtered local field potential data to the ripple band (70-180Hz), then selected SWR events exceeding 3 standard deviations from the average signal between 20 and 250ms. We computed SWR rate for all conditions using a rolling average spanning .1-5sec post-stimulation.

**Results:** Following stimulation of the OFC, both patients repeatedly reported complex memories from childhood and early adulthood. Repeated stimulation at these sites evoked consistent memory content across trials. Neither sham nor extra-OFC site stimulation evoked recall. For patient 2, a total of n=261 SWR were identified across trials. In the experimental stimulation condition SWR rate was significantly higher than in the control stimulation and rest conditions ( $p = 0.011$ ) at the 1-3sec bin post-stimulation.

**Conclusions:** Bipolar EBS of the left lateral OFC evoked reliable retrieval of complex memories across two patients. This is a deviation from previous reports of EBS-induced memory reactivation mainly localizing to temporal lobe sites. An associated increase in SWR rate just prior to patient 2's memory reports indicate an involvement of the hippocampus in this process. Interestingly, this occurred in a partially resected hippocampus, providing evidence for typical function despite an anterior lesion. Finally, these novel findings strongly support the idea that memory processes involve highly connected, widespread networks.

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**Keywords:** memory: normal, electroencephalography, neurostimulation

**E. ANTEBI-LERMAN, A. RAHMAN-FILIPAK, T. TYSKOWSKI, A. D. IORDAN, B. GIORDANI, B. M. HAMPSTEAD. Caudate and Hippocampal Contributions to Spatial Navigation.**

**Objective:** Prior work suggests 1) the hippocampus and caudate mediate allocentric and egocentric spatial navigation, respectively, 2) there is an age-related shift from allocentric to egocentric with healthy aging, 3) there is an age related decline in hippocampal volume but relative stability of the caudate with healthy aging; an effect exacerbated in those with mild cognitive impairment (MCI). However, little is known about the effects of MCI on spatial navigation. Here, we tested these structure-function relationships in a mixed sample of cognitively unimpaired (CU) older adults and those with mild cognitive impairment (MCI).

**Participants and Methods:** Thirty-nine older adults (age  $71.4 \pm 6.7$  years;  $n=20$  CU,  $n=19$  MCI) viewed both allocentric and egocentric navigation videos while undergoing functional MRI. During the allocentric videos, participants traveled through three distinct environments (e.g., apartment, English garden) and were instructed to remember the spatial relationships between encountered landmarks in order to create a mental map. Memory was later evaluated using two methods. First, participants completed a touchscreen cued recall task where they saw a specific landmark and then touched the monitor where they believed the target landmark was located relative to a given cue. The primary outcome was the distance between the observed and actual location of that landmark (i.e., error score where higher values reflect worse performance). Second, participants completed a standard recognition task where they selected the location of the target landmark from among three options. Egocentric videos provided the perspective of moving through a contiguous series of “T” mazes and participants were instructed to remember the sequence of left and right turns. Memory assessment used a recognition format that required participants to select either a left or a right turn, in order, at each intersection of the given maze. Hippocampal and caudate volumes were calculated via automated analysis of T1 MRI scans using NeuroQuant.

**Results:** Consistent with other neuropsychological data, the CU group performed significantly better than those with MCI on both allocentric and egocentric recognition tasks ( $p \leq .023$ ). However, the groups were not significantly different on the allocentric cued recall task ( $p = .29$ ). Partial correlations (controlling for age and sex) revealed comparatively stronger relationships between hippocampal volume and recognition tasks (allocentric  $r = .205$ , egocentric  $r = .382$ ) versus allocentric cued recall error ( $r = -.13$ ). Conversely, caudate volume was more strongly associated with allocentric cued recall error ( $r = .283$ ; i.e., a larger caudate = more error) than allocentric ( $r = .04$ ) or egocentric ( $r = -.04$ ) recognition. The difference between hippocampal and caudate volumes was inversely related to allocentric cued recall error ( $r = -.28$  – i.e., more error as the volumetric difference favors the caudate) but unrelated (allocentric  $r = .08$ ) or positively related (egocentric  $r = .24$ ) to recognition performances.

**Conclusions:** The overall results support the general role of the hippocampus in navigational memory; however, the nature of the memory task appears vital. The continuous nature of our recall error score appears to better reflect the differential integrity of the hippocampus and caudate. Future studies will evaluate the encoding of related patterns of activation during these tasks to further support/refute the functional duties of these brain regions.

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**Keywords:** mild cognitive impairment, hippocampus, neuroimaging: structural

**M. BOWREN, J. BRUSS, K. MANZEL, D. TRANEL, A. BOES. Lesion-Network Mapping of General Cognitive Ability.**

**Objective:** General cognitive ability, or general intelligence (g), refers to the domain-general capacity to coordinate mental processes and modulate mental representations. There is growing interest in the relationship between g and functional brain networks - collections of brain regions defined by their co-fluctuation in resting-state fMRI signal across time. However, most prior work exploring the relationship between g and functional brain networks has relied on data collected from healthy individuals, making it difficult to draw conclusions about the necessity of functional brain networks for g. Lesion studies, which use data from individuals with focal brain damage, offer a potential solution to this problem, as they allow for causal inferences about brain-behavior relationships. Lesion network mapping is an application of the lesion method that integrates lesion location data with normative resting-state fMRI data for the purpose of linking functional brain networks with cognitive-behavioral deficits. To our knowledge, no previous lesion network mapping study has directly explored the relationship functional brain networks and g. Here, we sought to address this gap by using a lesion-behavior map of g to identify seed regions-of-interest for a lesion network mapping analysis.

**Participants and Methods:** We analyzed neuropsychological and neuroanatomical data from 402 individuals with chronic, focal brain lesions. Structural equation models were used to model g from the covariance among a large battery of cognitive tests. We used multivariate lesion-behavior mapping to explore the neuroanatomical regions on which g depends. Next, we masked the lesion-behavior map of g by a gray matter mask and segmented the result into spatially distinct clusters, which we further segmented based on a previously published 7-network parcellation scheme derived from normative resting-state fMRI data. Each cluster was binarized and used as a seed region-of-interest for functional connectivity seeding using resting-state fMRI data from 98 neurologically healthy individuals, where the average BOLD signal within each cluster was correlated with BOLD signal across all voxels in the brain, and compared to the Yeo 7-network atlas.

**Results:** The lesion-behavior map of g identified 7 anatomically distinct gray matter clusters: the left posterior middle/inferior gyrus, the right posterior middle gyrus, the right posterior insula, the left anterior insula, the right supramarginal gyrus, the left extrastriate cortex, and the right fusiform gyrus. Lesion network mapping demonstrated that these clusters were located within several different functional brain networks: the frontoparietal network, the default mode network, the ventral attention network, the visual network, and a ventral temporal network.

**Conclusions:** Results suggest that g depends on several functional brain networks. Although previous research has focused on the relationship between g and the frontoparietal network, our results suggest that g depends on multiple functional brain networks, including networks canonically associated with “lower-order” functions like basic visual processing. These findings are consistent with recent work demonstrating the importance of dynamic coupling between different functional brain networks for g. Clinical applications seeking to predict cognitive deficits from lesion location may benefit from taking multiple networks into account.

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**Keywords:** connectomics, brain damage, fluid intelligence

**A. RAPHAIL, G. Y. NAVARRO, F. ERANI, M. SPLIT, M. SHOWELL, J. D. MEDAGLIA, R. HAMILTON, M. T. SCHULTHEIS. Evaluating the Role of Hemispheric Rivalry in Visual Attention Using Repetitive Transcranial Magnetic Stimulation.**

**Objective:** Right parietal lobe lesions can result in deficits to visual attention and disorders such as visuospatial neglect. Previous research has used low-frequency, inhibitory repetitive transcranial magnetic stimulation (rTMS) in the contralesional parietal lobe to improve visual attention based on the theory of hemispheric rivalry. However, few studies have examined the effect of high-frequency, excitatory rTMS in the ipsilesional parietal lobe, another method of improving visual attention and potentially restoring the balance of inhibition. The aim of the current study was to compare the effect of low- and high-frequency rTMS in both the right and left hemispheres to examine what parameters are effective in improving visual attention and to inform our understanding of the neural mechanism underlying visual attention.

**Participants and Methods:** To examine this, 10 healthy individuals were administered five different rTMS conditions on separate days: 1) 1 Hz low-frequency (inhibitory) rTMS in the left angular gyrus, 2) 1 Hz low-frequency rTMS in the right angular gyrus, 3) 10 Hz high-frequency (excitatory) rTMS in the left angular gyrus, 4) 10 Hz high-frequency rTMS in the right angular gyrus, and 5) 10 Hz high-frequency rTMS at a control location (vertex) to control for placebo effects. They completed a visual shifting attention task (Posner Task) before and after stimulation. Reaction times were measured during the four Posner trial types (left invalid, left valid, right invalid, and right valid).

**Results:** Multiple two-way repeated measures ANOVA's were run to compare the effects of the five different TMS conditions and time (pre vs. post-TMS) on reaction times during the Posner Task. Though there were no statistically significant differences in reaction times, there was a marginally significant effect of TMS condition during left invalid Posner trials,  $F(4, 28) = 2.46$ ,  $p = 0.068$ ,  $\eta^2_G = .06$ . While keeping in mind that there was only a trend towards significance, pairwise comparisons were analyzed to examine what specific trends were present. It was found that reaction times were significantly slower in the left inhibitory TMS condition compared to the location-control TMS condition ( $p = 0.03$ ).

**Conclusions:** Taken together, our results did not support the theory of hemispheric rivalry, as there was a trend towards slower reaction times following left inhibitory rTMS which is the opposite of what would be expected based on hemispheric rivalry theory. This trend raises the possibility that this theory may not be able to fully explain the mechanism underlying visual attention in healthy individuals. Despite limitations such as small sample size and lack of a stroke group, the current study raises several important theoretical considerations, such as whether hemispheric rivalry may be an appropriate model for individuals with stroke but not healthy individuals and whether it may apply to certain aspects of visuospatial neglect (i.e. reorienting attention vs. spatial bias). Further research is needed to evaluate whether there is a different model that may better characterize the mechanism underlying visual attention, which could potentially improve our approach to rehabilitation of visuospatial neglect using rTMS.

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**Keywords:** neurostimulation, cognitive rehabilitation, neglect

**Symposium 03: Novel neuropsychological approaches for assessing cognitive decline in the early stages of the Alzheimer's disease continuum**

**Chair and Presenter: Louisa Thompson**

**Presenters: Roos Jutten, Karra Harrington, David Libon, Deirdre O'Shea, Jet Vonk**

**1:00 PM - 2:00 PM**

**L. THOMPSON, R. J. JUTTEN, K. D. HARRINGTON, D. LIBON, D. O'SHEA, J. M. J. VONK. Novel neuropsychological approaches for assessing cognitive decline in the early stages of the Alzheimer's disease continuum.**

The global fight against Alzheimer's disease (AD) poses unique challenges for the field of neuropsychology. Along with the increased focus on early AD detection using in-vivo biomarkers, characterizing the earliest clinical stage of the disease has become a priority to enable early intervention. This shift provides neuropsychology with an opportunity to re-examine how our characterization of cognitive impairment can be expanded and improved to detect subtle cognitive changes during early stage AD. We will begin this symposium with a review of some of the limitations of traditional neuropsychological assessment methods in the context of AD research. We will consider the potential advantages and challenges of shifting towards characterizing cognitive decline using a continuous approach. Next, our speakers will present on a range of novel approaches designed to assess cognitive function in the context of aging and AD research, including the use of digital assessment tools, advanced analytic methods, novel approaches to scoring, and repeated assessments. We will discuss the implications of adopting novel assessment methodologies and directions for future research.

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**Keywords:** assessment, aging disorders, dementia - Alzheimer's disease

**R. J. JUTTEN, L. THOMPSON, S. A. SIKKES, P. MARUFF, J. MOLINUEVO, H. ZETTERBERG, J. ALBER, D. FAUST, S. GAUTHIER, M. GOLD, J. HARRISON, A. LEE, P. SNYDER. A neuropsychological perspective on defining cognitive impairment in the clinical study of Alzheimer's disease: Taking a continuous approach. .**

**Background.** Alzheimer's disease (AD) is currently understood as a continuous process of gradual cognitive decline, starting with a preclinical phase lasting 15 years or more during which clinical symptoms remain insufficient to qualify for diagnosis of mild cognitive impairment (MCI). Despite this long presymptomatic phase wherein neuropathological progression occurs and cognition is subtly and gradually declining, all diagnostic systems developed for AD imply that cognitive function should be classified as either normal or impaired as if there is an abrupt change at one point. While the aggregation of cognition into categories of healthy or impaired is practical for clinical settings, it also leads to a lack of precision and can limit the design of research and clinical trials focused on secondary prevention, i.e. preventing individuals with preclinical AD from developing MCI or dementia.

**Objectives.** We will provide a critical examination of how we define and measure cognitive impairment in the context of aging and AD, by including: 1) a summary of pitfalls of current methods for defining cognitive impairment within the context of research shifting to earlier (pre)symptomatic disease stages; 2) a proposal to shift towards a continuous approach based on new assessment methods for identifying early predictors of cognitive decline and characterizing

progression; 3) an examination of the potential implications and challenges of characterizing cognitive decline using a continuous approach.

**Results:** Topics covered include: 1) Operationalizing AD-specific cognitive decline and distinguishing it from potential age-related cognitive changes remains particularly difficult, since there no universal consensus on the actual definition of cognitive health. We will discuss two main complexities inherent in relying on ‘traditional’ neuropsychological approaches to diagnosing MCI and AD, including the use of cross-sectional normative data to gauge individual impairment, followed by the inclusion of subjective complaints in defining cognitive health. 2) We advocate against classifying individuals as cognitively normal versus impaired at the time of a screening or baseline examination. Rather, we propose that a shift towards a more continuous approach, i.e. assessing cognitive performance using multiple repeated assessments across two or more narrow and/or long-time windows. Change scores resulting from these repeated assessments would enable the identification of ‘progression markers’, that is, cognitive decline determined by within-person change scores. 3) Utilizing a multiple time point assessment approach also raises several challenges, such as the fact that it is time-consuming to do with current testing paradigms. We identified several potential approaches to address these challenges, including the implementation of digital neuropsychological assessment tools, advanced analytic methods, novel approaches to scoring, and high-frequency, remote repeated assessments.

**Conclusion.** We propose a multipronged, flexible approach to allow for the assessment of cognitive change on a continuum, particularly as a means to improve future AD prevention clinical trial design, which incorporates the development and use of ‘cognitive progression markers’ based on repeated assessments. We summarize several promising approaches and methods to define these progression markers, any or all of which are likely to provide an improved reflection of the continuous nature of cognitive aging and cognitive decline in the context of AD.

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**Keywords:** dementia - Alzheimer's disease, aging disorders, cognitive functioning

**K. D. HARRINGTON, J. HAKUN, R. ZHAOYANG, E. CERINO, J. HYUN, J. MOGLE, J. PAVLOVIC, M. KATZ, R. B. LIPTON, M. SLIWINSKI. Feasibility, Reliability, and Validity of Novel Mobile App-Based Cognitive Assessments for use with Older Adults at Risk of Alzheimer’s Disease: Results from the Einstein Aging Study.**

**Objective:** Mobile app-based cognitive assessments offer an opportunity to efficiently measure cognitive performance of older adults in ecologically valid settings and with greater precision than traditional neuropsychological assessments. The application of these methods to study the preclinical stage of Alzheimer’s disease (AD) may allow for more sensitive detection and characterization of subtle cognitive decline occurring in the earliest stages of the disease. This presentation will review preliminary data from the Einstein Aging Study (EAS) and the Mobile Monitoring of Cognitive Change (M2C2) project, including feasibility, validity, and reliability of mobile cognitive assessments relative to traditional neuropsychological assessments.

**Methods:** Participants (n = 311, age 70 - 90 years, 66.6% female, 31.8% MCI) were drawn from the existing EAS cohort and were provided with a study-owned mobile device with the M2C2 app pre-installed. Prior to completing the mobile cognitive assessments, participants underwent comprehensive neuropsychological assessment with tests for the diagnosis of mild cognitive

impairment (MCI) and dementia. An ecological momentary assessment (EMA) design was employed for the mobile cognitive assessments, with participants completing up to 6 sessions per day for up to 16 days. Each session took approximately 5 minutes to complete and included a brief survey followed by the four mobile cognitive assessments (Grid Memory, Color Dots, Color Shapes, Symbol Match). The mobile cognitive assessments included measures of working and associative memory, attention, and perceptual speed.

**Results:** Overall, average adherence rates were high, with >78% of all assigned sessions completed across the 16 day protocol. Intraclass correlations were used to assess the reliability of each of the mobile cognitive tasks across multiple sessions. After 6 sessions (i.e. 1 day of testing), Color Shapes and Color Dots had reliabilities >.80 and Symbol Match >.90. After 18 sessions (i.e. 3 days of testing) all four of the mobile cognitive assessments had reliabilities >.90. Confirmatory factor analysis, with cognitive domain factors defined according to the traditional neuropsychological battery, was used to evaluate construct validity. Each of the mobile cognitive assessments had significant factor loadings to the relevant cognitive domain factors, without significant cross-loadings. Receiver operator curve analysis indicated that each of the four mobile cognitive assessments had sensitivity and specificity for identification of MCI equivalent to that of the traditional neuropsychological tests, many of which were used to assign MCI status.

**Conclusions:** Use of the M2C2 app with older adults was feasible, including for those with MCI, with participants having high adherence rates to the intensive EMA protocol across the 16 days. Furthermore, the mobile cognitive assessments demonstrated remarkable efficiency, with high reliabilities evident after a single day of testing (equivalent to 6 minutes of testing per mobile cognitive assessment) for three of the four assessments, and equivalent sensitivity and specificity to MCI as that of the traditional neuropsychological assessments. The results of this study demonstrate the potential for mobile cognitive assessments to enhance detection and characterization of cognitive dysfunction in the earliest stages of AD.

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**Keywords:** assessment, dementia - Alzheimer's disease, computerized neuropsychological testing

**D. LIBON, S. EMRANI, M. LAMAR, C. C. PRICE, S. BALIGA, E. MATUSZ, V. WASSERMAN, R. SWENSON, J. STRATE, G. BALIGA. Defining the Neurocognitive Constructs Underlying the Model of Executive Attention with Time-Based and Error Data in Patients with Mild Cognitive Impairment.**

**Objective:** The model of executive attention (Fuster, 2015) proposes that successful mental manipulation is governed by three separate, but highly integrated neurocognitive constructs that (1) initially generate and monitor attention to establish mental set (*working memory*); (2) marshal the neural resources directed toward sustaining mental set (*preparatory set*); and (3) the inhibition of external/internal stimuli that cause errors (*inhibitory control*). These neurocognitive constructs were operationally-defined with memory clinic patients assessed for suspected mild cognitive impairment (MCI) using time-based parameters obtained from the Backward Digit Span Test (BDST) and the WRAML-2 Symbolic Working Memory Test-Part 1 (SymWM); and, errors produced on the BDST.

**Participants and Methods:** Using Jak/Bondi criteria, patients were diagnosed with non-MCI or MCI. An iPad was used to calculate average time to completion; and reaction times, or *intra-*

*component latency*, for each response on all correct trials. An analysis of BDST errors was analyzed from incorrect trials.

**Results:** On the 5-span BDST trial block non-MCI (n= 36) and MCI (n= 22) groups did not differ for total average time to completion. A 2-group by 5-serial order latency repeated measures ANOVA interaction was found. Non-MCI patients produced *slower latencies* for positions 2 (p< .008) and 4 (p< .026); MCI patients produced *slower latencies* for position 3 (p< .002). On the 4-span SymWM test trial block non-MCI (n= 33) and MCI (n= 24) groups; again, did not differ for total average time to completion. A 2-group by 4-serial order position repeated measures ANOVA yielded a significant interaction (p< .029). MCI patients produced *slower latencies* on serial positions 1 (p< .005) and 4 (p< .050). On the BDST MCI patients made more within and between trials *capture errors* (i.e., incorrectly inserting a number from 1-2 preceding trials into their current response; p< .031, both analyses). Capture errors tended to occur *before*, rather than *after* their correct serial order position (i.e., anticipation > postponement errors).

**Conclusions:** Patient groups did not differ for total average time; rather, there were clear differences in the *allocation* of time. Slower initial BDST latency (position 2) for non-MCI patients suggest more time allocated toward the necessary neurocognitive resources to establish mental set (*working memory*). However, slower latency for BDST position 3 produced by MCI patients suggests more time was needed to sustain mental set (*preparatory set*). Lastly, slower BDST latency for position 4 by non-MCI patients suggests a greater capacity to “check-in” or monitor their behavior (*response inhibition*). This notion is further supported by greater anticipation versus postponement capture errors. The fact that it was the MCI, and not the non-MCI group that showed slower position 2 and position 4 latencies during SymWM may signal more time allocation was needed to coordinate the cross-temporal contingencies to establish and sustain mental set on this visually-based task. These data provide operational-definitions of the three neurocognitive constructs underlying the model of executive attention (Fuster, 2015). A combination of latency and error data obtained with these iPad administrated tests could yield neurocognitive biomarkers for the early detection of emergent neurodegenerative illness.

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**Keywords:** mild cognitive impairment, executive functions

**D. O'SHEA, K. R. THOMAS, B. M. ASKEN, A. LEE, J. D. DAVIS, P. MALLOY, S. SALLOWAY, S. CORREIA. Adding Cognition to the Alzheimer's Disease Biomarker Framework Improves Prediction of Cognitive and Functional Decline in Non-Demented Older Adults.**

**Objective:** To determine whether adding cognition to a model with AD biomarkers based on the A/T/(N) biomarker framework predicts rates of cognitive and functional decline in older adults without dementia.

**Method:** The study included 465 Alzheimer's Disease Neuroimaging Initiative participants who completed amyloid PET, CSF phosphorylated tau, structural MRI, and serial neuropsychological testing. Using the AT(N) framework and a newly validated cognitive metric of predicted vs. measured cognitive test scores (DELTA score) as the independent variables, we used linear mixed effects models to examine a 4-year rate of change in cognitive and functional measures.

**Result:** The inclusion of the DELTA score improved model fit in predicting rate of decline in outcomes above and beyond biomarker variables. Specifically, those with worse than expected cognitive functioning at baseline had faster rates of memory and functional decline over a four

year period, even when accounting for amyloid, tau and hippocampal volume. Baseline DELTA was not a significant predictor of rate of decline in executive function after the AT(N) biomarkers were included in the model.

**Conclusion:** Including a newly validated measure of cognition (DELTA score) may improve cognitive and functional prognosis in non-demented older adults beyond the use of AT(N) biomarkers alone.

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**Keywords:** cognitive course, dementia - Alzheimer's disease

**J. M. VONK, M. GEERLINGS. Item-level metric of semantic fluency relates to brain volume in non-demented adults over and above traditional risk factors of Alzheimer's disease.**

**Objective:** There is a critical need for cognitive tools that are sensitive to the preclinical phase of Alzheimer's disease (AD) that are low-cost, high-access, and fast to administer. Novel approaches to scoring neuropsychological tests may offer such sensitive metrics. Recent studies have shown that item-level metrics of the semantic fluency task—generating as many words of a category in a given time frame—can predict APOE e4 status, cognitive decline over time, and incident Mild Cognitive Impairment in older adults without dementia, while the traditional total number score cannot. This study investigated in non-demented adults how lexical frequency (how often a word occurs in our language), as an item-level metric of semantic fluency, related to global brain volume, a marker of neurodegeneration.

**Participants and Methods:** Participants were drawn from the SMART-MR cohort (n = 692, age = 62.2±9.4, 17.8% women), designed to investigate brain changes on MRI in patients with arterial disease, which puts them at high risk for dementia. Linear regression models adjusted for age, sex/gender, education, and history of stroke analyzed effects of standardized lexical frequency or standardized total number score as a determinant on overall brain parenchymal fraction (BPF; total brain volume/intracranial volume) individually (model 1), as well as in combination with traditional risk factors of AD: model 1 + APOE e4 (model 2), model 1 + subjective cognitive decline (model 3), model 1 + delayed memory recall (model 4), and model 1 + all three risk factors (model 5). Lexical frequency was derived from the SUBTLEXus database, measured as the log of the mean of the ten lowest frequency words generated in a 2-minute animal fluency task, and multiplied by -1 such that higher values reflected better performance.

**Results:** In model 1, lexical frequency (B=.25, SE=.09, p=.004) and total number score (B=.20, SE=.09, p=.027) were both associated with BPF, yet frequency had a larger effect. Moreover, frequency remained associated with BPF even when APOE e4 status (model 2: B=.23, SE=.09, p=.009), subjective cognitive decline (model 3: B=.25, SE=.09, p=.005), or delayed recall (model 4: B=.21, SE=.09, p=.017) were added, and when all three traditional risk factors added (model 5: B=.19, SE=.09, p=.038). In contrast, the total number score was not associated with BPF in extended models (model 2: B=.17, SE=.09, p=.064; model 4: B=.15, SE=.09, p=.106; model 5: B=.11, SE=.10, p=.255), except for the model with subjective cognitive decline (model 3: B=.19, SE=.09, p=.037).

**Conclusion:** Accurate identification of the preclinical phase of AD is important for intervention and timely diagnosis, but the preclinical phase is currently only detectable with expensive or invasive biomarkers. These results showed the relation between item-level information of semantic fluency and MRI-detected neurodegeneration, over and above established genetic,

subjective, and cognitive risk factors. Valuable item-level information could be applied in clinical research for low-cost, high-access, and quick screening and pre-selection of individuals at risk for the biomarker-defined preclinical phase of AD.

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**Keywords:** dementia - Alzheimer's disease, neuroimaging: structural, semantic processing

## Paper Session 06: Aging & Dementia: Neuroimaging

2:00 PM - 3:00 PM

### **A. KISELICA, J. BENGE. Empirically Defining the Preclinical Stages of the Alzheimer's Continuum in the Alzheimer's Disease Neuroimaging Initiative.**

**Objective:** In 2018, the National Institute on Aging and the Alzheimer's Association published research criteria defining the Alzheimer's continuum (AC) by the presence of positive  $\beta$ -amyloid biomarkers. Under these criteria, individuals on the AC are staged across six levels of severity. Stages 3-6 are familiar and map onto current conceptualizations of mild cognitive impairment and mild, moderate, and severe dementia. Stages 1 and 2 represent relatively novel conceptions of the preclinical stages of the disease. AC stage 2, the second preclinical stage, is defined by the presence of at least one of the following: 1) transitional cognitive decline; 2) subjective cognitive decline; or 3) neurobehavioral symptoms. In contrast, AC stage 1 is defined by the absence of these symptoms. While these stages have been described conceptually, researchers have yet to develop empirical procedures for implementing staging in practice. Consequently, we developed an empirical approach to classifying individuals into AC stages 1 and 2 and provided preliminary evidence for the validity of this method.

**Participants and Methods:** We conducted analyses on data from the Alzheimer's Disease Neuroimaging Initiative. Transitional cognitive decline and subjective cognitive complaints were defined on the basis of demographically-adjusted data from a group of robustly normal individuals ( $n = 365$ ), and neurobehavioral symptoms were indexed through a combination of self-reported (Geriatric Depression Scale Short Form) and observer-reported (Neuropsychiatric Inventory) data. We then applied the developed empirical criteria in a sample of 285 cognitively normal, amyloid positive individuals for purposes of AC stage 1 and 2 classification.

**Results:** In this sample, 61.10% of participants were asymptomatic and were classified as AC stage 1. In contrast, 38.60% of individuals were positive for at least one symptom class (24.00% for transitional cognitive decline, 19.90% for SCD, and 3.10% for neurobehavioral symptoms) and were classified as AC stage 2. AC stage was a predictor of cognitive/functional decline (as indexed by the Clinical Dementia Rating Sum of Boxes score) over four years of follow up in a longitudinal growth model ( $B = .33, p < .001$ ), even after controlling for demographic factors, including age, sex, and education. Post-hoc analyses indicated that neurobehavioral symptoms were the symptom that best predicted declines in cognition/functioning over time ( $B = .31, p < .001$ ).

**Conclusions:** Results provide a methodology to operationalize the National Institute on Aging and Alzheimer's Association AC stage 1 and 2 criteria and include preliminary evidence for the validity of this approach. Findings also highlight neurobehavioral symptoms as potentially important markers of risk for decline among individuals with preclinical Alzheimer's disease. The methods outlined in this manuscript can be used to test hypotheses regarding the preclinical

stages of the AC. Furthermore, they can be applied to select participants in prodromal states for when conducting clinical trials. Future research is needed to replicate these findings, particularly in samples with higher rates of conversion to clinical states.

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**Keywords:** aging disorders, dementia - Alzheimer's disease, neuropsychological assessment

**E. KIDD, R. VAN PATTEN, A. M. FAGAN, T. L. BENZINGER, D. S. KAUFMAN.**  
**Relationship Between MRI Volumes and Attentional Control in Asymptomatic Older Adults at Risk for Developing Alzheimer Disease.**

**Objective:** Attentional control deteriorates in the earliest stages of Alzheimer Disease (AD) and even appears to decline in the asymptomatic, preclinical phase of the disease. While older adults at risk for AD have shown reduced cortical volumes in certain areas of the brain (e.g., entorhinal, precuneus, and parahippocampal cortices), many questions remain about the cognitive correlates of preclinical neuropathology in individuals who may go on to develop AD dementia. The objective of this cross-sectional study was to investigate associations between performance on an attentional control task and MRI brain volumes in asymptomatic, healthy older adults with varying levels of biomarker risk for AD.

**Participants and Methods:** A total of 37 participants, aged 60-90, completed a neuropsychological battery, a computerized, cued-Stroop task of attentional control, and underwent lumbar punctures to acquire cerebrospinal fluid (CSF). Volumetric MRI data were collected on a subset of this sample ( $n = 20$ ), including whole brain volume and regions of interest including the precuneus and medial temporal, inferior parietal, and frontal lobes. Performance on the cued-Stroop task was examined and correlated with CSF biomarkers of AD tau and amyloid pathology (pTau and  $A\beta_{42}$ ). Brain volume measures were then correlated with behavioral performance on the cued-Stroop task.

**Results:** Participants' scores on the neuropsychological test battery fell in the average range and did not differ as a function of CSF biomarkers. Participants demonstrated reduced accuracy and greater response time (RT) variability on cued-Stroop trials that required the greatest level of attentional control (i.e., incongruent, long delay, cue-switch trials). RT variability from the cued-Stroop task was positively correlated with pTau/ $A\beta_{42}$  ratio ( $r = .43, p = 0.02$ ). There were also positive correlations between cued-Stroop accuracy and volumes of the entorhinal cortex ( $r = .63, p = .003$ ) and precuneus ( $r = .60, p = .005$ ), and negative correlations between RT variability and volumes of the entorhinal cortex ( $r = -.53, p = 0.18$ ) and the parahippocampal cortex ( $r = -.53, p = .016$ ).

**Conclusions:** Consistent with prior research, results from this study showed that markers consistent with AD were associated with poorer attentional control performance, even in the absence of other cognitive symptoms. These preclinical levels of attentional control were associated with reduced brain volumes in the precuneus and entorhinal and parahippocampal cortices. The results of this study are noteworthy given that these brain regions help to coordinate the executive control of attention and are among the earliest to show signs of structural change in AD. Future research is needed to replicate these findings in a larger sample and further examine how attentional control deficits may help identify the impact of preclinical neuropathology in AD.

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**Keywords:** aging disorders, attention

**E. FLETCHER, D. MUNGAS, B. GAVETT, F. DELEON, S. FARIAS. A Comparison of Brain Gray Matter Signatures for Everyday Memory Ratings and Verbal Episodic Memory Performance.**

**Objective:** Memory plays a central role in cognition and everyday function. Episodic memory performance and everyday functional memory (informant-based) measures are known to be early predictors of future trajectories. The brain structures associated with episodic memory (EM) have been well-studied. However, there has been little investigation of brain substrates for functional memory (FM) abilities. We investigate comparative brain signatures of episodic and functional memory in order to better understand how brain implementations of these domains are shared and differ.

**Participants and Methods:** Our participants were 255 subjects from the UC Davis Alzheimer's Disease Center (ADC) Aging and Diversity Cohort. Average age was  $75.3 \pm 7.1$  years, education  $13.2 \pm 4.5$  years; 41% were male. By race / ethnicity, 116 were White, 61 were African American, 70 were Hispanic and 8 were Asian. By clinical diagnosis, 128 were normal, 97 were MCI, 30 were demented and 7 were unclassified. We used a voxel-based brain signature approach computing statistically significant maximal clusters of gray matter (GM) voxels explaining variance in verbal episodic memory (EM signature) or everyday functional memory (FM signature), correcting for multiple comparisons. Model fit was determined by the adjusted R<sup>2</sup> for episodic or functional outcome regressed onto GM density variables.

**Results:** Brain signatures for our subject MRI population mapped to template space had volume extents of 292 cc for EM and 141 cc for FM. Intersection of the two was 125 cc, constituting 43% of EM signature and 87% of FM signature. Heavy overlap occurred in medial and ventral temporal regions, while EM signature also contained medial prefrontal, cingulate, precuneus and insular associations missing from FM. In models of cognitive or functional memory outcome, EM signature explained more variance of EM than FM signature explained for its outcome (38.8% vs 23%), while the intersection of both signatures explained essentially the same amount of variance as the full signature for each outcome. However, the component of EM signature not in FM also explained a substantial amount of EM variance (29% of EM), unlike the comparable model for FM.

**Conclusions:** To our knowledge this is the first systematic investigation of comparative brain substrates for EM and FM, using an exploratory signature approach. Results suggest a strong overlap of brain signatures for both memory outcomes in medial and ventral temporal regions typically associated with episodic memory, with additional brain components mainly in cingulate, medial prefrontal and precuneus cortices for EM, while FM substrates are largely subsumed by EM with little left over. This provides a validation of functional memory as represented by similar brain structures as EM (particularly in temporal regions known to be important for memory). However, FM is less tightly coupled with brain structure, likely due to the fact that it is an informant-based measure of everyday memory and is therefore expected to be more strongly influenced by non-brain factors as well.

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**Keywords:** brain structure, cognitive processing, neuroimaging: structural

**P. SUNDERARAMAN, L. SEONJOO, E. VARANGIS, S. CHAPMAN, J. L. JOYCE, M. BARKER, W. HARTSTONE, A. M. BRICKMAN, Y. STERN, S. COSENTINO. Self-Awareness related to Financial Decision Making is linked to Right Temporal Cortical Thickness in Cognitively Healthy Older Adults.**

**Objective:** Self-awareness is critical for everyday decision making, including financial decision making. Lack of awareness regarding declining financial abilities that may occur in the context of cognitive aging can result in tremendous financial loss (e.g., transferring funds to suspicious accounts, falling victim to scams). Although awareness is multi-faceted, studies in healthy older adults as well as clinical populations suggest that compromise to specific neuroanatomic substrates may be particularly consequential for self-awareness. Whether similar structures are also important for financial awareness is unknown. Understanding how brain structure is related to self-awareness may help prevent or mitigate financial losses. In the current study, we therefore examined MRI-derived cortical thickness in relation to financial awareness. Memory awareness was also examined alongside of financial awareness as a well-established element of self-awareness. Based on previous work, we hypothesized that both aspects of awareness would be associated with thinner right hemisphere mid-line structures. **Methods:** *Design* - Cross-sectional, prospective study. *Setting* - Community-based. **Participants:** 49 individuals were included with mean age=68.35 years (SD=5.5) and mean education=15.91 (SD=2.36). 61% were women, the majority were White (67%) while 30% were Black and 3% belonged to other races, and 95% were non-Hispanics.

**Measures:** *Awareness Metrics* – Memory awareness was derived using an established episodic metamemory task in which participants rate the likelihood of recognizing newly learned information. Financial awareness was measured in an analogous fashion by integrating metacognitive ratings into the Objective Financial Competency Assessment Inventory. Level of awareness on each measure was operationalized as absolute accuracy (i.e., calibration; average performance subtracted from the average confidence) to reflect the extent to which individuals were over- or under-confident. *Cortical Thickness* - FreeSurfer was used to measure regional cortical thickness. Based on previous literature, 14 regions were examined for right and left hemispheres separately including: (i) Dorsolateral Prefrontal, (ii) Medial Prefrontal, (iii) Temporal, (iv) Parietal, (v) Anterior Cingulate Cortex, (vi) Posterior Cingulate Cortex, and (vii) Insula.

**Results:** Overconfidence in financial decision making was associated with thinner right temporal thickness ( $r = -0.286, p = 0.047$ ), and this same region was also associated with overconfidence in memory ( $r = -0.287, p = 0.035$ ).

**Conclusions:** Consistent with the broader literature on self-awareness, results highlight a differential role for right versus left-sided structures in supporting financial awareness in healthy older adults. In particular, thickness of the right temporal lobe rather than midline regions emerged as the sole significant neuroanatomic correlate of both financial and memory awareness. Importantly, however, this region has been implicated in disordered awareness of cognitive impairment in Alzheimer's disease, hemiplegia in stroke, and socio-emotional deficits in frontotemporal dementia. Our findings shed light on the importance of the right temporal region in supporting financial awareness in cognitively healthy older adults and point to a common substrate for self-awareness.

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**Keywords:** aging (normal), anosognosia, decision-making

**E. BANKS, A. MECCA, E. SHARP, R. O'DELL, H. BARTLETT, M. CHEN, M. NAGANAWA, T. TOYONAGA, J. E. HARRIS, G. NI, W. ZHAO, N. NABULSI, B. VANDER WYK, Y. HUANG, A. ARNSTEN, E. BANKS. Synaptic Loss Measured In Vivo with [<sup>11</sup>C]UCB-J PET is Associated with Cognitive Impairment in Alzheimer's Disease.**

**Objective:** Although synaptic loss has commonly been referred to as the major structural correlate of cognitive impairment in Alzheimer's disease (AD), this assessment is based on a small number of postmortem and brain biopsy studies with limited sampling of brain regions in later stages of disease or indirect measurement of synaptic function *in vivo* via [<sup>18</sup>F]FDG PET. Recently, the radiotracer [<sup>11</sup>C]UCB-J was developed to bind synaptic vesicle glycoprotein 2A (SV2A), thereby providing a means of measuring synaptic density *in vivo*. Building on our previous work that demonstrated widespread medial temporal and neocortical synaptic loss due to AD *in vivo* using [<sup>11</sup>C]UCB-J PET, we examined the relationship between synaptic density and cognitive impairment in a group of individuals with early AD.

**Participants and Methods:** Using [<sup>11</sup>C]UCB-J binding to SV2A, synaptic density was measured in 45 amyloid positive participants with AD (17 amnesic mild cognitive impairment and 28 mild dementia) and 20 amyloid negative cognitively normal participants aged 50-85 years. Synaptic density was calculated as distribution volume ratios (DVR) with a whole cerebellum reference region in a composite made up of prefrontal, lateral temporal, medial temporal, lateral parietal, anterior cingulate, posterior cingulate, precuneus, and lateral occipital regions. Validated neuropsychological measures were used to assess verbal memory, language, executive functioning, processing speed, and visuospatial ability. An estimate of global cognition was composed by averaging the z-scores from each of the five cognitive domains.

**Results:** In a multiple linear regression model controlling for age, sex, and education, synaptic density was a significant predictor of cognitive ability in participants with AD ( $b=3.21$  DVR/z-score,  $h^2=0.29$ ,  $P=0.0001$ ). Synaptic density was also a significant predictor of performance in all five cognitive domains. The strongest association was with language ( $b=3.82$  DVR/z-score,  $h^2=0.25$ ,  $P=0.001$ ) and the weakest association was with verbal memory ( $b=1.35$  DVR/z-score,  $h^2=0.11$ ,  $P=0.022$ ), the latter attributed to floor effects on memory measures. The observed association between synaptic density and cognition remained significant after correction for partial volume effects ( $b=2.16$  PVC-DVR/z-score,  $h^2=0.23$ ,  $P=0.001$ ) and was a stronger predictor of cognition than gray matter volume ( $b=0.01$  cm<sup>3</sup>/z-score,  $h^2=0.17$ ,  $P=0.005$ ).

**Conclusion:** Our findings *in vivo* utilizing [<sup>11</sup>C]UCB-J PET corroborate neuropathologic studies, establishing synaptic loss as a reliable biological correlate of cognitive decline in AD. They extend the previous literature by utilizing in-depth neuropsychological testing to show that the relationship between synaptic density and cognitive performance extends to the early stages of AD.

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**Keywords:** dementia - Alzheimer's disease, neuroimaging: functional, neuropsychological assessment

**R. A. BERNIER, S. J. BANKS, A. L. SHEPHERD, A. L. CLARK, E. E. SUNDERMANN. Sex-Specific Associations Between AD-Biomarkers and Cognition in Older Adults Extend to Vascular Pathology Markers .**

**Objective:** There are important sex differences in the clinical trajectory of Alzheimer's disease (AD), whereby women are better able to maintain cognitive function despite mild-to-moderate burden of AD pathology (hippocampal volume loss, increased amyloid- $\beta$ , and tau accumulation) than men (Sundermann et al., 2017; Digma et al., 2020); however, they show more rapid cognitive decline in later disease stages when pathology is more advanced (Lin et al., 2015). There is evidence that sex hormones differentially impact cerebrovascular disease risk (Stanhewicz et al., 2018), which has been identified as a driver of AD pathology (Brickman et al., 2015). Pulse pressure (systolic-diastolic blood pressure; PP), a proxy for arterial stiffness, has shown associations with AD-biomarkers such as p-Tau (Nation et al., 2013). We sought to examine sex differences in the relationship between PP and cognition in older adults with evidence of pre-clinical AD. We hypothesized that, similar to findings with other AD pathology markers, higher PP would relate to poorer cognition more strongly in men versus women in this pre-clinical cognitively normal sample.

**Participants and Methods:** Participants were 2398 amyloid- $\beta$  positive individuals (1422 women; 926 men) enrolled in the A4 study who were, on average, 72.0 (4.8) years-old, 95.7% White, with 16.6 (2.8) years of education. Participants completed tests of global cognition (Mini Mental Status Exam, MMSE), verbal learning (Free Recall from the Free and Cued Selective Reminding Test, FR), memory (First Letter Name Recall from the Face Name Associative Memory Exam; FNLT), and processing speed (Digit Symbol Substitution Test, DSST). Women were younger ( $p < .001$ ), less educated ( $p < .001$ ), and performed better on the four neuropsychological tests of interest ( $p < .001$ ). There were no sex differences in PP ( $p = .686$ ), amyloid- $\beta$  burden ( $p = .535$ ), or race ( $p = .113$ ). We used linear regression to test whether PP related to cognitive performance beyond other covariates associated with cognition and PP (age, education, race, BMI, hippocampal volume, amyloid- $\beta$  burden), and whether this relationship was moderated by sex.

**Results:** There were significant sex-by-PP interactions on MMSE ( $\beta = 0.41$ ,  $p < .001$ ), FNLT ( $\beta = 0.25$ ,  $p = .018$ ), and FR ( $\beta = 0.26$ ,  $p = .013$ ). Within men, there were significant negative associations between PP and performance on MMSE ( $\beta = -0.06$ ,  $p = .039$ ) and FNLT ( $\beta = -0.08$ ,  $p = .018$ ). In contrast, within women, PP was not significantly associated with FNLT ( $\beta = 0.02$ ,  $p = .415$ ), but showed a positive relationship with MMSE performance ( $\beta = 0.065$ ,  $p = .015$ ). There was no significant effect of PP on FR performance within sex. However, the interaction was driven by opposing effects, where the expected inverse relationship in men ( $\beta = -0.05$ ,  $p = .106$ ) and the unexpected positive relationship in women were observed ( $\beta = 0.04$ ,  $p = .140$ ). There was no main effect of PP ( $\beta = 0.001$ ,  $p = .958$ ) or sex-by-PP interaction ( $\beta = 0.18$ ,  $p = .085$ ) on DSST.

**Conclusions:** Results revealed sex-by-PP interactions whereby higher PP was associated with worse cognition on MMSE and FNLT in men only. Unexpectedly, among women, higher PP was associated with better performance on MMSE. Vascular pathology may exert an early, negative effect on cognition in men, but does not appear to be as deleterious to cognition in women. These results mirror findings with other AD-biomarkers, extending this pattern to vascular pathology measures.

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**Keywords:** aging disorders, cerebrovascular disease, cognitive functioning

**Symposium 04: Ethical Considerations in the Field of Neuropsychology: Addressing Increasing Needs for Competence in Multicultural Neuropsychology and Advances in Technology**

**Chair and Presenter: Michelle R. Madore**

**Presenters: Rachel L. Hughes, Travis M. Scott, Rebecca Avila-Rieger, Jasmine S. Dixon**

**2:00 PM - 3:00 PM**

**M. R. MADORE, R. L. HUGHES, T. M. SCOTT, R. AVILA-RIEGER, J. S. DIXON.**

**Ethical Considerations in the Field of Neuropsychology: Addressing Increasing Needs for Competence in Multicultural Neuropsychology and Advances in Technology.**

Professional development guidelines of clinical neuropsychologists indicate that neuropsychologists work within their scope of competence. As the field of neuropsychology changes, the knowledge areas that neuropsychology researchers and clinicians need has expanded at a rate far faster than the training structure has been able to accommodate. Two rapidly changing areas where neuropsychologists have had to quickly adapt are multicultural competence and advances in technology. Despite this ever-pressing need, there continues to be a significant lack of available resources.

This symposium consists of four talks, two focused on multicultural competence and two focused on advances in technology, that aim to elucidate ethical considerations that are associated with practice and research in these areas. From the lens of the American Psychological Association's *Ethical Principles of Psychologists and Code of Conduct* (2010) and *Multicultural Guidelines* (2017), practical strategies and information will be outlined to help individuals: understand and assess their gaps in multicultural competence, advance their multicultural neuropsychology knowledge base, identify resources to increase multicultural competence in neuropsychology, describe the available technological advances in neuropsychological assessment, assess their knowledge gaps for utilization of these technological tools, and identify resources to increase competence in the context of the technological advances in neuropsychological assessment.

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**Keywords:** diversity, computerized neuropsychological testing, multiculturalism

**R. L. HUGHES, M. R. MADORE, C. PADULA. Ethical and Practical Considerations in Computerized Assessment.**

**Objective:** Computerized assessment is a novel approach to understanding cognitive functioning. Use of these measures can limit resources required, enhance the robustness of information obtained, and maximize efficiency. Despite these advantages, clinical utilization of computerized assessments is low. Clinicians may hesitate to use these measures due to a lack of exposure, and may not understand how to use them responsibly and in concordance with best practices. Increasing familiarity with computerized assessment and the ethical guidelines surrounding this practice may facilitate implementation. We aim to address this need through offering an accessible introduction to the potential roles of computerized assessment, discussed

through the lens of ethical responsibility in their utilization, in order to facilitate their safe, routine integration into standard clinical practice.

**Method:** To achieve this aim, we provide a brief overview of available measures with applicable data when available, discuss the different settings and populations in which they have been used, and technological requirements for effective utilization.

**Results:** Using the American Psychological Association's (APA) Ethical Principles of Psychologists and Code of Conduct (2010) and the APA Multicultural Guidelines (2017) as a framework, this presentation will introduce relevant ethical considerations of computerized assessment, including 1) test construction, validation, and equivalence, 2) clinician competence, 3) experiences of the patient, and 4) privacy and confidentiality of information.

**Conclusion:** Specific attention will be paid to how clinicians can responsibly navigate these principles, recommendations for translation to clinical practice, and address whether these modalities provide sufficient consideration of individuals from different racial and ethnic groups. Correspondence: *Rachel Hughes, Palo Alto University, Palo Alto, CA, 94304, United States. Email: rhughes@palou.edu*

**T. M. SCOTT, K. M. MARTON, M. R. MADORE. The Ethical Practice of Teleneuropsychology During and Beyond the COVID-19 pandemic: A discussion of considerations applied to multiple models of practice.**

**Objective:** The emergence of the COVID-19 has generated renewed interest in the utility and feasibility of transitioning assessment from in-person telehealth. Recent surveys indicate that, while a majority of clinicians will or currently engage in TeleNP services, a substantial portion express concerns about ethical issues related to TeleNP. No formal APA ethical guidelines or standards of practice exist for TeleNP. We discuss ethical considerations and provide suggestions based on new models of practice derived in response to the COVID-19 pandemic.

**Method:** Operational definitions of TeleNP and emerging models of TeleNP including: In-Clinic, Home, and Hybrid TeleNP models will be discussed. We outline ethical considerations and suggestions in general and by model related to: the benefits and risks of conducting TeleNP compared to another modality, issues of competence, education and training, the potential relationship with health disparities, changes to informed consent procedures, possible increased risk to violations of patient privacy and confidentiality, increased risk of violating test security, and changes to the administration and interpretation of standardized assessments.

**Conclusions:** The neuropsychologist must ascertain whether or not it is in the best interest of the patient to be assessed and, if an assessment is warranted, determine the most ethically sound and clinically valid model while balancing the needs and safety of the patients, providers, and the community at large. We will present and discuss a decision-making model to help clinicians balance these ethical considerations in their selection of a TeleNP model.

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**R. AVILA-RIEGER, L. ABRAMS-SILVA, M. IAMPIETRO. Ethics of Cultural Competence in Neuropsychology: Preliminary Findings and Future Directions .**

**Objective:** Multicultural neuropsychology has historically been treated as a “niche” area of practice and research. The project was the first to identify trends in inclusion of cultural considerations and diversity factors in clinical neuropsychological reports.

**Participants and Methods:** A pilot project was developed to assess current practices of Children's Hospital of Philadelphia (CHOP) pediatric neuropsychologists. Survey questions explored inclusion frequency and location of specific cultural and diversity factors, and special approaches to score interpretation and considerations of assessment limitations.

**Results:** 14 of 15 individuals completed the survey. Inclusion of factors other than sex and age was variable, 14% documenting race/ethnicity. Race/ethnicity was not consistently included in the same sections of the report. 36% reported including a separate report section addressing cultural factors and diversity in case conceptualization, while over 80% reported using special approaches to interpret performance. 100% have commented on possible limitations of an assessment due to language proficiency, fewer tend to comment about limitations due to patient acculturation (64%) or race/ethnicity (40%).

**Conclusions:** Preliminary findings reveal inconsistencies regarding inclusion of basic demographic factors (e.g., race/ethnicity) in the report. Findings reveal inconsistencies between consideration of individual factors and the representation in the written product. This has implications for the understanding of important cultural factors by the report reader. Although limited to one institution, these preliminary findings highlight the need for the creation of standards for cultural competence training, and development of guidelines for written products. Future directions include surveying a larger group of neuropsychologists on their current practices.

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**J. S. DIXON, M. MATHER, R. FANTON, M. R. MADORE. A Multicultural Approach to Neuropsychological Assessment with Racial and Ethnic Minority Older Adults.**

**Objective:** To best serve the growing population of racial and ethnic minority older adults in the U.S., it is of the utmost importance for geriatric neuropsychologists to utilize a multicultural approach. This approach includes building awareness of the influences that older age, racial/ethnic minority status, and cultural background have on the neuropsychological evaluation. The APA's Multicultural Guidelines (2017) can direct best practices for neuropsychological assessment with racial/ethnic minority older adults. This presentation will discuss how several of the APA Multicultural Guidelines are applicable to working with racial and ethnic minority older adults in neuropsychological assessment.

**Methods:** In this presentation we offer a selective, in-depth consideration of Multicultural Guidelines that emphasize 1) the importance of understanding the intersectionality of marginalized identities (e.g., racial/ethnic minority and older adult), 2) encourage clinicians to be aware of their own identities and biases, especially as they relate to the identities of their patients, 3) focus on the physical and social environment of the patient and considering how culture provides context within assessment setting, and 4) outline the importance of oppression, power, and privilege.

**Results:** Using these guidelines as a framework, we will cover intersectionality of marginalized identities, implicit biases of neuropsychologists, health literacy, mental health stigma, family dynamics, historical racism and discrimination in healthcare, and education quality.

**Conclusion:** Neuropsychologists must acknowledge their own cultural identity as well as that of their patients. They should strive to understand how social, familial, community, and institutional contexts influence the clinician-patient relationship and patient behavior in clinical settings.

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### **Symposium 05: Competing Models of Cognitive Decline and Dementia in Epilepsy**

**Co-Chairs and Presenters: Carrie R. McDonald, Robyn M. Busch**

**Presenters: Hyunmi Choi, Evan Thacker, Albert P. Aldenkamp, Anny Reyes, Alice Lam**

**2:00 PM - 3:00 PM**

#### **C. R. MCDONALD, R. M. BUSCH, H. CHOI, E. THACKER, A. P. ALDENKAMP, A. REYES, A. LAM. Competing Models of Cognitive Decline and Dementia in Epilepsy.**

Epilepsy is the fourth most common neurological disorder in the United States and is associated with significant cognitive co-morbidity. Patients with epilepsy are at increased risk for abnormal brain and cognitive aging and dementia. Furthermore, older adults with epilepsy represent the fastest growing segment of patients, including patients with early-onset, chronic epilepsy and patients with late-onset epilepsy. Despite individuals with epilepsy representing a group of patients with a host of risk factors for dementia and progressive neurodegenerative disorders, the underlying mechanisms of abnormal aging in epilepsy remains unclear. There are multiple models of cognitive decline and dementia in epilepsy. One model focuses on the *common pathogenesis risk* theory, which was inspired by rodent models demonstrating salient similarities between temporal lobe epilepsy (TLE) and Alzheimer's disease (AD). Specifically, studies have found the presence of tau pathology, amyloid-B precursor protein, and senile plaques in TLE, all of which are pathological hallmarks of AD. Furthermore, studies have found an association between *APOE* genotype and TLE severity. A second model purports that an accumulation of *vascular risk factors*, including hypertension, diabetes, elevated body mass index, culminating in occult cerebral small vessel disease and cerebral hypoperfusion among others, lead to accelerated brain and cognitive aging in epilepsy. These pathological brain changes include progressive brain atrophy of cortical and subcortical structures. A third model conceptualizes cognitive decline in epilepsy as representing *accelerated aging* secondary to a "double-hit" to the brain in which pre-existing low brain reserve makes the brain more vulnerable to a second hit from the development of epilepsy.

Given compelling evidence demonstrating the risk for pathological aging in epilepsy, there is a critical need to characterize cognitive and brain aging in older adults with epilepsy, identify underlying mechanisms of abnormal aging, and target modifiable risk factors that would prevent or mitigate progressive cognitive and functional decline.

This symposium will cover competing theories of cognitive aging and dementia in epilepsy with a focus on possible mechanistic links between epilepsy and AD. First, Drs. McDonald and Busch will review common neuroimaging and genetic biomarkers of AD-associated cognitive decline in TLE. Second, Drs. Thacker and Choi will describe on-going work from the Cardiovascular Health Study on genetic and vascular risk factors associated with cognitive decline in epilepsy. Third, Dr. Aldenkamp will provide evidence that a "double-hit" to the brain of patients with epilepsy can lead to accelerated aging in older adults. These theory-guided presentations will be complemented by two clinically-oriented presentations. Ms.

Reyes will describe neuropsychological methods for diagnosing cognitive disorders in older adults with epilepsy. Dr. Lam will present two clinical cases at the boundary of epilepsy and AD that present diagnostic challenges from the perspective of a neurologist. Together, the presentations in this symposium will provide compelling evidence that common mechanisms underlie cognitive decline in older adults with epilepsy and AD, raising awareness of co-morbidities and inspiring research into shared therapeutic targets for both disorders.

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**Keyword:** aging disorders, epilepsy / seizure disorders, dementia - Alzheimer's disease

### **C. R. MCDONALD. Neuroimaging and Genetic Biomarkers of Cognitive Decline in Epilepsy.**

**Objective:** To identify neuroimaging and genetic biomarkers of cognitive aging in temporal lobe epilepsy (TLE). Two studies will be discussed; the first study characterizes patterns of cortical atrophy and cognitive impairment in older adults with TLE. The second compares the brain transcriptome between TLE patients with and without memory impairments to identify genes and signaling networks important for memory.

**Methods:** Structural MRI and verbal memory scores were compared in 73 older adults with TLE (>55 years) and compared to 70 healthy controls and 79 patients with amnesic mild cognitive impairment (aMCI). RNA-seq and small RNA-seq were performed using brain tissue specimens obtained from a separate sample of 23 TLE patients who underwent temporal lobectomies.

**Results:** Older adults with TLE demonstrated a similar pattern and magnitude of medial temporal lobe (MTL) atrophy to aMCI. Thinning was particularly pronounced in late-onset epilepsy of unknown etiology. Although TLEs and aMCI both showed memory and language impairments, patients with aMCI demonstrated poorer delayed recall relative to early- and late-onset TLE. Tissue samples revealed an overrepresentation of differentially expressed genes impacting pathways associated with neurodegenerative diseases, memory, and cognition (APOE, APP, MAPT, PINK1) that appear to be regulated by upstream differentially expressed microRNAs.

**Conclusions:** MTL atrophy, memory impairments, and gene expression profiles overlap in older adults with TLE and aMCI, raising concerns of a common pathogenesis and Alzheimer's Disease (AD) co-morbidity. These data suggest an urgent need for research aimed at identifying shared mechanisms that could lead to common therapeutic targets in TLE and AD.

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### **H. CHOI, E. THACKER. Cognitive Decline in Older Adults with Epilepsy: The Cardiovascular Health Study.**

**Objective:** Cognitive decline is a major concern for older adults with epilepsy. Whether and how much faster older adults with epilepsy experience cognitive decline beyond expected age-related cognitive change remains unclear. We sought to estimate and compare rates and underlying mechanisms of cognitive decline in older adults with epilepsy.

**Participants/Methods:** The Cardiovascular Health Study is a population-based longitudinal study of 5,888 adults aged 65+. Cognitive function is assessed annually with Modified Mini-Mental State Exam (3MS) and Digit Symbol Substitution Test (DSST). Linear mixed models are used to estimate rates of decline in 3MS and DSST scores by epilepsy status (prevalent, incident,

no epilepsy). We are also analyzing the role of vascular risk factors (VRFs; smoking, blood pressure, antihypertensive treatment, waist to hip ratio, HDL, diabetes, cardiovascular disease, and atrial fibrillation), sex, race, and their interactions in association with cognitive decline.

**Results:** The rate of decline in 3MS was faster in prevalent epilepsy, followed by incident epilepsy, compared with no epilepsy. Prevalent epilepsy and *APOE4* had a synergistic interaction; together they were associated with 1.51 points faster annual decline in 3MS. Older adults with prevalent epilepsy had lower initial DSST score and faster rates of decline compared to individuals without epilepsy. Analysis of VRFs is underway and will be reviewed in this session.

**Conclusion:** Faster decline in global cognitive ability in older adults with epilepsy is potentiated by the presence of *APOE4* status. Further research that includes VRFs is warranted to explore biological mechanisms and possible interventions to mitigate cognitive decline.

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#### **A. P. ALDENKAMP. Accelerated Cognitive Aging in Epilepsy.**

**Objective:** A long-standing concern has been whether epilepsy contributes to cognitive decline or so-called 'epileptic dementia'. This is generally reported in the context of childhood-onset refractory epilepsy, in which slow and gradual cognitive decline may occur as a consequence of chronicity and the accumulation of the negative effects of seizures, treatment and other epilepsy-related factors. Evidence is emerging that deterioration can also occur in a 'second hit model', especially in adulthood-onset epilepsy.

**Methods/Results:** A subgroup of patients with localization-related epilepsy exhibit cognitive decline described as deterioration of basic attentional processes, especially central processing speed with preservation of higher order cognitive functions including Verbal IQ and memory. This group is characterized by older age of epilepsy onset, comorbid pathology, lower education and premorbid IQ, and older age; all factors that increase vulnerability of the brain by diminishing cognitive reserve capacity. In addition to the 'accumulation chronic model', cognitive deterioration may develop in a 'second hit model', thereby accelerating the cognitive aging process, a process labeled 'accelerated cognitive ageing (ACA).' Using fMRI and effective connectivity in epilepsy adults with ACA, we found the temporal dynamics from the cingulate cortex to be increased towards the right fronto-parietal cortex, salience network, and the dorsal attention networks compared to normal aging adults.

**Conclusion:** Our results suggest over-recruitment at low cognitive load, and exhaustion at higher cognitive load, as shown by the CRUNCH model for ageing, supporting the idea that cognitive decline in older adults with epilepsy reflects 'normal aging', but in an accelerated mode.

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#### **A. REYES. Diagnostic Classification of Cognitive Disorders in Older Adults with Temporal Lobe Epilepsy.**

**Objective:** To characterize the nature and prevalence of cognitive disorders in older adults with temporal lobe epilepsy (TLE) and compare their cognitive profiles to patients with amnesic mild cognitive impairment (aMCI) and normal aging controls (NAC).

**Methods:** Seventy-eight older patients with TLE, 77 aMCI, and 69 NAC, all 55-80 years of age, completed neuropsychological measures of memory, language, executive function and

processing speed. An actuarial neuropsychological method designed to diagnose MCI was applied to individual patients to identify older adults with TLE who met diagnostic criteria for MCI (TLE-MCI). A linear classifier was performed to evaluate the ability of our diagnostic criteria to differentiate patients with TLE-MCI from aMCI. In TLE, the contribution of epilepsy-related and vascular risk factors to cognitive impairment was evaluated using multiple regression.

**Results:** Forty-three TLE patients (60%) met criteria for TLE-MCI, demonstrating marked deficits in memory and language. A classification model between TLE-MCI and aMCI correctly classified 81.1% (90.6% specificity, 61.3% sensitivity) of the cohort based on neuropsychological scores. Whereas TLE-MCI showed greater deficits in language relative to aMCI, patients with aMCI showed greater rapid forgetting on memory measures. Both epilepsy-related risk factors and the presence of leukoaraiosis on MRI contributed to impairment profiles in TLE-MCI.

**Conclusions:** Approximately 60% of older adults with TLE meet diagnostic criteria for a cognitive disorder associated with aging (i.e., MCI). The TLE-MCI phenotype may be secondary to an accumulation of epilepsy and vascular risk factors, signal the onset of a neurodegenerative disease, or represent a combination of both factors.

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#### **A. LAM. Clinical Cases at the Boundary of Alzheimer's disease and Epilepsy.**

**Objective:** The increased incidence of seizures in Alzheimer's disease (AD) has been well-documented and is likely underestimated due to the prevalence of subclinical seizures particularly early in the disease. This raises diagnostic challenges for neurologists and neuropsychologists alike who evaluate and treat older adults with epilepsy or AD.

**Participants/Methods/Results:** Through two case presentations, Dr. Lam will address the challenge of early diagnosis of AD in the presence of epilepsy, as well as the difficulty of diagnosing seizures in the presence of AD. She will also address the clinical semiology and electrographic features of seizures in AD and highlight signs and symptoms that may suggest the presence of AD/epilepsy co-morbidity. Dr. Lam will provide a unique perspective as an epileptologist with expertise in treating older adults with epilepsy and AD who has studied "silent" seizures in patients with AD through intracranial recordings.

**Conclusions:** These case presentations will increase awareness that recurrent seizures may be more prevalent and more likely to contribute to cognitive symptoms observed in AD than is generally appreciated. Understanding the convergence of epilepsy and AD and developing mechanism-based treatments is of increasing interest, with new therapeutic possibilities on the horizon.

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### **INS Awards**

**2:00 PM - 3:30 PM**

#### **L. B. ZAHODNE. INS Early Career Award Presentation .**

Introduction by Dr. Patricia Reuter-Lorenz

**Title:** Biopsychosocial Pathways in Dementia Inequalities

**Abstract:** The incidence of Alzheimer's disease and related dementias (ADRD) differs across racial/ethnic groups, even after controlling for socioeconomic status and vascular diseases. My research program seeks to understand these persistent inequalities by examining whether: (1) known ADRD risk factors exhibit differential impact across race/ethnicity; and/or (2) unrecognized ADRD risk factors exist for racial/ethnic groups with a history of marginalization in the United States. To provide evidence for each of these explanations, I will present data from multiple racially/ethnically diverse, longitudinal studies of cognitive aging in the United States. Compared to non-Hispanic Whites, marginalized racial/ethnic groups face more social and economic constraints, are more likely to live in under-resourced neighborhoods, and more frequently encounter negative environmental messages that can corrode biopsychosocial resources. In the face of these inequities, many of these groups also demonstrate greater engagement in culturally-relevant protective factors. In this talk, I will focus on pathways by which racially-patterned psychosocial factors get under the skin and into the skull to shape ADRD inequalities.

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**C. C. PRICE. INS Mid-Career Award Presentation.**

Introduction by Dr. David Libon

**Title:** Minding the Gap in Evidence Based Perioperative Brain Behavioral Research for Older Adults Electing Surgical Procedures with Anesthesia

**Abstract:** Since mid-20<sup>th</sup> century there has been increasing concern for older adults' risk of cognitive complications after major elective surgery such as knee or cardiac surgery. Yet, there are still no accepted mechanisms for why some older adults experience post-operative cognitive complications. The topic is of increasing concern given: 1) at least 20% of older adults electing surgeries have signs of preoperative cognitive vulnerability; 2) individuals with neurodegenerative diseases will arrive at preoperative centers in exponentially larger numbers over the next 25 to 50 years; and 3) our healthcare systems extensive gap in evidence-based perioperative care for adults with Alzheimer's disease and other progressive neurodegenerative disorders (e.g., PD). Catherine Price's presentation will highlight NIH funded interdisciplinary clinical research addressing the complex and controversial topic of preoperative brain and cognitive profiles, pre to postoperative neuroimaging changes, and pre to postoperative cognitive-behavioral changes assessed with traditional and digital technologies. She will touch upon the gap in evidence based research addressing perioperative approaches for individuals with neurodegenerative disorders, and how neuropsychology is the ideal profession to spearhead interdisciplinary educational, research, and clinical training opportunities addressing this area of need.

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**THURSDAY, FEBRUARY 4, 2021**

**CE Workshop 09: Practice Effects in Clinical Trials for Alzheimer's Disease: What We Know, What We Don't Know, and What We Better Figure Out Really Quick**

**Presenter: Kevin Duff**

**8:00 AM - 9:30 AM**

**K. DUFF. Practice Effects in Clinical Trials for Alzheimer's Disease: What We Know, What We Don't Know, and What We Better Figure Out Really Quick.**

Clinical trials in Alzheimer's disease (AD) often require that participants are repeatedly cognitively tested across multiple years to track progression of symptoms. However, frequent repeat testing can lead to practice effects, even in patients with amnesic Mild Cognitive Impairment (MCI) and mild AD. These practice effects can have untoward consequences, including misinterpretation of trial results. This presentation will review existing literature on repeat testing and practice effects in trials of AD and MCI. It will also explain the ramifications of ignoring the current knowledge of practice effects, which can lead to inefficient, expensive, and inaccurate trials. Finally, some recommendations will be made for incorporating this information about practice effects into future clinical trials.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe the current state of our knowledge on practice effects in AD and MCI 2) Explain the negative consequences of ignoring practice effects in these trials 3) Compare methods for incorporating practice effects into future trials.

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**CE Workshop 10: Neuropsychological Assessment of American Indian and Alaska Native Populations: Cultural Implications for Research and Practice**

**Presenters: Lynette Abrams-Silva, Steven P. Verney**

**8:00 AM - 9:30 AM**

**L. ABRAMS-SILVA, S. P. VERNEY. Neuropsychological Assessment of American Indian and Alaska Native Populations: Cultural Implications for Research and Practice.**

American Indian and Alaska Native (AI/AN) peoples experience disproportionately high physical, educational, and mental health disparities relative to the general U.S. population. While neuropsychological services are needed in Native communities, neuropsychological assessments have been developed for and normed on the White majority population, and with the assumption of mainstream U.S. education. Very few AI/AN studies exist and typically include only small sample sizes, one or a few select tribes, and limited measures. This workshop will first offer an overview of the vast cultural diversity of AI/ANs and the multiple sociocultural considerations of AI/ANs that may affect the appropriateness and usefulness of neuropsychological assessment including the quantity and quality of education, culture (including language and cultural adaptation), socioeconomic factors, and socialization factors. We will present recent research findings highlighting sociocultural factors in a large sample of older American Indians. We will offer case examples to illustrate how assessments may impact the lives of AI/AN individuals.

We then offer guidelines for clinical practice and recommendations for research. We hope our workshop may be used to guide culturally appropriate research and clinical practice.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe the cultural diversity within the American Indian/Alaska Native population and the historical context rendering research and clinical work challenging 2) List various cultural factors that may impact neuropsychological assessment with American Indian/Alaska Native populations 3) Discuss steps to increase the cultural appropriateness of neuropsychological assessment in research and practice.

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### Paper Session 07: HIV & Infectious Diseases

8:00 AM - 9:00 AM

**K. N. DEVLIN, T. GIOVANNETTI, D. LIBON, M. T. SCHULTHEIS, K. MALONE, W. DAMPIER, V. PIRRONE, M. NONNEMACHER, J. JACOBSON, Z. SZEP, B. WIGDAHL. Vascular and Metabolic Risk Factors Differ Among Neurocognitive Phenotypes In HIV+ Adults.**

**Objective:** Persons with HIV-1 infection (PWH) experience neurocognitive impairment despite effective suppression of HIV-1 by antiretroviral therapy (ART). Vascular and metabolic dysfunction, whether related to chronic HIV-1 infection, ART toxicity, and/or comorbidity, represents one explanation for this persistence. As HIV-associated neurocognitive disorders are heterogeneous and likely multifactorial, the contribution of vascular/metabolic dysfunction may vary across neurocognitive phenotypes. We previously identified four neurocognitive phenotypes among PWH that have unique demographic and clinical characteristics (e.g., age, HIV-1 duration, ART history), raising the possibility of distinct underlying mechanisms. In the present study, we investigated whether these phenotypes differ in their rates of vascular/metabolic risk factors.

**Participants and Methods:** Participants were 193 PWH (ages 26-73, 97% on ART, 86% with viral suppression) enrolled in a longitudinal study of NeuroHIV through the Drexel University/ Temple University Comprehensive NeuroHIV Center (CNHC). Based on a previously described latent class analysis (LCA) of comprehensive neuropsychological evaluations, patients were assigned to one of four classes: cognitively intact (n=72; 37%), mild-to-moderate psychomotor/motor slowing (n=34; 18%), mild-to-moderate memory/visuospatial impairment (n=56; 29%), and moderate-to-severe multi-domain impairment (n=31; 16%). Height, weight, and waist circumference were measured, and hypertension, hyperlipidemia, and diabetes were obtained from self-report and medical records. Rates of obesity, large waist circumference, hypertension, hyperlipidemia, and diabetes, and the total number of these risk factors, were compared across classes.

**Results:** Groups differed significantly in the rate of diabetes ( $p=.033$ ), with trends for hypertension ( $p=.077$ ) and total risk burden ( $p=.102$ ), and did not differ in rates of obesity, large waist circumference, or hyperlipidemia (all  $p>.05$ ). Diabetes was significantly more common in the multi-domain impairment (39%) and psychomotor/motor slowing classes (38%) than the memory/visuospatial impairment class (17%; both  $p=.023$ ), and marginally more common in the

multi-domain impairment and slowing classes than the intact class (21%; both  $p=.058$ ). Compared with the memory/visuospatial impairment class (50%), hypertension was significantly more common in the multi-domain impairment class (74%,  $p=.029$ ) and marginally more common in the psychomotor/motor slowing (71%,  $p=.057$ ) and intact classes (67%,  $p=.059$ ). Compared with the memory/visuospatial impairment class ( $M=2.0$ ,  $SD=1.4$ ), total risk burden was comparable in the intact class ( $M=2.2$ ,  $SD=1.3$ ), significantly higher in the psychomotor/motor slowing class ( $M=2.7$ ,  $SD=1.4$ ,  $p=.037$ ), and marginally higher in the multi-domain impairment class ( $M=2.6$ ,  $SD=1.7$ ,  $p=.053$ ).

**Conclusions:** Cognitive phenotypes of HIV-associated neurocognitive disorders have differing profiles of vascular/metabolic risk and potentially distinct neuropathological mechanisms. Total vascular/metabolic risk is higher, and diabetes and hypertension are more common, in PWH with psychomotor/motor slowing or multi-domain impairment than in those with memory/visuospatial impairment alone. In PWH, vascular/metabolic dysfunction may have a greater impact on psychomotor slowing than on other domains, consistent with the known influence of vascular/metabolic abnormalities on attentional and subcortical functions. Future research will investigate the mechanism of this finding.

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**Keywords:** HIV/AIDS, vascular cognitive impairment, diabetes

**M. A. HUSSAIN, W. WATSON, E. E. MORGAN, S. C. ROESCH, J. E. IUDICELLO, R. K. HEATON, S. L. LETENDRE, D. JESTE, D. J. MOORE. Combined Effects of Loneliness and Inflammation on Depression in People with HIV (PWH).**

**Objective:** Over half of people with HIV (PWH) report feelings of loneliness, the discrepancy between one's desired and actual social relationships (i.e., perceived social isolation), in their lifetime. Loneliness is also a risk factor for depression, which is highly prevalent in PWH and associated with a range of adverse health-related consequences. Research examining the underlying biological processes of loneliness has found links with systemic inflammation, which can also contribute to depression. However, research examining systemic inflammation, loneliness, and depression together is scarce in PWH. Thus, this study sought to investigate (1) the relationship between loneliness and biomarkers of systemic inflammation, and (2) their independent and joint contributions on depressive symptoms in PWH.

**Participants and Methods:** This cross-sectional study included 82 PWH (mean age [ $SD$ ]=53.2 [9.0]) on suppressive antiretroviral therapy (ART) from the NIMH-funded Multi-Dimensional Successful Aging among Adults living with HIV study. All participants completed the revised UCLA Loneliness Scale-Version 3 (UCLA-3) and the Center for Epidemiologic Studies Depression Scale (CES-D). Five biomarkers of inflammation (and associated processes; e.g., coagulation) were measured in blood using commercial enzyme-linked immunosorbent assay kits: C-reactive protein (CRP), Interleukin-6 (IL-6), chemokine (C-C motif) ligand 2/monocyte chemoattractant protein-1 (CCL2/MCP-1), soluble cluster of differentiation 14 (sCD14), and d-dimer. Severe psychiatric or non-HIV neurological conditions were excluded. The sample was mostly male (86.6%) and non-Hispanic White (58.5%). The mean estimated duration of HIV infection was 15.3 years ( $SD=10.8$ ). Stepwise regression analysis using backwards Akaike information criterion (AIC) selection was used to examine the independent and combined effects of loneliness (UCLA-3 total) and systemic inflammation on depressive symptoms (CES-D total).

Biomarkers were included in the model if they were significantly associated with loneliness or

depression at the univariable (UV) level ( $p < .05$ ). Other demographic and medical covariates were considered if univariably associated with depression ( $p < 0.20$ ). Interactions between loneliness and biomarkers significantly associated with loneliness at the UV level were also considered.

**Results:** At the univariable level, loneliness was significantly associated with more depressive symptoms ( $\rho = .53$ ,  $p < .0001$ ) and higher d-dimer ( $\rho = .26$ ,  $p = .02$ ), and depressive symptoms were associated with higher IL-6 and CCL2/MCP-1 ( $\rho$ s = .23 and 0.24,  $p$ s < .05). The overall model predicting depressive symptoms, after stepwise backwards AIC selection, was significant ( $F = 10.73$ ,  $R^2 = .54$ ,  $p < .0001$ ). After accounting for covariates (e.g., race/ethnicity, current CD4, hypertension), significant independent effects were found for loneliness ( $b = 0.31$ ,  $p < .0001$ ) and CCL2-MCP-1 ( $b = 25.67$ ;  $p = .0005$ ). An interaction between loneliness and d-dimer ( $b = 0.59$ ,  $p = .050$ ) was also observed, whereby d-dimer was associated with more depressive symptoms, but only at higher levels of loneliness.

**Conclusions:** Consistent with the literature, loneliness and biomarkers of systemic inflammation were independent predictors of depression. Moreover, loneliness had an additive effect on the relationship between coagulation, a process associated with inflammation, and depression. These findings provide preliminary insight into the underlying biological processes of loneliness and depression, which may be dissociable to some degree. Given the potential synergistic effect of loneliness and systemic inflammation on depression, future research should investigate the possibility of simultaneously targeting loneliness and inflammation in the treatment and amelioration of depression, especially in PWH.

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**Keywords:** HIV/AIDS, depression, emotional processes

**L. KAMALYAN, T. BENMARHIA, L. C. GALLO, D. R. FRANKLIN, S. L. LETENDRE, J. MCCUTCHAN, I. GRANT, M. J. MARQUINE. Higher Allostatic Load is Associated with Lower Cognition among a Cohort of Older Diverse Adults Living with HIV.**

**Objective:** Higher allostatic load (AL), a biological phenotype of life stress, has been associated with older age, racial/ethnic underrepresented minority (URM) status, and cognitive impairment. However, little is known about these relationships among persons living with HIV (PLWH). We examined racial/ethnic differences in AL among a diverse sample of PLWH and whether the association of AL with cognition was stronger for URM. **Participants and Methods:** Participants were 257 PLWH age 50 and older, 113 URM (Hispanics:  $n = 69$ ; non-Hispanic Black:  $n = 44$ ) and 144 non-Hispanic White, from observational cohort studies at the HIV Neurobehavioral Research Program (Age:  $M = 61.0$ ,  $SD = 7.5$ ; Education:  $M = 13.7$ ,  $SD = 3.0$ ; 81% Male). Participants completed a neuropsychological battery assessing seven domains. Individual raw test scores were converted to scaled scores and averaged to compute a global cognition score. AL was measured via nine cardiovascular (i.e., systolic and diastolic blood pressure), metabolic (i.e., BMI, waist-hip ratio, high-density lipoprotein, total cholesterol, glycosylated hemoglobin), and inflammation (i.e., WBC, CRP) biomarkers. The number of individual biomarker indicators for which participant values fell into high-risk quartile ranges were summed and averaged per physiological system to create an overall AL risk score. AL risk levels higher than the 75% quartile were labeled “high risk” and used as potential moderator of ethnic group on cognition. Three multivariable regression models controlling for age, sex, and years of

education examined 1) the relationship between ethnicity and cognition 2) whether AL moderated the relationship between ethnicity and cognition 2) main effects of AL and ethnicity on cognition. **Results:** URM had significantly less years of education and were more likely to be female ( $p < .0001$ ) compared to non-Hispanic Whites, but AL did not differ significantly by ethnic group ( $p = .80$ ). Controlling for demographic covariates, the effect of ethnicity (comparing URM to non-Hispanic Whites) on global cognition was  $-0.87$  (95%CI:  $-1.42$  to  $-0.31$ ). We did not find that this relationship was different across high- or normal- AL ( $b = 0.79$ ; 95%CI:  $-0.57$  to  $2.07$ ). Main effect model results indicated higher AL ( $b = -0.70$ ; 95%CI:  $-1.34$  to  $-0.05$ ) and being an URM ( $b = -0.69$ ; 95% CI:  $-1.28$  to  $-0.11$ ) were associated with lower global cognition. **Conclusions:** We found that higher allostatic load (i.e., more physiological dysregulation due to life stress) is associated with worse cognition above and beyond demographics and ethnicity among diverse older persons with HIV. Future research should investigate underlying causal pathways that may disentangle the relationships between life stress, race/ethnicity, HIV and cognitive aging.

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**Keywords:** aging (normal), cognitive functioning, minority issues

**E. PAOLILLO, R. SALONER, W. WATSON, R. J. ELLIS, S. L. LETENDRE, J. E. IUDICELLO, I. GRANT, R. K. HEATON, D. J. MOORE. Higher Cumulative Depression and Plasma D-Dimer Synergistically Predict Steeper Neurocognitive Declines Over Time among People with HIV.**

**Objective:** Depression is prevalent among people with HIV (PWH), and both conditions are associated with coagulation dysfunction. Chronic elevations in depression and markers of coagulation independently contribute to high rates of neurocognitive impairment in PWH. However, possible interactive effects of depression and coagulation in the context of HIV are unclear. This longitudinal study examined the independent and interactive effects of cumulative depression and cumulative coagulation on neurocognitive decline among PWH.

**Participants and Methods:** Participants were 166 PWH (baseline mean age = 48.1, SD = 10.6) enrolled in various studies at the UC San Diego HIV Neurobehavioral Research Program. All participants had at least 3 comprehensive study visits (average total years on study = 5.5; min = 1.5; max = 11.2) in which they completed a blood draw, the Beck Depression Inventory-II (BDI-II), and a comprehensive neurocognitive battery. Practice-effect corrected neurocognitive scaled scores ( $M = 10$ ,  $SD = 3$ ) were used. Coagulation was measured via plasma D-dimer. Cumulative depression and cumulative D-dimer were calculated by averaging BDI-II and plasma D-dimer values, respectively, within persons across visits. Multilevel modeling was used to examine the effects of cumulative depression, cumulative D-dimer, and their interaction on linear neurocognitive change over time. Person-specific random intercepts and a random effect of time (i.e., years since baseline) were specified.

**Results:** There was a significant interaction between cumulative depression and cumulative D-dimer on the rate of global neurocognitive change over time ( $b = -0.040$ ,  $SE = 0.014$ ,  $p = 0.005$ ). To understand directionality and examine simple slopes of cumulative depression, cumulative D-dimer was dichotomized using a median split. Among PWH with low cumulative D-dimer, cumulative depression did not significantly predict global neurocognitive change ( $p = 0.250$ ); however, among PWH with high cumulative D-dimer, higher cumulative depression was associated with steeper declines in global neurocognition over time ( $p = 0.022$ ). These effects on

global neurocognition were driven by the domains of executive functioning ( $p = 0.002$ ), verbal fluency ( $p = 0.020$ ), and processing speed ( $p = 0.033$ ).

**Conclusions:** Findings are consistent with the hypothesis that chronically elevated depression and markers of coagulation may confer synergistic harm to neurocognition among PWH. Given that PWH are at high risk for elevations in both depression and markers of coagulation, future work should examine whether conjoint treatment of depression and coagulation dysfunction may promote better neurocognitive functioning than simply treating either condition alone.

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**Keywords:** HIV/AIDS, depression, cardiovascular disease

### **J. YOUNG, A. BITNUN, S. E. READ, M. SMITH. Early Academic Achievement of HIV-Exposed Uninfected Children .**

**Objective:** It is estimated that there are over 14 million HIV-exposed uninfected (HEU) children under the age of 14 worldwide<sup>1</sup>. HEU children are at-risk for compromised developmental outcomes due to multi-factorial risk factors such as in utero and perinatal exposure to HIV and/or anti-retroviral (ARV) medication, increased likelihood of prematurity, poorer health outcomes, and psychosocial effects of familial HIV exposure<sup>2</sup>. As such, HEU children may be at-risk for poorer academic achievement compared to HIV-unexposed uninfected (HUU) children. Understanding the risk factors for academic underachievement is important for implementing timely intervention and academic supports.

**Participants and Methods:** At the Hospital for Sick Children in Toronto, Canada, HEU and HUU children underwent neurodevelopmental assessments at 5-6 years of age. Measures of intellectual ability and academic achievement (single-word reading, spelling, and math computation skills) were assessed by the Wechsler Preschool and Primary Scale of Intelligence - Third Edition<sup>3</sup> and the Wide Range Achievement Test - Fourth Edition<sup>4</sup>. A subset of HEU children underwent neurodevelopmental assessments at both 3-4 and 5-6 years of age. Demographic and pertinent medical information of the children and their mothers were obtained. Non-parametric Kruskal Wallis tests, chi-square tests of independence, Fisher's exact test, and multiple linear regression models were used as appropriate.

**Results:** A total of 110 HEU children and 43 HUU children were included with a mean (SD) age of 5.59 (0.22) and 5.73 (0.64), respectively. Of the 110 HEU children, 57 HEU children also had cognitive measures at 3.6 (0.19) years of age. HUU children scored significantly higher than HEU children on all intellectual measures ( $p < 0.001$ ), reading ( $p = 0.006$ ), and math skills ( $p = 0.003$ ). After controlling for several demographic factors, HEU children continued to perform less well on reading and math skills. Verbal intellectual ability at 3-4 years predicted later academic achievement, yet demographic and medical factors, including ARVs did not.

**Conclusions:** These findings demonstrate that HEU children obtained significantly lower scores of intellectual, reading, and math abilities compared to HUU children during early childhood. Verbal intellectual skills were associated with later academic abilities, highlighting the importance for access to early language interventions and monitoring. Addressing these gaps in academic abilities before HEU children enter primary school will be critical for optimizing their learning and academic potential.

**References: (1)** Slogrove, A. L., Powis, K. M., Johnson, L. F., Stover, J., & Mahy, M. (2020). Estimates of the global population of children who are HIV-exposed and uninfected, 2000–18: a

modelling study. *The Lancet Global Health*, 8(1), e67–e75. (2) Wedderburn, C. J., Evans, C., Yeung, S., Gibb, D. M., Donald, K. A., & Prendergast, A. J. (2019). Growth and Neurodevelopment of HIV-Exposed Uninfected Children: a Conceptual Framework. *Current HIV/AIDS Reports*, 501–513. (3) Wechsler, D. (2002). *Wechsler Preschool and Primary Scales of Intelligence, Third Edition*. San Antonio, TX: The Psychological Corporation. (4) Wilkinson, G., & Robertson, G. (2006). *Wide Range Achievement Test, Fourth Edition*. Lutz, FL: Psychological Assessment Resources.

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**Keywords:** academic achievement, HIV/AIDS, pediatric neuropsychology

**M. A. BABICZ, S. P. WOODS, A. MATCHANOVA, L. D. MEDINA, J. L. THOMPSON, S. RAHMAN, B. JOHNSON, K. PODELL, R. WALKER, A. FETTERMAN, K. L. SULLIVAN, I. BELTRAN-NAJERA, J. BROOKS, Y. L. MORALES. Wear a Mask and Don't Drink Bleach: The Role of Neurocognition and Health Literacy in COVID-19 Online Information Seeking Skills, Knowledge, Prevention Intentions, and Prevention Behaviors.**

**Objective:** The development of COVID-19 into a pandemic over the course of only a few months required people to quickly acquire, evaluate, and apply novel complex health-related information. This study examined the possible interplay between neurocognition and health literacy in the early uptake and use of COVID-19 public health information.

**Participants and Methods:** Data were collected between April 23 and May 21, 2020, a period during which 42 out of 50 states in the U.S. were under a stay-at-home order. A total of 217 healthy adults completed a telephone-based battery that included standard tests of neurocognition (i.e., Hopkins Verbal Learning Test-Revised, Oral Trail Making Test, verbal fluency, digit span forward and backwards, prospective memory measure) and health literacy (i.e., Electronic Health Literacy Scale, Subjective Numeracy Scale, Expanded Numeracy Scale, Health Motivation Questionnaire). Participants also completed measures of COVID-19 online information-seeking skills, knowledge, prevention intentions, and prevention behaviors.

**Results:** A series of hierarchical multiple regressions with data-driven covariates showed that neurocognition (viz., declarative verbal memory and executive functions) was independently related to COVID-19 knowledge (e.g., symptoms, risks) at a medium effect size ( $\beta = .24, p = .001$ ), but not to COVID-19 online information-seeking skills, prevention intentions, or prevention behaviors. Health literacy was independently related to all measured COVID-19-related outcomes ( $\beta$ s = .21 to .41,  $ps < .013$ ) and did not interact with neurocognition for any of these outcomes.

**Conclusions:** The acquisition of COVID-19-related knowledge in the early months of the pandemic was partially explained by individual differences in declarative verbal memory and executive functions. Findings align with research indicating that the strategic aspects of memory are important for the development of health-related knowledge and skills. Future studies might examine whether executive functions and memory supports (e.g., spaced retrieval practice) can improve COVID-19-related knowledge in vulnerable populations. Future studies may also examine interventions aimed at improving health literacy to improve COVID-19 health outcomes.

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**Keywords:** infectious disease, neurocognition, learning

**Paper Session 08: Pediatric Cancer****8:00 AM - 9:00 AM**

**C. LEVITCH, B. MALKIN, L. LATELLA, W. GUERRY, G. MCDONNELL, S. GARDNER, J. FINLAY, S. SANDS.** Long Term Neuropsychological Outcome of Young Children Treated with Intensive Chemotherapy Followed by Myeloablative Consolidation Chemotherapy and Autologous Hematopoietic Cell Rescue for Brain Tumors: Follow-Up for Head Start 2 Survivors.

**Objective:** The Head Start treatment protocols have focused on curing young pediatric brain tumors while avoiding or delaying radiotherapy through a combination of high-dose, marrow-ablative chemotherapy and autologous hematopoietic cell transplantation (AuHCT). Data on the late effects of treatment on the Head Start 2 (HS-2) protocol have previously been published for short-term follow-up (STF) at a mean of 39.7 months post-diagnosis. At STF, participants' neurocognitive functioning was stable from baseline and within the average to low average ranges. The current study examines longer-term follow up (LTF) outcomes from the same cohort.

**Participants and Methods:** Eighteen HS-2 participants diagnosed with malignant brain tumors <10 years of age at diagnosis completed a battery of neurocognitive assessments and psychological questionnaires at a mean of 104.7 months ( $SD = 33.1$ ) post-diagnosis. Participants were on average 10.2 years of age ( $SD = 3.8$ ) and 61.1% male.

**Results:** There was no significant change in Full Scale IQ at LTF compared to baseline or STF ( $p$ 's > 0.05). Similarly, survivors did not demonstrate significant change in most domains from STF, including verbal IQ, performance IQ, academics, receptive language, learning/memory, visual-motor integration, and externalizing behaviors ( $p$ 's > 0.05). Internalizing behaviors increased slightly at LTF ( $p = 0.04$ ). Clinically, most domains were within the average range of functioning, except for low average mathematics and receptive language. Performance did not significantly differ by age at diagnosis or time since diagnosis ( $p$ 's > 0.05). However, children treated with high-dose methotrexate for either disseminated disease or atypical teratoid/rhabdoid tumor had worse neurocognitive outcomes in the domains of receptive language, learning/memory, and reading (Cohen's  $d \geq 0.50$ ).

**Conclusions:** These results extend the prior findings of relative stability in intellectual functioning for a longer-term follow-up period. For other neurocognitive and psychological domains, there were also no significant changes at LTF, except for an increase in reported internalizing behaviors, albeit still within normal limits. Of note, the sample sizes for the latter comparisons were small and may have limited the ability to detect true effects. Nevertheless, this study supports that treatment strategies for avoiding or delaying radiotherapy using high-dose, marrow-ablative chemotherapy and AuHCT may decrease the risk of neurocognitive and social-emotional declines in young survivors of pediatric brain tumors.

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**Keywords:** pediatric neuropsychology, brain tumor, neuropsychological outcome

**T. B. FAY-MCCLYMONT, N. CAUGHERTY HAN, F. M. SCHULTE, W. MACALLISTER, L. LAFAY-COUSIN, N. LOGIE, M. VASSERMAN, S. MISH, B. L.**

### **BROOKS. Memory and Learning in Pediatric Brain Tumor Survivors Compared to Children with Acute Lymphoblastic Leukemia.**

**Objective:** Cognitive impairments in survivors of pediatric brain tumors (PBT) are often due to a multitude of factors. Memory difficulties have been shown to be related to speed of processing and executive dysfunction, but there is a relative dearth of information on specific visual and verbal memory outcomes in this group. The objectives of this study were to examine visual and verbal learning and memory in pediatric brain tumor survivors, compared to a childhood acute lymphoblastic leukemia (ALL) sample. A secondary objective was to examine the impact of cranial radiation on memory and learning.

**Participants and Methods:** Memory was assessed in N=72 children and adolescents (5-19 years; mean age=11.43, SD=4.3; n=31 female) with diagnoses of pediatric brain tumor (PBT; n=33) or acute lymphoblastic leukemia (ALL; n=39). Sixteen children were treated with cranial radiation (n=12 PBT; n=4 ALL) prior to the neuropsychological assessment (ranging from 12-55.8Gy; 88% craniospinal). Children with pre-existing developmental disabilities were excluded from the analysis. All children were assessed as part of a comprehensive neuropsychological evaluation using Wechsler scales of intelligence (i.e., WPPSI-IV, WISC-IV/V, WAIS-IV,) and the Child and Adolescent Memory Profile (ChAMP).

**Results:** The PBT group performed significantly worse on the Verbal Memory Index ( $t=-2.78[37]$ ,  $p=.008$ ; PBT=91.64 [SD=25]; ALL=106.8 [SD=14.4]; Cohen's  $d$  effect size=.74). In a regression analysis, full scale intellectual functioning (FSIQ;  $\beta=.51$ ,  $t=4.65$ ,  $p<.001$ ) accounted for 30% of the variance in predicting the Verbal Memory Index, and group (PBT vs. ALL;  $\beta=.30$ ,  $t=2.68$ ,  $p=.010$ ) further accounted for 9% of the variance ( $F[2, 51]=16.22$ ,  $p<.001$ ). In predicting the Visual Memory Index scores, FSIQ accounted for 28% of the variance ( $\beta=.41$ ,  $t=3.68$ ,  $p=.001$ ), the child's age at assessment accounted for a further 12% of the variance ( $\beta=-.41$ ,  $t=-3.69$ ,  $p=.001$ ) with older children demonstrating worse memory, and group accounted for a 5% of the variance ( $\beta=.23$ ,  $t=2.08$ ,  $p=.042$ ;  $F[3, 49]=13.38$ ,  $p<.001$ ). FSIQ did not differ between the PBT and ALL groups (i.e., mean FSIQ PBT=90.94 [SD=17.3], ALL=94.18 [SD=15]) and five children (3 PBT, 2 ALL) had FSIQ  $\leq 70$ . Children who received radiation performed significantly worse on visual memory subtests, including object learning and memory ( $t=2.32-2.43$  (69),  $p=.023$  and  $p=.018$ ; Cohen's  $d=.70-.77$ ). When examining rates of clinical impairment (i.e., Standard Score  $<80$ ), PBT survivors demonstrated much higher rates of impairment. Rates of memory impairment in all domains ranged from 18-27% in the PBT group, and 0-8% in the ALL group.

**Conclusions:** At the group level, children with brain tumours demonstrate greater impairments across measures of visual and verbal learning and memory as compared to children with ALL. Importantly, up to a quarter of all children with brain tumors demonstrate clinically significant impairments in memory. Furthermore, cranial radiation has an added deleterious impact on children's ability to learn and remember, particularly in terms of visually presented stimuli.

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**Keywords:** brain tumor, pediatric neuropsychology, memory disorders

### **H. ALEKSONIS, L. C. KRISHNAMURTHY, V. DOTSON, T. Z. KING. Periventricular White Matter Hyperintensity Relationships with Processing Speed in Long-Term Survivors of Childhood Posterior Fossa Tumor.**

**Objective:** Treatments (i.e., surgery, chemoradiation therapy) and related complications (e.g., hydrocephalus, hearing loss) for childhood brain tumor put survivors at increased risk of compromised white matter integrity, including white matter hyperintensities (WMHs). Processing speed performance has direct influence on working memory, attention, and academic achievement and is consistently related to white matter integrity. WMH severity has previously been shown to be related to cognitive outcomes in survivors of childhood cancer. However, previous research has not investigated relationships among WMH location and cognitive skill performance in this population. The aim of this study is to use a novel automated multivariate regression neuroimaging analysis to explore brain-behavior relationships among WMHs and processing speed in long-term survivors of childhood posterior fossa tumor.

**Participants and Methods:** 56 long-term adult survivors of childhood posterior fossa tumor ( $M_{\text{age}}=22.34$  years,  $SD=4.41$ ) and 35 healthy controls ( $M_{\text{age}}=21.29$  years,  $SD=6.51$ ) underwent magnetic resonance imaging (MRI). Segmentation and quantification of WMHs was completed using the Lesion Growth Algorithm in the Lesion Segmentation Tool toolbox for SPM12. Quantified values were normalized with whole brain volume and log transformed. Participants also completed the Oral Symbol Digit Modalities Test (OSDMT) as a measure of processing speed. Independent *t*-tests and an ANOVA were used to investigate differences in processing speed and WMH volumes. Multivariate voxel-based lesion-symptom mapping regression via LESYMAP, with a lesion overlap of at least 4 subjects, was used to identify significant brain-behavior relationships with processing speed.

**Results:** Survivors had significantly poorer performance on the OSDMT compared to healthy controls,  $t(89)=3.19$ ,  $p=.002$ , with a medium effect size,  $d=0.71$ . Additionally, survivors treated with chemoradiation therapy had significantly poorer performance on the OSDMT compared to both survivors treated with surgery only and healthy controls,  $F(2,85)=11.31$ ,  $p<.001$ , with a large effect size,  $d=0.92$ . Survivors had significantly higher normalized WMH volumes compared to healthy controls,  $t(89)=-10.66$ ,  $p<.001$ , with a large effect size,  $d=2.29$ . Multivariate voxel-based lesion-symptom mapping results revealed significant WMH clusters (FDR-corrected,  $p<.05$ ), almost exclusively periventricular, that were related to performance on the OSDMT. The largest cluster sizes (2,115 voxels and 1,572 voxels) were located in the posterior subcallosal region and next to the anterior portion of the right ventricle, respectively.

**Conclusions:** Findings from this study revealed robust brain-behavior relationships among presence of WMHs in periventricular regions and processing speed performance. These findings further support that long-term survivors are susceptible to increases in WMH volumes and impairments in processing speed after posterior fossa tumor treatment. Furthermore, this study supported the efficacy of using multivariate regression in this population, which has not previously been done. Automated multivariate analyses such as these have potential to inform clinical care about which survivors are most at risk for cognitive impairments based on the location of WMHs after treatment. Future research should consider using this multivariate regression analysis to confirm these findings and investigate other relationships among WMHs and outcomes in survivors of childhood brain tumor.

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**Keywords:** neuroimaging: structural, brain tumor, executive functions

**O. HALLER, H. ALEKSONIS, L. C. KRISHNAMURTHY, T. Z. KING. White Matter Hyperintensities Relate to Executive Dysfunction in Long-Term Adult Survivors of Pediatric Posterior Fossa Tumor.**

**Objective:** Survival rates for pediatric brain tumor continue to rise, necessitating an understanding of long-term cognitive outcomes in survivors. Long-term survivors report poor outcomes on measures of executive function (EF), including apathy, metacognition, attention, planning, among others. For populations who experience other neurological injuries, such as neurodegenerative disease or traumatic brain injury white matter hyperintensities has been linked to impairments in EF. The goal of this research was to extend this relationship to long-term adult survivors of pediatric brain tumors by identifying and characterizing relationships between white matter hyperintensities (WMHs) and EF in this population.

**Participants and Methods:** 31 survivors of pediatric posterior fossa tumor and 58 controls completed a Magnetic Resonance Imaging (MRI) scan. Informants for participants completed the Frontal Systems Behavior Scale (FrSBe), with three subscales that assess Apathy, Disinhibition, and ED. MRI data were used to identify WMHs, which were quantified, normalized, and then log-transformed to reduce notable skewness and kurtosis. Quantified total, periventricular, and subcortical WMH volumes were used in analyses to investigate relationships with FrSBe subtest scores. Additionally, a multivariate symptom-lesion mapping regression analysis (LESYMAP) was performed to further explore potential brain-behavior relationships. To address issues with restriction of range, survivors and controls were pooled into one group for WMH analyses.

**Results:** Mean age of survivors (51.6% female) was 23.77 years (SD=5.14). Mean age of controls (53.4% female) was 22.51 years (SD=4.36). Survivors had significantly higher ED scores (M=51.8, SD=12.8) compared to controls (M=45.6, SD=11,  $t(47.9)=-2.4$ ,  $p=.023$ ). Higher total volumes of WMHs were significantly correlated with greater ED scores ( $r=.33$ ,  $p=0.02$ ). Subcortical WMH volumes were positively correlated with scores on Apathy ( $r=.23$ ,  $p=.04$ ) and ED ( $r=.23$ ,  $p=.04$ ) subscales when controlling for periventricular WMHs. Periventricular WMH volumes were positively correlated with scores on the ED ( $r=.25$ ,  $p=.02$ ) subscale when controlling for subcortical WMHs. In our multivariate regression analysis, we showed significant brain-behavior relationships among Apathy ( $p=.05$ , FDR corrected) and ED ( $p=.05$ , FDR corrected) scores. Significant voxel clusters were in similar locations, predominately periventricular, for both Apathy and ED subscales. Significant clusters were larger for the Apathy subscale (e.g., largest cluster: 1,048 voxels) compared to the ED subscale which were approximately half the size (e.g., largest cluster: 496 voxels).

**Conclusions:** In survivors of pediatric brain tumor and healthy controls, WMH volumes appear to modestly correlate with facets of EF, specifically apathy and ED. Scores on the FrSBe Apathy and ED subscales were significantly correlated with WMHs; suggesting that increased WMH volumes are associated with greater levels of apathy and ED. Informants for survivors also reported significantly higher scores on the ED subscale compared to informants for controls. These findings are consistent with the literature in other populations that link increased hyperintensities with disrupted EF. Greater support and management of EF changes for survivors of pediatric brain tumor may be necessary to improve adaptive functioning. Future prospective studies should investigate the development of WMHs in pediatric brain tumor survivors and its relationship with onset of apathy and ED over time.

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**Keywords:** executive functions, neuroimaging: structural, brain tumor

**P. BANERJEE, W. LIU, M. EHRHARDT, A. WILLIAMS, N. PHILLIPS, T. BRINKMAN, N. BHAKTA, I. HUANG, R. KHAN, G. ARMSTRONG, K. SRIVASTAVA, L. ROBISON, M. HUDSON, K. KRULL. Neurocognitive Phenotypes in Long-Term Survivors of Childhood Cancer: A Report from the St. Jude Lifetime Cohort Study.**

**Objective:** Phenotypic profiles of impairment across multiple neurocognitive measures have not been well-characterized in long-term survivors of childhood cancer. This study aimed to examine neurocognitive profiles across a large, heterogeneous group of survivors.

**Participants and Methods:** Twenty neurocognitive variables across several cognitive domains were evaluated in 2,958 survivors of childhood cancer (mean[SD] age 34.1[9.4] years; 25.7[9.3] years post-diagnosis; 47% female) enrolled in the St. Jude Lifetime Cohort Study. Neurocognitive performance was converted to age-adjusted z-scores using normative data, and impairment was defined as a z-score <-2.0 for each variable. Latent class analysis was used to identify phenotypic patterns of neurocognitive impairment. Chronic health conditions (CHCs) were classified according to CTCAE criteria (grade 1=mild, 2=moderate, 3=severe/disabling, 4=life-threatening) and then combined into a severity/burden score by frequency and grade (no/low, medium, high, very high). Multinomial logistic regression was used to examine the impact of sex, age at diagnosis, time since diagnosis, cancer therapy, and CHC severity/burden on neurocognitive phenotype class membership.

**Results:** Five groups of survivors with mutually exclusive neurocognitive phenotypes were identified: those with global impairment (n=109; 3.7%), attention impairment (n=163; 5.5%), executive function/processing speed impairment (n=295; 10.0%), memory impairment (n=217; 7.3%), and no impairment (n=2,174; 73.5%). Relative risks (RR) for global impairment and memory impairment were higher for survivors with exposure to neurosurgery (global RR=3.49, 95%CI 1.68-7.27; memory RR=1.72, 95%CI 1.04-2.86) or cranial irradiation (per 10 Gy; global RR=1.47, 95%CI 1.29-1.68; memory RR=1.11, 95%CI 1.001-1.23). RRs for global impairment and attention impairment were lower for survivors with older age at diagnosis (per 1 year; global RR=0.86, 95%CI 0.81-0.91; attention RR=0.95, 95%CI 0.91-0.98). Compared to males, females had a lower RR of executive function/processing speed impairment (RR 0.59, 95%CI 0.44-0.79) and a higher RR of memory impairment (RR 2.09, 95%CI 1.53-2.85 CI) versus no impairment. Survivors of central nervous system tumors had the highest proportions of class membership for global (12.1%), executive function/processing speed (20.4%), and memory (13.4%) impairment, while survivors of acute lymphoblastic leukemia had the highest proportion of attention impairment (5.8%). The risk for membership in the global versus no impairment class was 20-fold greater for survivors with very high CHC severity/burden scores (OR=20.17, 95%CI 11.41-35.63) and 5-fold greater for survivors with high CHC severity/burden scores (OR=5.01, 95%CI 3.01-8.35). The risk for membership in the memory impairment class was 3-fold greater for survivors with very high CHC severity/burden scores (OR=3.83, 95%CI 2.55-5.74) and 2-fold greater for survivors with high CHC severity/burden scores (OR=2.13, 95%CI 1.60-2.84), compared to survivors with no/low/medium severity/burden.

**Conclusion:** Long-term survivors of childhood cancer present with distinct phenotypes of neurocognitive impairment, which will require personalized and multi-faceted therapeutic approaches to rehabilitation.

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**Keywords:** cancer, neurocognition

**A. C. APPLE, C. LINDBERGH, S. M. LANDAU, W. J. JAGUST, J. KRAMER, H. S. RUGO, L. H. HEFLIN. Longitudinal Trajectories of Memory Performance in Cancer Patients: the Role of Chemotherapy on Practice Effects. .**

**Objective:** Breast cancer and its treatments are known to affect cognition, although these effects tend to be diffuse and the longitudinal trajectories of cognition among women receiving differing cancer treatment types remain poorly understood. Prior research has shown that integrity of a hippocampal-prefrontal cortex network may influence objective and subjective cognition in cancer patients, although how this network predicts performance over time has yet to be studied. This study aimed to answer the following question: Do specific cognitive domains (memory, processing speed and executive function) differ over time between controls and breast cancer patients treated with chemotherapy and hormone therapy, hormone therapy alone, chemotherapy alone and healthy controls? Secondly, do baseline hippocampal or frontal lobe volumes predict differing trajectories of change in cognition over time.

**Participants and Methods:** The analyses included 69 breast cancer patients (33 who underwent chemotherapy and hormone therapy, 22 who underwent hormone therapy alone, 14 who underwent chemotherapy alone) as well as 12 matched controls. Longitudinal cognitive testing was conducted at four timepoints: pretreatment (baseline), post-treatment at 6-7 months, 14-15 months and 23-24 months. Sample-based, standardized cognitive composite scores of episodic memory, executive functioning, and processing speed were calculated. Baseline structural MRI was obtained in a subset of these participants (controls  $n=10$ , cancer  $n=34$ ) and hippocampal and prefrontal cortex regional volumes were extracted.

**Results:** At baseline (cancer mean age = 54, control mean age = 49), cancer patients demonstrated higher levels of depression than controls ( $F= 8.75$ ,  $p=0.004$ ), while controls demonstrated lower memory performance ( $F=3.19$ ,  $p=0.02$ ); there were no other differences in cognition at baseline. Baseline hippocampal or prefrontal volumes did not differ between groups ( $p > .05$ ). Longitudinal linear mixed modeling revealed significant group (cancer versus controls) by time interactions on performance in the episodic memory domain, after controlling for age, education and baseline depression ( $\beta= -0.31$ ,  $p =0.013$ ). Specifically, controls demonstrated significantly better memory trajectories compared to cancer patients, actually improving slightly over time. Post-hoc analyses revealed that this effect was driven by patients who had undergone chemotherapy alone or chemotherapy and hormone therapy together ( $\beta= -0.33$ ,  $p = 0.022$ ). Group membership did not significantly moderate the relationship between time and processing speed or executive functioning.

**Conclusions:** These results suggest that cancer patients may not benefit from practice effects seen in healthy controls, specifically in the memory domain. Baseline hippocampal or prefrontal cortex volume do not appear to influence cognitive trajectories, though this may represent a power issue. The evidence that cancer patients appear not to benefit from practice effects in the same way as controls lends support to the subjective cognitive concerns that many patients report during and after treatment. While subtle, this points to objective longitudinal differences in memory performance for cancer patients, specifically those undergoing chemotherapy. Given the variability in studies of neuropsychological deficits in cancer patients, absence of longitudinal practice effects may be a new measure for capturing breast cancer patients' experience of cognitive difficulties during and after treatment.

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**Keywords:** cancer, memory complaints, chemotherapy

**Poster Session 4: Assessment/Diversity and Inclusion  
8:30 AM - 9:30 AM**

**H. DOTTERER, C. S. NEUMANN. Using a Biocognitive Approach to Parse Psychopathic Personality .**

**Objective:** Psychopathy is a personality construct characterized by related but distinct traits and behaviors, including interpersonal manipulation, callous affect, erratic behavioral lifestyle, and overt antisocial tendencies (Hare & Neumann, 2008). Psychopathic personality is strongly predictive of severe violence and recidivism (Reidy et al., 2015). Unfortunately, individuals with psychopathic traits are difficult to treat, potentially due to the heterogeneity of symptom presentation, which is not captured by traditional syndrome-based classifications of psychopathy (Jurjako, Malatesti, & Brazil, 2020). Conversely, Research Domain Criteria (RDoC) approaches that emphasize biocognitive classification may better delineate underlying distinct etiological mechanisms of psychopathic traits (Brazil, van Dongen, Maes, Mars, & Baskin-Sommers, 2018). For example, research suggests that different features of psychopathy are associated with differing neurocognitive processes (Baskin-Sommers et al., 2015). As such, unique neurocognitive profiles may more accurately classify individuals with psychopathic traits, and ultimately inform distinct targets of treatment.

**Participants and Methods:** Latent profile analysis (LPA) was conducted with Mplus to determine whether 374 male offenders (59.9% White, 35.3% Black) could be subtyped in terms of their neuropsychological performance on tasks reflecting processing speed (Trails A), executive functioning (Trails B; Digit Span Backwards; DKEFs Tower, DKEFs Color-Word Inhibition, DKEFs Color-Word Inhibition/Switching, DKEFs Proverbs), and verbal abilities (DKEFs Letter and Category Fluency). Age, race, general IQ, and education were used as covariates. The 3-step approach was used to validate the neuropsychological subtypes on measures of psychopathic traits (Psychopathy Checklist-Revised; PCL-R), affective regulation (Toronto Alexithymia Scale; TAS), and general personality (Minnesota Personality Questionnaire- Brief; MPQ-B).

**Results:** LPA results indicated a 2-class solution had the best fit, with one subtype displaying worse processing speed, executive functioning, and verbal abilities (LC1) versus the other subtype with better cognitive functioning abilities (LC2). Class membership in the poorer cognitive functioning subtype (LC1) was associated with lower levels of interpersonal but higher affective psychopathic traits, relative to the subtype with better cognitive performance (LC2). Additionally, LC1 evidenced worse affective regulation (i.e., higher levels of externally oriented thinking via the TAS), whereas LC2 displayed better affective regulation. Finally, LC1 reported higher MPQ Wellbeing, and yet also higher Alienation and Harm Avoidance, but lower Social Potency and Achievement, compared to LC2.

**Conclusions:** Findings replicate and extend prior associations between neurocognitive functioning and psychopathic traits and suggest differential links between cognitive functioning and interpersonal versus affective traits of psychopathy. The results suggest that individuals with greater callousness, shallow affect, and lack of remorse may benefit from cognitive remediation and affective regulation approaches, in contrast to individuals with higher levels of primarily interpersonal traits (i.e., superficial charm, grandiosity). Taken together, the results demonstrate

that cognitive data may be used to identify subgroups of offenders with psychopathic traits, who are also characterized by distinct affective regulation abilities and personality traits.

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**Keywords:** cognitive functioning, psychopathy, neuropsychological assessment

**K. BORESS, O. GAASEDELEN, A. CROGHAN, M. KING JOHNSON, D. DAWSON, K. CARAHER, M. R. BASSO, D. M. WHITESIDE. The Cognitive Bias Scale: Replication and Cross-Validation in a Mixed Clinical Sample .**

**Objective:** This study is a cross validation of Gaasedelen and colleagues' (2019) newly developed Cognitive Bias Scale (CBS), a 10-item symptom validity measure using items from the Personality Assessment Inventory (PAI). This study further assessed the utility of the CBS in assessing cognitive response bias using consecutive adult outpatients who completed neuropsychological evaluations that included the study measures.

**Participants and Methods:** Participants were 332 patients (55% female, 84% Caucasian) evaluated at a large academic medical center in the Midwest (mean age = 37.8, SD = 15.70; mean education = 13.9, SD= 2.80). The participants completed the study's embedded and free-standing performance validity tests (PVTs) and the PAI. The participants were then divided based on PVT performance (criterion of failing 2+ PVTs including the Test of Memory Malingering and several embedded PVTs like Reliable Digit Span), with 298 in the pass group and 34 in the fail group, to evaluate classification accuracy of the CBS.

**Results:** Using ROC analysis showed that the CBS had better overall classification accuracy (AUC= 0.71) and incremental predictive ability compared to the existing PAI validity scales. Additionally, the effect size was comparable to that obtained in the original validation study. Further, the original cut-score of 19 had similar classification accuracy in the current study, with sensitivity (SN)= 0.35 (original study SN 0=.31) when specificity (SP)= 0.92 (original study SP =0.96). Some PAI clinical scales and subscales, such as the Somatization scale (SOM) and the SOM Conversion subscale (SOM-C) also demonstrated good classification accuracy (SOM AUC = 0.72, SOM-C AUC = 0.70), a finding not observed in the original study based on West Coast private practice participants.

**Conclusions:** The results supported the CBS as a measure of cognitive bias. Additional research is needed to validate the use of the CBS for specific populations (e.g. forensic populations). Finally, findings from this present study suggest the relationship between somatic conversion traits and PVT failure is more pronounced in the current sample of Midwesterners compared to the initial validation sample of participants from the West Coast.

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**Keywords:** assessment, effort, noncredible presentations

**J. R. LIVINGSTONE, R. ROSENFELD, C. S. REESE. Minnesota Multiphasic Personality Inventory-2-Restructured Form (MMPI-2-RF) Elevated Validity Scales Prediction of Over-Reported Neurological/Cognitive Complaints and Effort Test Failure in a General Clinical Sample.**

**Objective:** This study's purpose was to determine the effectiveness of the Minnesota Multiphasic Personality Inventory-2 Restructured Form (MMPI-2-RF) over-reporting validity

scales in predicting over-reported neurological complaints, cognitive complaints, and effort test failure in a general clinical sample.

**Participants and Methods:** Data were collected from 38 adults (22-72) evaluated within an outpatient neuropsychology clinic. All were administered full neuropsychological batteries, including different performance validity test (PVT) combinations (e.g., Reliable Digit Span, Animals raw score, Trails A t-score, etc.), and the MMPI-2-RF. Multivariate, regression, and chi-square analyses were utilized.

**Results:** Group categorization was determined by any possible MMPI-2-RF over-reporting (based on elevating one or more validity scales). Over-reporters scored significantly higher on both NUC ( $p=.001$ ) and COG ( $p=.000$ ) substantive scales. Among over-reporters, 88% over-reported cognitive symptoms, and 83% over-reported neurological symptoms. Among normal-reporters, rates were 7% and 53%, respectively. Multiple regression models, excluding most predictors, showed RBS accounted for the most COG variability ( $F(1, 37) = 47.445, p < .001, R^2 = .513$ ), while Fs accounted for the most NUC variability ( $F(1, 37) = 38.889, p < .001, R^2 = .577$ ). Elevated validity scales did not predict effort test failure.

**Conclusions:** Like forensic populations, in general clinical populations whose validity scales reflected over-reporting, the RBS scale better predicted over-reported memory complaints. However, unlike forensic populations, over-reporting was not observed to predict effort test failure. One possible limitation is that most of the battery PVTs were embedded.

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**Keywords:** effort, neuropsychological assessment

**S. LEIB, K. J. JENNETTE, D. A. CARTER, G. P. OVSIEW, Z. J. RESCH, W. SONG, N. H. PLISKIN, J. R. SOBLE. Concordance Between Minnesota Multiphasic Personality Inventory-2-Restructured Form (MMPI-2-RF) and Clinical Assessment of Attention Deficit-Adult (CAT-A) Over-Reporting Validity Scales for Detecting Invalid ADHD Symptom Reporting.**

**Objective:** Objective symptom validity assessment is critical for Attention Deficit/Hyperactivity Disorder (ADHD) evaluations to ensure the accuracy and credibility of examinee's responses on self-report measures. Given that very few ADHD measures have embedded symptom validity tests (SVTs), other psychological measures with broad-based SVTs, such as the Minnesota Multiphasic Personality Inventory-2-Restructured Form (MMPI-2-RF), are often utilized to identify symptom over-reporting. Nonetheless, the accuracy of these SVTs for detecting over-reported ADHD symptoms remains poorly understood. This study examined the concordance between the MMPI-2-RF validity scales and the Clinical Assessment of Attention Deficit-Adult (CAT-A), an ADHD-specific symptom measure that includes three embedded SVTs.

**Participants/Method:** This cross-sectional study included data from 148 consecutive ADHD referrals, with a mean age of 27.00 ( $SD=6.67$ ) and mean education of 15.51 years ( $SD=2.32$ ). The sample was 53% female, 45% Caucasian, 26% Hispanic, 14% African American, 10% Asian, and 4% of other racial/ethnic identities. To determine concordance, patients were divided into four groups based on MMPI-2-RF and CAT-A symptom over-reporting results: 1) valid MMPI-2-RF/CAT-A; 2) questionable MMPI-2-RF/CAT-A; 3) questionable MMPI-2-RF/valid CAT-A; and 4) questionable CAT-A/valid MMPI-2-RF.

**Results:** Base rates of questionable symptom reporting (i.e.,  $\geq 1$  validity elevation) were 54% for the MMPI 2-RF (65 valid/75 questionable) and 21% for the CAT-A (111 valid/29

questionable). Overall, results indicate that over-reporting scales on the MMPI-2-RF and CAT-A were concordant in 51% of cases, with 38% valid and 13% questionable on both measures in the total sample. In the 49% of cases with discrepant SVT findings, patients were more likely to provide valid CAT-A/questionable MMPI-2-RF responses (41% of overall cases) than questionable CAT-A/valid MMPI-2-RF responses (8%).

**Conclusions:** Roughly half of the sample had concordant responses on the over-reporting scales of the MMPI-2-RF and CAT-A. When validity responses were discordant, patients were more likely to have questionable reporting on the MMPI-2-RF than the CAT-A. Therefore, SVTs on the CAT-A and MMPI-2-RF appear to capture different types of symptom over-reporting and should not be used interchangeably to capture over-reporting of ADHD symptoms. These findings raise concern about the use of ADHD measures that do not contain ADHD-specific SVTs during neuropsychological evaluations.

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**Keywords:** attention deficit hyperactivity disorder, noncredible presentations

### **S. MUSLIN, J. MOSES. Crystallized and Fluid Intelligence Components of Benton's Visual Retention Test.**

**Objective:** The present study is an analysis of the components of the Benton Visual Retention Test (BVRT), a measure of visual recall. Variables representing crystallized and fluid intelligence were utilized from the WAIS-III in addition to demographic variables to identify which verbal and nonverbal cognitive components contribute to performance on the BVRT.

**Participants and Methods:** Independent variables of the Visual Naming subtest from the Multilingual Aphasia Examination (MAE), representing verbal or crystallized intelligence, were used to further determine the quality of verbal mediation and association with crystallized and fluid intelligence. Components of the MAE Visual Naming as well as the BVRT developed in previous studies were utilized in attempts to further refine dimensional analysis and reveal underlying constructs of these measures in terms of crystallized and fluid intelligence. Statistical analyses were conducted in order to determine which aspects of the BVRT are associated with nonverbal abilities or fluid intelligence, and which aspects are more associated with verbal functioning, or crystallized intelligence.

**Results:** Factor analyses revealed a dimensional relationship between BVRT recall and fluid intelligence, and identified working memory as independent from fluid and crystallized intelligence.

**Conclusions:** BVRT is largely a test of fluid intelligence. Addressing these concepts in the context of the other test scores, neuropsychologists may better understand the underlying weaknesses or strengths that contribute to performance on the BVRT.

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**Keywords:** fluid intelligence, intellectual functioning, verbal abilities

### **W. F. GOETTE, P. DE BOECK, J. SCHAFFERT, A. CARLEW, H. ROSSETTI, L. H. LACRITZ. Identification of Word Characteristics and Individual Factors that Predict Word Learning on the CERAD List Learning Test.**

**Objective:** Identify both item- and person-level covariates that influence the probability of correct recall of words from the CERAD List Learning immediate recall trials in a normal aging population.

**Participants and Methods:** Data were derived from 1390 participants (36% male; 77% White; Mage=75.02, SD=7.18; Medu=13.22, SD=2.76) in the Health and Retirement Study's (HRS) Harmonized Cognitive Assessment Protocol (HCAP). Sample inclusion criteria included completion of all CERAD immediate recall trials, no informant report of cognitive impairment, no Blessed Dementia Rating Scale item endorsed as impaired due to a cognitive reason, and completion of all HCAP surveys in English. Explanatory item response theory was conducted using generalized linear mixed models with 10 item and 5-8 person explanatory covariates. Item covariates included lexical traits from the English Lexicon Project, which provides normative data for psycholinguistic characterization of nearly 40,500 English words. Person covariates included health, socioeconomic, lifestyle, and demographic variables from the larger HRS. Four person covariate models were fit based on groups of person variables. A final person covariate model was then selected from these results.

**Results:** Order of item presentation was significantly related to item recall difficulty ( $p < .001$ ) with the last items presented being the most likely to be recalled, followed by the first and then middle items. Degree of body-object interaction ( $p < .001$ ) and semantic density of words ( $p = .002$ ) were associated with greater item recall. Frequency ( $p < .001$ ), concreteness ( $p < .001$ ), semantic diversity ( $p = .02$ ), age of acquisition ( $p = 0.02$ ), number of phonemes ( $p < .001$ ), and number of parts of speech ( $p = .006$ ) for words were associated with items being more difficult to recall. Years of education ( $p < .001$ ), age ( $p < .001$ ), place of birth (US vs not US;  $p = .002$ ), social engagement ( $p < .001$ ), life satisfaction ( $p = .04$ ), and perceived discrimination (Everyday Discrimination Scale;  $p < .001$ ) were associated with overall learning. In exploratory person covariate models, living in an urban vs rural area ( $p = .02$ ) and race (white vs not white;  $p = .001$ ) were significant predictors of learning.

**Conclusions:** Results indicate word recall is influenced by semantic features (e.g., word frequency, age of acquisition) of the English-language words selected for the CERAD. Word recall likely builds from existing semantic and lexical networks that are measured in addition to simple memory encoding from repetition of the word list. Additionally, evidence for a serial position (i.e., recency and primacy) effect was found in which items presented last were easiest to recall. This is of particular interest since CERAD word order is changed on every trial. Person explanatory analyses support using variables related to life experience in addition to demographics in predicting individual learning. Notably, including a measure of discrimination caused race, which was significant in other models, to no longer significantly predict learning. Consistent with other findings, the amount of social engagement in older age also predicted individual learning. These findings support the need to expand predictors of neuropsychological performance beyond group membership.

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**Keywords:** psychometrics, psychometric constructs, memory: normal

**C. A. HUSTON, T. GREZMAK, S. RODMAN, K. A. LOGAR, S. SAKMAR, L. J. NEOKRATIS, N. D. RIEDLER, A. POREH. The Tri-Choice Naming and Response Bias Measure (N-Tri) - A Novel Measure of Response Bias.**

**Objective:** The prevalence of malingering following a personal injury is estimated to be more than 50% (Resnick, 1997). Thus, it is imperative to have malingering measures that are well-validated and reliable (Janaski et al., 2011). Ideally, malingering tests should have high sensitivity and specificity (Trevethan, 2017). The Tri-Choice Naming and Response Bias Measure (N-Tri), adapted from the Multilingual Naming Test (MINT; Gollan et al., 2012), is a novel malingering test that is similar to the forced-choice paradigm that many malingering tests utilize, but instead of having one target and one distractor item, the N-Tri uses one target and two distractor items. The goal of this study was to determine the ideal cutoff values for the total score and each trial of the N-Tri.

**Participants and Methods:** 400 neurotypical participants completed an online version of the N-Tri, which consists of three trials: (1) naming phase and forced-choice phase, where images must be named and then the target image selected from three options, (2) study phase and forced-choice phase, identical to the forced-choice in trial 1 but after a study period, and (3) delayed forced-choice phase, which is identical to the forced-choice phase of trials 1 and 2 but after a 15-minute delay. Participants were randomly assigned to one of three groups (coached malingerers, uncoached malingerers, controls). For this analysis, uncoached and coached groups were combined into one malingering group. The malingering group was instructed to perform as if they have a brain injury resulting from a car accident and must exaggerate the severity of their injury to receive compensation. The control group was told to try their best.

**Results:** ROC curves were used to determine optimal cutoff values. In order to maximize both sensitivity and specificity, the cutoff value for each trial and the total score of the N-Tri was determined by applying Youden's index, the sum of specificity and sensitivity minus one (Youden, 1950). Scores with the largest Youden's index were selected as the best cutoff values. For Trial 1, a score of 23.50 was determined to be the optimal cutoff value, with a sensitivity of 92.9% and a specificity of 98.6%. Trial 2 was found to have an optimal cutoff value of 27.50, with a sensitivity of 94.9% and a specificity of 97.9%, and trial 3 was found to have an optimal cutoff value of 28.50, with a sensitivity of 96.5% and a specificity of 97.3%. For total score, it was determined that 82.50 is the optimal cutoff value, with a sensitivity of 96.9% and a specificity of 96.6%. The score from the naming phase of trial 1 is considered a separate score, therefore it's not included in the total or trial 1 score calculations.

**Conclusions:** This study demonstrated that a novel malingering test, the N-Tri, was able to distinguish between simulated malingerers and controls with high levels of sensitivity and specificity for all trials and the total score. These results highlight the utility of the N-Tri for the detection of malingered neurocognitive deficit. Further research utilizing patients with documented memory deficits are proposed.

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**Keywords:** assessment, malingering

**C. A. HUSTON, T. GREZMAK, S. RODMAN, K. A. LOGAR, S. SAKMAR, N. D. RIEDLER, L. J. NEOKRATIS, A. POREH. Sensitivity and Specificity of the Reliable Digit Span: Online vs. In-Person.**

**Objective:** The prevalence of malingering following a personal injury is estimated to range from 1% (Hickling et al., 1999) to more than 50% (Resnick, 1997). Hickling et al. (1999) suggest that more than 50% of individual with cases emerging from car accidents were exaggerating psychological symptoms. Thus, it is critical to have malingering measures that are well-validated

and reliable (Janaski et al., 2011). With the proliferation of telehealth and online neuropsychological assessment, a question is raised to whether the results of such measures are comparable to those used in person. The purpose of this study was to validate an online version of the Reliable Digit Span (RDS; Greiffenstein et al., 1994) for the detection of malingering. Sensitivity and Specificity between in-person and online versions of the RDS were compared.

**Participants and Methods:** 400 neurotypical participants completed an online version of the RDS. Participants were randomly assigned to one of three groups (coached malingerers, uncoached malingerers, controls). For this analysis, the coached and uncoached groups were combined into one malingering group. The malingering group was instructed to perform as if they have a traumatic brain injury (TBI) resulting from a car accident and now must exaggerate the severity of their injury in order to receive compensation. The control group was instructed to try their best. Sensitivity and specificity for online RDS scores were compared to published in-person RDS scores from simulation studies that used cutoff scores of  $\leq 6$  and/or  $\leq 7$ . Online RDS scores are also compared to in-person RDS weighted averages of sensitivity.

**Results:** ROC analysis of the online RDS scores demonstrated a sensitivity of 94.5% and a specificity of 89.7% when using a cutoff of  $\leq 7$ , and a sensitivity of 90.6% and a specificity of 91.8% when using a cutoff of  $\leq 6$ . When compared to published studies that used a cutoff of  $\leq 6$  and/or  $\leq 7$  (e.g. Etherton et al., 2005; Greve et al., 2007; Inman & Berry, 2002; Schwarz et al., 2006; Strauss et al., 2000; Strauss et al., 2002), the online version of the RDS consistently had a higher sensitivity, but did not consistently have a higher specificity. However, it is important to note that not all the in-person studies used control groups comparable to that of the online study. The weighted mean sensitivity rate for all studies using a  $\leq 7$  cutoff ( $N = 84$ ) was 46% and 38% for studies using a  $\leq 6$  cutoff ( $N = 165$ ) (Schroeder et al., 2012). The online RDS showed a higher sensitivity than the weighted mean sensitivity for both  $\leq 7$  and  $\leq 6$  cutoffs.

**Conclusions:** This study has demonstrated the validity of an online version of the RDS for detection of malingering. When compared to the sensitivity and specificity of in-person RDS scores, the online version had higher sensitivity consistently for both cutoffs. Online RDS specificity was better or equal to those reported in some studies but not others. Additional research and comparisons are needed to further validate the online version of the RDS for detection of malingering.

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### **C. A. HUSTON, A. POREH. The Detection of Coached Malingering: Preliminary Validation of the Tri-Choice Naming and Response Bias Measure (N-Tri).**

**Objective:** The prevalence of malingering following a personal injury is estimated to range from 1% (Hickling et al., 1999) to more than 50% (Resnick, 1997). Thus, it is imperative to have malingering measures that are well-validated and reliable (Janaski et al., 2011). Currently, there are several well-established forced-choice malingering tests, including Test of Memory Malingering (TOMM; Tombaugh, 1997), Word Memory Test (WMT; Green et al., 1996), and Portland Digit Recognition Test (PDRT; Binder & Willis, 1991). While forced-choice malingering tests are commonly used, an important limitation is their susceptibility to coaching. The purpose of this study was to validate a novel test for the detection of malingering that is aimed to be less vulnerable to coaching than existing measures, the Tri-Choice Naming and Response Bias Measure (N-Tri). The N-Tri, adapted from the Multilingual Naming Test (MINT; Gollan et al., 2012), is similar to the forced-choice paradigm that many common malingering

tests utilize, but instead of having one target and one distractor item, the N-Tri uses one target and two distractor items.

**Participants and Methods:** 282 Participants who were assigned to either the coached malingerers' group or the control group completed online versions of the N-Tri, Reliable Digit Span (RDS), and PDRT adaptation. The N-Tri consists of three trials: (1) a naming and forced-choice trial, where images must be named and then the target image selected from three options, (2) a study and forced-choice trial, identical to the forced-choice section in trial 1 but after a study period, and (3) a delayed forced-choice trial, which is identical to the forced-choice section of trials 1 and 2 but after a 15-minute delay. The coached malingerers' group was instructed to perform as if they have a traumatic brain injury (TBI) resulting from a car accident and now must exaggerate the severity of their injury in order to receive compensation. They were also given a test-taking strategy and symptoms of a TBI. The control group was told to try their best.

**Results:** ROC curves were used to determine the sensitivity of each measure. A cutoff score of  $\leq 6$  or  $\leq 7$  is commonly used for the RDS (Schroeder et al., 2012). Using these cutoffs, a sensitivity of 89% and 94.1% were found for  $\leq 6$  and  $\leq 7$ , respectively. Using the suggested cutoff of 29.50 for the PDRT adaptation, sensitivity was found to be 92.6%. Using the suggested cutoff value of 82.50 for the N-Tri, sensitivity was found to be 97.1%. Thus, the N-Tri correctly identified 97.1% of coached malingerers, while the RDS correctly identified 89% or 94.1%, depending on the cutoff, and the PDRT correctly identified 92.6% of coached malingerers.

**Conclusions:** These results provide initial data that demonstrate that an online version of the N-Tri better detected coached malingerers, and therefore is less vulnerable to coaching, than online versions of the RDS and adaptation of the PDRT. It is suggested that the N-Tri may be useful for detecting response bias in individuals that have received coaching. However, additional studies and further validation of the N-Tri are needed.

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**Keywords:** assessment, malingering

### **C. COHEN, K. J. JENNETTE, N. M. DURKIN, K. BASURTO, G. P. OVSIEW, Z. J. RESCH, W. SONG, N. H. PLISKIN, J. R. SOBLE. Classification Accuracy and Stability of Abbreviated Versions of the Test of Memory Malingering Across Visuospatial Memory Impairment Severity.**

**Objective:** The Test of Memory Malingering (TOMM) is a well-established freestanding performance validity test (PVT). Abbreviated versions of the TOMM, such as Trial 1 (T1) and errors on the first 10 items (T1e10), have shown more robust sensitivity to invalid performance compared to the standard, two-trial administration. However, less is known about the classification accuracy and stability of these abbreviated forms as PVTs in the context of bona fide learning/memory deficits. This study examined the effect of material-specific visuospatial memory impairment severity on the classification accuracy of the T1 and T1e10 indices.

**Participants and Methods:** This cross-sectional study included data from 149 clinical patients who completed T1, T1e10, and Brief Visuospatial Memory Test Revised (BVMT-R) during outpatient evaluation. Four independent criterion PVTs yielded groups of 120 valid and 29 invalid patients. Visuospatial memory impairment severity amongst valid group was based on the BVMT-R Total Recall T-scores:  $\geq 40$ T (no impairment); 30-39T (mild impairment);  $SD=16.3$ ) and mean education was 14.0 years ( $SD=2.6$ ). Receiver operating characteristic (ROC)

curve analyses were conducted for T1 and T1e10 for each of the three impairment bands to determine if accuracy and associated psychometrics vary as a function of increasing impairment.

**Results:** In the no memory impairment group, T1e10 demonstrated moderate classification accuracy (AUC=.84,  $p<.001$ ;  $\geq 2$ : 59% sensitivity/94% specificity, whereas T1 yielded excellent classification accuracy (AUC=.92,  $p<.001$ ;  $\leq 44$ : 90% sensitivity/91% specificity). For the mild impairment group, both T1e10 and T1 produced moderate classification accuracy (T1e10: AUC=.79,  $p<.01$ ;  $\geq 3$ : 38% sensitivity/95% specificity; T1: AUC=.87,  $p<.001$ ;  $\leq 36$ : 62% sensitivity/90% specificity). Similarly, among the severely impairment group, T1e10 and T1 again produced moderate performance classification accuracy (T1e10: AUC=.71,  $p<.01$ ;  $\geq 4$ : 24% sensitivity/91% specificity; T1: AUC=.85,  $p<.001$ ;  $\leq 36$ : 62% sensitivity/89% specificity).

**Conclusions:** Both abbreviated versions of the TOMM retained good classification accuracy, even in the context of increasing visuospatial memory dysfunction and are beneficial for detecting invalid neuropsychological test performance. In particular, T1 showed the most robust classification accuracy and best sensitivity for detecting invalidity, even among the patients with the severe visuospatial memory impairment. Further research exploring T1 and T1e10 in the context of material-specific verbal memory deficits is warranted.

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**Keywords:** neuropsychological assessment, effort, malingering

**D. DAWSON, K. BORESS, O. GAASEDELEN, A. CROGHAN, M. KING JOHNSON, K. CARAHER, M. R. BASSO, D. M. WHITESIDE. Assessing Cognitive Bias with the Personality Assessment Inventory (PAI): Development of New Measures in a Mixed Clinical Sample.**

**Objective:** This exploratory study aimed to evaluate the classification accuracy of newly derived Personality Assessment Inventory (PAI) scales designed to detect cognitive response bias in neuropsychological samples. This study additionally aimed to compare the classification accuracy of the newly derived scales to the existing PAI validity measures and the recently developed Cognitive Bias Scale (CBS).

**Participants and Methods:** Participants were 334 patients (55% female, 84% Caucasian) who completed the study measures and were evaluated at a large Midwestern academic medical center (mean age = 37.28, SD = 15.96; mean education = 13.9, SD = 2.73). This sample also included individuals who met diagnostic criteria for depression (33%), ADHD (15%), anxiety disorders (14%), mild traumatic brain injury (11%), chronic pain (4%) and severe traumatic brain injury (3%). Following completion of the study's embedded and free-standing performance validity tests (PVTs) and the PAI, participants were divided into two groups based on PVT performance (PASS/FAIL) to evaluate classification accuracy of the novel scales. Assignment to the fail group required failure of two PVTs with at least one standalone failure (pass group  $n = 298$ ). Three novel scales called Cognitive Bias Scale of Scales (CB-SOS 1, CB-SOS 2, CB-SOS 3) were created from existing PAI scales using different combinations and weighting techniques. Specifically, the CB-SOS 1 was created by simple summation of PAI scales previously supported in the literature (NIM, SOM, DEP, ANX, SCZ and SUI). The CB-SOS 2 scale was created by entering the scales from the first analysis into a logistic regression equation predicting group status and then the beta weights from each scale were used to construct a logistically derived variable. The third scale, CB-SOS 3, was created by summing the T-scores for 7 scales chosen based on the highest individual classification accuracy in ROC analysis (SOM\_C,

DEP\_P, SOM\_S, ANX\_P, SCZ, NIM, PAR) then dividing them by the total number of included scales.

**Results:** All scales had acceptable overall classification accuracy. By a small margin, CB-SOS 3 showed the highest clarification accuracy (AUC = 0.75), with all three scales performing similarly in the ROC analysis (i.e., SOS-1 AUC = 0.72; SOS-2 AUC = 0.73). With 90% specificity, sensitivity was highest for the CB-SOS 2 (SN = 0.41). Both the CB-SOS 2 and CB-SOS 3 had similar or slightly greater sensitivity when compared to other measures of embedded symptom validity. Additionally, CB-SOS3 marginally outperformed the CBS in overall classification accuracy (CBS AUC = 0.72) while the CB-SOS2 slightly outperformed the CBS in sensitivity (CBS SN = 37%), when specificity was held to 90%.

**Conclusions:** The results support the use of scale level PAI data in the prediction of PVT failure. This is particularly advantageous due to its resilience to coaching for litigating patients. Future research should focus on the validation of the CB-SOS scales for forensic populations.

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**Keywords:** neuropsychological assessment, effort, noncredible presentations

### **C. S. GASS, B. PATTEN. Does Anxiety Impact Memory Test Performance?: Relation of Anxiety Measures to Cognitive Complaints and Performance..**

**Objective:** Evaluate the relation between anxiety, cognitive complaints, and performance on 10 neuropsychological tests: Revised Category Test, Trail Making Test, Parts Speed, A, and B, Tactual Performance Test, Total Time, Memory, and Location, Aphasia Screening Test, Seashore Rhythm Test and Speech Perception Test.

**Participants and Method:** Participants were 149 women and 93 men referred for neuropsychological evaluation in an outpatient memory disorders clinic. Mean age was 61.5 ( $SD = 12.7$ ) and education 15 ( $SD = 2.7$ ) years. Participants did not include 26% of the original sample that failed to satisfy standard performance and symptom validity criteria. Diagnostically, 49% had diagnosed mood disorders. Using MMPI-2 *Pt* scores, patients were classified into High and Low Anxiety Symptom groups ( $n_s = 107$ ). The two groups were no different on age, education, or Test of Premorbid Function. The Cognitive Difficulties Scale (CDS; McNair & Kahn, 1983) measured subjective cognitive complaints.

**Results:** On all 10 of the neuropsychological measures, scores were compared across the Low and High Anxiety groups. Results revealed no statistically significant effects of anxiety on any of the 10 cognitive test scores. Anxiety level was related to cognitive complaint severity (*Pt*,  $r = .39$ ,  $p < .001$ ; ANX,  $r = .29$ ,  $p < .001$ ). Complaint severity was not related to neuropsychological test performance.

**Conclusion:** Results suggest that anxiety is related to subjective complaints but not to performance on these neuropsychological tests. In examinees who pass performance and symptom validity criteria, these neuropsychological tests are valid for assessing brain-based abilities independent of anxiety symptom severity.

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**Keywords:** neuropsychological assessment, memory complaints, anxiety

### **B. LAMBEZ, E. VAKIL. Logical Memory Subtest of the Wechsler Memory Scale: Gist and verbatim information and their role in auditory and visual memory.**

**Introduction:** The Logical Memory (LM) subtest is the most frequently used clinical assessment measure of memory (WMS, Wechsler, 1945). The prose nature of recall depends upon a range of high-level cognitive functions such as episodic memory, conceptual organization and schema formation. It is used both clinically and experimentally for cognitively impaired populations. We suggest that the LM subtest might be further developed, improving its diagnostic sensitivity through additional scoring systems and admissions procedures.

**Objectives:** We address three diagnostic issues regarding the use of the LM subtest: 1) the need for a scoring system for assessing memory through information units of different importance levels and gist abilities 2) the validation of visual modality administration; 3) validation of group administration. Therefore, in the current study we compared visual and auditory versions of the LM test, asking whether forgetting rate over time for gist and verbatim information is affected similarly in both versions, as a function of the information units' importance.

**Participants and Method:** Sixty-nine participants were randomly allocated into two modality groups (Auditory vs. Visual). For the Auditory group the story was read aloud, in standard fashion as described in the manual, except that participants were asked to write what they remembered of the story instead of repeating it aloud. For the Visual group the story was administered in a single written paragraph, projected on a screen for 25 seconds. Both groups had group admission. Recall of the story was requested three times (immediate, 40 minutes and one-week delay). After the one week recall, participants were presented with the story paragraph on a separate sheet of paper. They were asked to rank the importance of each story unit (1-Most important, 2-Important, & 3-Least important).

**Results:** Mixed ANOVA with repeated measures was conducted in order to test the effects of Importance (1-3), Time (Immediate, 40 minute & one Week delay), and Modality at the study phase (Auditory vs. Visual). We found significant main effects for both importance and time, demonstrating the forgetting rate of the less important information, while the important information units were significantly steeper for the most important units of information. We also found a significant triple interaction: comparing the importance levels of 1 vs. 2, we found a difference between group modalities; the auditory group showed a main effect for importance, where level 2 information units were remembered significantly better than level 1 units. The visual group showed a significant dissociation between the two importance level units, where the less important units' information forgetting rate (level 1) was steeper than the important units of information.

**Conclusion:** The present results indicate that the LM subtest can be modified and utilized in order to increase its diagnostic sensitivity. This can be done through the improvement and upgrading of the LM subtest by visual and group administration and by using a more sensitive scoring system.

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**Keywords:** assessment, memory: normal, cognitive processing

### **E. T. KASEDA, S. A. MILLER, L. WU, S. K. HILL. Measurement Invariance of the UK Biobank Cognitive Battery in Neurologic, Pre-Clinical, and Non-Clinical Samples.**

**Objective:** There is strong evidence that a broad range of cognitive test batteries assess a similar underlying general cognitive factor (*g*). The UK Biobank is a large prospective cohort study that collected baseline cognitive data on participants to understand factors that contribute to disease development. Previous research suggested that a one-factor solution best fit the UK Biobank cognitive data. However, participants with neurological disease (e.g., epilepsy, stroke, multiple

sclerosis, etc.) were excluded from the analyses. Determining whether the UK Biobank cognitive battery consistently assesses a similar underlying cognitive construct across non-clinical, pre-clinical, and clinical groups is a critical step in evaluating the utility of cognitive data in shedding light on disease development and progression.

**Participants and Methods:** A total of 451,323 participants were included in the analyses ( $M = 56.19$  years; 53.4% female). This research has been conducted using the UK Biobank Resource. Participants represented non-clinical, cancer pre-clinical, and twelve neurological clinical populations. Participants were administered a brief computerized cognitive battery on a touch screen including tests of fluid reasoning, visual memory, prospective memory, and reaction time. Participants were randomly assigned to two samples to cross-validate all statistics. Confirmatory factor analysis was conducted on the non-clinical control data. Measurement invariance (i.e., psychometric equivalence) was assessed using the alignment method to estimate configural and metric invariance across the non-clinical, pre-clinical, and clinical groups.

**Results:** Consistent with previous findings, a one-factor solution provided a good fit for non-clinical participants (Sample 1: CFI = 0.965, SRMR = 0.022; Sample 2: CFI = 0.967, SRMR = 0.020). Configural invariance (“weak invariance”) was indicated across all groups, with the exception of prospective memory in the subdural hematoma group. Metric equivalence (“strong invariance”) was found across all pre-clinical and non-clinical groups for visual memory, and for most clinical groups for prospective memory and fluid reasoning, with the exception of the subdural hematoma group for prospective memory and the subdural hematoma and pre-clinical cancer groups for fluid reasoning. Metric non-invariance was found for the non-clinical, cerebral aneurysm, head injury, meningitis, multiple sclerosis, subarachnoid hemorrhage, and pre-clinical cancer groups for reaction time. The Average Invariance Index is interpreted like a multiple  $R^2$ , with a value close to 1 implying high invariance and a value close to 0 implying low invariance (Sample 1: Average Invariance Index: 0.163; Sample 2: Average Invariance Index: 0.112).

**Conclusions:** Configural invariance was supported across thirteen of the fourteen groups, suggesting that the UK Biobank cognitive battery assesses a single underlying cognitive construct that generalizes to a wide range of clinical, pre-clinical, and non-clinical groups. Metric invariance was also supported for most cognitive subtests in a majority of the fourteen groups. Thus, use of the one-factor solution of the UK Biobank’s brief computerized cognitive battery generalized widely across groups. Additionally, the fluid reasoning, visual memory, and prospective memory subtests contributed to the latent cognitive construct similarly across most groups; however, the reaction time subtest may be appropriate for comparisons between certain clinical populations but not others.

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**Keywords:** psychometrics, computerized neuropsychological testing

**S. A. BELL, S. JEFFERS, J. B. MILLER, J. Z. CALDWELL, C. G. WONG. Rates of Impairment on Verbal Memory Tests and Association with Executive Functioning .**

**Objective:** Episodic memory tests vary in format (structured and unstructured) and modality (verbal and nonverbal), leading to potential differences in sensitivity when diagnosing memory impairment. Previous research suggests that executive dysfunction is associated with impaired performance on list-learning measures and may contribute to increased rates of impairment on these tasks. The current study examined impairment rates for common verbal memory tests and their associations with executive functioning in a clinical sample.

**Participants and Method:** Records from 1527 patients (age range: 36–93,  $M=71.7$ ,  $SD=8.16$ ) referred for neuropsychological evaluation from an outpatient neurology clinic were included. Measures of interest included Wechsler Memory Scale-IV Logical Memory (story memory) Hopkins Verbal Learning Test-Revised (list-learning) and DKEFS Trail Making Number-Letter Switching (set-shifting). Memory scores  $>1.5$  SD below age-adjusted normative means were classified as impaired. Frequency distributions examined the percentage of patients with impaired scores on story memory and list-learning. Participants were then grouped based on verbal memory delayed recall performance: 1) not impaired on story memory or list-learning, 2) impaired on story memory only, 3) impaired on list-learning only, 4) impaired on both story memory and list-learning. ANOVA comparing verbal memory groups on executive functioning as measured by set-shifting scaled scores was conducted. Spearman's correlations examined the association between set-shifting and memory performance.

**Results:** Story memory was less likely to be impaired across learning (19%), recall (32%), and recognition (20%) trials compared to list-learning (learning=32%, recall=45%, recognition=35%). Regarding patterns of impairment (memory groups), 6% of participants were impaired on story memory only, 18% were impaired on list-learning only, and 27% were impaired on both. A significant main effect between memory groups' performance on set-shifting was found,  $F[3,1523]=55.33$ ,  $p<.001$ . Pairwise comparison showed that groups with impairment on list-learning alone ( $M=7.21$ ,  $SD=4.10$ ) and dual impairment on story memory and list-learning ( $M=7.33$ ,  $SD=4.26$ ) performed significantly worse on set-shifting than the group that was not impaired on either test ( $M=9.89$ ,  $SD=3.52$ ) and the group that was impaired on story memory only ( $M=9.07$ ,  $SD=3.52$ ). Set-shifting was significantly correlated with learning and delayed recall for both tests ( $p$ 's $<.001$ ). Set-shifting showed relatively stronger associations with list-learning (learning:  $r=.37$ , recall:  $r=.35$ ) than with story memory (learning:  $r=.33$ , recall:  $r=.27$ ), though the strength of these correlations did not significantly differ by memory test.

**Conclusions:** Story memory may be less sensitive to memory decline than list-learning. However, our findings support that list-learning measures are more susceptible to executive dysfunction, as patients who were impaired on list-learning had lower set-shifting scores than those who were impaired on story memory only. Story memory and list-learning do not appear to be interchangeable, and inclusion of both types of tests may be beneficial for comprehensive memory assessment.

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**Keywords:** neuropsychological assessment, memory disorders, executive functions

### **S. SINGH, N. CHAYTOR, E. PASSELL, L. JUNG, L. GERMINE. Evaluating Usage and Reliability of Tests in the TestMyBrain Digital Neuropsychology Toolkit .**

**Objective:** The TestMyBrain Digital Neuropsychology Toolkit (DNT) is a not-for-profit, web-based tool that was developed and disseminated to clinicians and researchers in the wake of the COVID-19 pandemic. The DNT consists of web-based, self-administered tests that are similar to traditional neuropsychological tests, but can be administered remotely by neuropsychologists looking to conduct evaluations while adhering to social distancing guidelines.

**Participants and Methods:** An initial survey was conducted to gather user data, but once given access to the DNT, no further clinician or user data were collected to preserve anonymity. Thus, the reported reliabilities are based on a mixed sample of individuals, with no knowledge of various patient referral questions, diagnoses, or specific use cases.

**Results:** Regarding user data, as of August 2020, there were 1205 requests for access to the DNT. Of those requests, 78.2% reported using the DNT for clinical purposes. Others reported requesting access for research (10.9%), educational/training purposes (8.5%), a combination of clinical and research purposes (1.2%), personal use (0.8%), or exploration (0.4%). Split-half reliability was used to measure internal consistency across DNT tests, including verbal and visual pairs, reaction time, trail making tests parts A and B, matrix reasoning, continuous performance test, and digit symbol matching. Internal reliability across these tests ranged between 0.84 and 0.98. Test correlations were also comparable for forward and backward digit span ( $r = 0.57$ ).

**Conclusions:** Based on these analyses, there is good internal reliability across DNT tests. Due to the nature of the sample and the unknown number of tests that were used solely for clinical purposes, future research should aim to conduct studies evaluating the internal reliability of the TestMyBrain DNT tests for specific clinical populations.

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**Keywords:** psychometrics, test reliability, test validity

**A. LAHIRI, U. MITRA, S. SEN, M. CHAKRABORTY, S. RAJ, R. GUHA, P. MITRA, P. CHAKRABORTY. Towards Evaluation of Cognitive Behaviour and Personality Traits Through Computer Based Gaming.**

**Objective:** Psychometric testing is extensively used for assessing an individual's characteristics, personality, and preferences. Paper based psychometric tests have various well-known limitations.

This work explores if the shortcomings of paper-based tests can be overcome through computer-based games using a gaming framework called Antarjami. This framework uses artificial intelligence, machine learning and deep learning to learn the process of cognitive and psychometric evaluation from human psychologists. The game framework evaluates 7 simple cognitive and psychometric parameters as outlined below:

1. Analytical Ability: This in turn can be split into two factors [Kahneman 2012]
  - a. Fast thinking – ability to react quickly
  - b. Strategic Analysis – ability to assess the direction of progress
2. Emotional Stability or Neuroticism - ability to ignore agitations and stay focussed on a goal or objective
3. Resilience - If the player performs poorly in one of the levels, is he/she able to recover in future levels.
4. Learning Ability – is the player able to learn quickly from previous levels and adapt accordingly
5. Perseverance – does the player lose hope quickly if faced with a difficult challenge
6. Competition vs Cooperation – does the player prefer to cooperate or compete
7. Social and Environmental Awareness – is the player attentive or oblivious to what is happening around them.

**Participants and Methods:** The study was conducted in an iterative fashion over a 2year period and involved more than 200 participants. It comprised of multiple batches with each batch having 20 to 30 participants who had never played the game before. The gaming framework was

trained and refined in between each batch as follows. In addition to playing the computer game, each participant is also interviewed by a panel of trained psychologists who use situational judgement tests to evaluate the psychometric parameters for the participants. These scores are then used to train the computer-based game model.

The final phase of the study involved 50 volunteers aged between 15 and 55. The game runs for a fixed time (12 minutes) for each participant, during which they would be presented a sequence of scenarios within the game. Their responses to these scenarios are captured by the framework and are used to compute the psychometric parameters.

**Results:** The game framework was enhanced iteratively between each batch or phase mentioned above and the scoring accuracy improved with each batch. The number of participants in subsequent batches were increased as there was greater confidence in the game model. The obtained scores in each batch were normalized with respect to all participants. The scores from final iteration of the study which involved 50 participants closely resembled those given by the panel of trained psychologists and the correlations ranged from 69 to 88%.

**Conclusions:** In summary the described computer based online game framework provides a promising alternative for conducting remote psychometric testing. Given the current impact of the Covid-19 virus, such online game based psychometric evaluation are expected to gain popularity since both paper-based tests or face-to-face interviews with psychologists have become less feasible.

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**Keywords:** computerized neuropsychological testing, personality, cognitive processing

### **L. WOOD, M. R. UDALA, J. PIERCY, H. MILLER, M. LIBBEN. The Validity, Feasibility, and Acceptability of At-Home Video Conference-Based Neuropsychological Assessment.**

**Objective:** With the unknown trajectory of the COVID-19 pandemic and the associated health and economic impacts, the onus is on health care providers to adopt alternative, innovative ways of delivering clinical services. Neuropsychological assessment conducted via video conference (VC) is an emerging application of telehealth technology, which may allow services to be provided to people who may find it otherwise impossible and/or difficult to see a neuropsychologist. Past research on VC assessment has typically been conducted in controlled lab settings rather than patients' homes, thus the influence of factors such as environmental distractions and patient comfort with technology has yet to be elucidated. Further, there is a lack of data regarding patient experience of VC assessment conducted from the patient's home. The objective of the present study is to examine the validity, feasibility, and acceptance of at-home VC-based neuropsychological assessment.

**Participants and Methods:** Participants included 80 university student participants and a subsample of 20 community-dwelling adults. To facilitate future development of test norms, cognitively healthy participants were recruited (i.e., no medical or psychiatric conditions that might affect cognitive functioning). After completing a demographic questionnaire, participants were administered a battery of tests, via VC technology, consisting of the California Verbal Learning Test-Third Edition, Consonant Trigrams, Symbol Digit Modalities Test, Matrix Reasoning (from the WAIS-IV), Similarities (from the WAIS-IV), and the Verbal Fluency Test. To measure testing fatigue, participants completed a fatigue questionnaire before and after neuropsychological testing. To assess satisfaction with VC assessment, participants completed a

survey evaluating their video technology use, experience with online testing (ease of use, technical issues, overall satisfaction), and willingness to use online psychological services in the future.

**Results:** Correlational analyses indicate good criterion validity for VC assessment. Post-testing fatigue was within normal limits and participants showed good endorsement of VC testing. Tests results were within the predicted range for age and education matched in-person norms.

**Conclusions:** The findings suggest that VC testing is a valid modality for neuropsychological assessment. Results will be informative for future normative studies. VC assessment will increase access to psychological services (e.g., for those in remote areas) and enhance options for appropriate referral practices (e.g., refer to a clinician who speaks the patient's primary language). Ultimately, an empirical validation of at-home VC assessment is needed to support neuropsychologists in accurately interpreting the results of testing and providing appropriate care to patients during the COVID-19 pandemic and beyond.

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**Keywords:** assessment, psychometrics, test validity

**J. T. FOX-FULLER, D. KIM, C. PLUIM, J. NGO, J. USSUI ANZAI, A. BAENA, H. M. KIM, G. PALACIOS-NAVARRO, I. GARCÍA-MAGARIÑO, A. CRONIN-GOLOMB, Y. QUIROZ. Preliminary Evidence of Reliability and Validity of the Computerized Memory for Semantically Related Objects (MESERO) Test – a Pilot Study in Healthy Young Adults.**

**Objective:** There is increasing need for cognitive assessments that can be administered remotely on personal electronic devices (e.g., computer and smartphone). Here we examined preliminary evidence of internal reliability and criterion-related validity of a recently developed computerized cognitive assessment, the Memory for Semantically Related Objects Test (MESERO), in healthy young adults.

**Participants and Methods:** Sixty-five English-speaking healthy volunteers (mean age 23.8 years [SD = 5.5]; mean education 15.5 years [SD = 2.4]) completed a brief cognitive testing session over HIPAA-compliant Zoom on their personal computers. The testing protocol included the Telephone Interview for Cognitive Status (TICS); Logical Memory Immediate and Delayed free recall (LM I and II – 1 story); Digit Span Forward and Backward from the Wechsler Adult Intelligence Scale, 4<sup>th</sup> Edition (WAIS-IV); Phonemic (FAS Words) and Semantic Fluency (Categories [Animals, Vegetables, and Fruits]), and the MESERO. The MESERO utilized a Delayed-Matching-to-Sample paradigm, showing sets of 4 or 6 objects that were semantically related (e.g., all fruits) or unrelated. After a brief delay, participants were asked to indicate via mouse-click whether an object was included in the set previously shown or not. The MESERO captured reaction time and response accuracy (correct or incorrect) across 80 trials, with 20 trials in each condition (4 related, 4 unrelated, 6 related, and 6 unrelated). Internal reliability was calculated using the Spearman-Brown split-half coefficient method between accuracy on the first 40 and last 40 trials. Pearson correlations were calculated between MESERO accuracy on the related and unrelated trials (i.e., average of 4 related and 6 related) and performance on the other cognitive tests.

**Results:** All participants scored  $\geq 32$  on the TICS (suggested cutoff for cognitive impairment) and  $\geq 7$  on Reliable Digit Span (a measure of performance validity). MESERO accuracy across conditions exhibited a ceiling effect, with mean total accuracy at 95.9% (SD = 3.6%). There was

a moderate positive Spearman-Brown split-half reliability correlation between accuracy on the two halves of the test ( $r_s = .41$ ). There was a trend for an association between overall MESERO accuracy (out of 80 trials) and Semantic Fluency ( $r = .23$ ,  $p = .06$ ). Accuracy on the semantically-related condition (4 and 6 objects averaged) was correlated with Digit Span Backwards scaled score ( $r = .25$ ,  $p = .04$ ), and accuracy on the unrelated condition with Semantic Fluency ( $r = .25$ ,  $p = .04$ ). Performance on the other cognitive tests (TICS, LM I and II) did not correlate with MESERO accuracy.

**Conclusions:** In healthy young adults, the computerized MESERO test demonstrated internal reliability. Criterion-related validity correlations between the MESERO and existing tests of working memory and semantic knowledge were small. Future work in healthy adults will examine test-retest reliability. The MESERO has recently been adapted to Spanish and Korean, with validation research currently underway in these languages. We also plan to test older adults, who are the ultimate target group of the test and in whom criterion-related validity may be higher than seen in this pilot study of young adults.

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**Keywords:** working memory, test reliability, test validity

**L. KUZMUK, A. D. REBCHUK, H. M. DEPTUCK, M. CAIRNCROSS, N. D. SILVERBERG, T. S. FIELD. Three-month Practice Effect of the NIH Toolbox Cognition Battery in Young Healthy Adults.**

**Objective:** The NIH Toolbox-Cognition Battery (NIHTB-CB) is a brief assessment of cognitive functions across the lifespan used in both clinical and research settings. Although practice effects have been investigated over shorter (7-21 days) and longer (15 months) time windows, this has not yet been examined over a 90-day window, which is a common assessment time-point for cerebrovascular clinical trials. To establish a reference for young stroke survivors in cerebrovascular clinical trials, we first investigated the practice effects of the NIHTB-CB in young healthy adults over a 3-month test-retest interval.

**Participants and Methods:** Healthy adults aged 18-55 years old were recruited via advertisement at a local academic hospital. Participants were fluent in English, had normal use of their dominant hand, reported no history of neurological or psychiatric disease, and had no prior exposure to the NIHTB-CB.

The NIHTB-CB is a tablet-based assessment comprised of seven instruments measuring five cognitive domains and can be administered in 30 minutes. Tests are aggregated into Crystallized Cognition (Picture Vocabulary and Oral Reading Recognition) or Fluid Cognition (Flanker Inhibitory Control and Attention, List Sorting Working Memory, Dimensional Change Card Sort, Pattern Comparison Processing Speed, and Picture Sequence Memory) composite scores. NIHTB-CB performance is normalized for age, sex, education, ethnicity, and race, and reported as fully-corrected T scores (mean=50, SD=10), which are used here.

Participants were administered the NIHTB-CB under the same test conditions with a three-month ( $\pm 2$  weeks) test-retest interval. Test-retest comparisons were made using paired t-tests and Wilcoxon rank tests ( $p < 0.05$ ) for parametric and nonparametric data respectively. Bonferroni correction was applied to adjust for multiple comparisons of NIHTB-CB subtests ( $p < 0.007$ ). Practice effects (effect sizes) were calculated using Cohen's  $d$  for repeated measures, or Eta squared effect size transformed to Cohen's  $d$  for nonparametric data.

**Results:** Twenty-two participants completed both NIHTB-CB assessments over a median interval of 94 (IQR 82-106) days. Median age was 38 (IQR 34-45); 55% were female. Self-identified race for the majority was either Caucasian (73%) or Asian (18%). Mean education was 16.0 (SD 2.5) years.

Mean NIHTB-CB scores for Fluid (54.7 [SD 10.9] vs. 61.9 [10.3];  $p=0.001$ ), Crystallized (60.0 [5.9] vs. 62.6 [6.6];  $p=0.01$ ), and Total (58.8 [7.2] vs. 64.6 [7.4];  $p<0.001$ ) Cognition were significantly higher at re-test compared to first administration. Significant practice effects were observed for all three composite scores, with large effect sizes for Fluid (Cohen's  $d=1.1$ ) and Total Cognition ( $d=0.8$ ) and a small effect size for Crystallized Cognition ( $d=0.4$ ). A small practice effect was also found for the Pattern Comparison Processing Speed task ( $d=0.3$ ). No significant practice effects were found for the other sub-tests.

**Conclusions:** We found significant practice effects across all composite scores of the NIHTB-CB. These results suggest that adjustments or control-group comparisons may be necessary for repeated administrations during longitudinal follow-up.

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**Keywords:** cognitive functioning, computerized neuropsychological testing, psychometrics

### **A. N. CORRERO, M. RANSOM, B. D. GRADWOHL, R. SPENCER. Mini-Mental State Examination (MMSE) Items Demonstrate Incremental Validity Among Veteran Outpatients.**

**Objective:** The Mini-Mental State Examination (MMSE) is a screening instrument for cognitive impairment with a maximum score of 30 points. It contains items involving orientation, immediate and delayed recall, attention, language, and visual-spatial construction. Although the total score is most frequently interpreted, some research has examined the validity of interpreting individual items as aspects of cognitive functioning. The objective of this study was twofold: 1) describe the degree with which individual MMSE items detect cognitive impairment and 2) evaluate the incremental validity of MMSE items. We expected each MMSE item to uniquely predict scores on more standard measures of neuropsychological functioning.

**Participants and Methods:** Participants were 202 Veterans (6.9% female; age = 64.1 years,  $SD = 16.0$ ; education = 11.9 years,  $SD = 2.7$ ; 95% White) undergoing outpatient neuropsychological evaluations who completed the MMSE and the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). For the MMSE, a language composite included items requiring naming objects, repeating a sentence, writing a sentence, and following commands. Measures of attention, visuospatial functioning, and immediate and delayed recall were derived from MMSE items pertaining to these skills. Each cognitive domain for the MMSE was compared to its corresponding RBANS Index using hierarchical regressions in which age and education were entered as predictors at Step 1, MMSE excluding the domain of interest entered in Step 2, and the MMSE domain of interest entered in Step 3. Based on these regressions, post hoc descriptive statistics were computed for the rate of impairment, defined as  $>1.5$  standard deviations below the mean, on the relevant RBANS index.

**Results:** Total MMSE ( $M = 25.4$ ,  $SD = 4.1$ ) and RBANS ( $M = 82.0$ ,  $SD = 16.9$ ) scores significantly correlated ( $r = .74$ ). Performances were significantly correlated for language ( $r = .39$ ), attention ( $r = .48$ ), visuospatial functioning ( $r = .53$ ), and immediate ( $r = .28$ ) and delayed recall ( $r = .63$ ). In hierarchical regressions, MMSE items added unique prediction to RBANS indices pertaining to attention ( $\Delta R^2 = .06$ ), visuospatial functioning ( $\Delta R^2 = .10$ ), and delayed

recall ( $\Delta R^2 = .16$ ) but not language or immediate memory. Rates of impairment were best characterized by extreme scores on these items, especially among items with greater score range. For example, 81% of Veterans had attentional impairment with scores of 0 on serial subtraction and 15% were impaired with scores of 5 on serial subtractions; relatedly, 85% were impaired with a score of 0 on delayed recall but only 8% were impaired with a score of 3.

**Conclusions:** Although it is standard practice to interpret MMSE total scores, this study provides support for examining some individual items. These results were most supportive of using extreme scores, especially on three-word recall and serial subtractions, to identify individuals in need of more comprehensive evaluations. Thus, item-level analysis of the MMSE provides predictive power in an outpatient setting. Importantly, using the MMSE and examining discrete items does not replace comprehensive assessments but may assist clinicians in triaging patients and customizing batteries.

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**Keywords:** cognitive screening, assessment, psychometric constructs

**R. C. HILSABECK, P. V. DEVORA, S. KARBOSKI, K. O'MAHAR. Comparison of the Boston Naming Test (BNT-60) and Multilingual Naming Test (MINT-32) in an Older Adult Memory Clinic Population.**

**Objective:** Confrontation naming measures are commonly used for clinical decision making in dementia (e.g., presence, etiology). The Boston Naming Test (BNT) is a widely used measure of confrontation naming but has outdated and culturally biased content. A new naming measure, the Multilingual Naming Test (MINT), has limited evidence of its validity in a variety of patient populations. The purpose of this study was to examine the BNT and MINT in a sample of older adults evaluated in an interprofessional memory clinic. Specifically, naming performance (both measures) between diagnostic groups was compared. Strength of agreement and impairment classification agreement between the BNT and the MINT was also evaluated.

**Participants and Methods:** Participants were 89 adults (50.6% women) who were administered the BNT and MINT as part of a comprehensive neuropsychological assessment. Most participants were non-Hispanic White (93.3%), and the remaining participants were Hispanic (3.4%) and Black (3.4%). Based on interprofessional consensus diagnoses, 33 participants (37.1%) were diagnosed with dementia (DEM), 19 (21.4%) with mild cognitive impairment (MCI), and 37 (41.6%) with no cognitive disorder (NCD). One-way analyses of variance (ANOVA) and Chi-square ( $X^2$ ) analyses were conducted to determine group differences, and Tukey's least significant difference (LSD) post hoc tests were used to identify where group differences emerged when present. To examine the level of agreement in T scores on the BNT and MINT, concordance correlation coefficient (CCC) and root mean square difference (RMSD) values were calculated for the total sample and each diagnostic group.  $X^2$  analyses were used to investigate level of agreement in percentage of participants classified as impaired (i.e., T scores 35 and below).

**Results:** Average age of participants was 73.3 years ( $SD = 9.1$ ), and average education was 16.7 years ( $SD = 2.6$ ). Participants in the DEM group were significantly older than participants in the NCD and MCI groups, but there were no significant group differences in education, gender, or ethnicity. Using age as a covariate, there were significant group differences in T scores on the BNT and MINT. In all cases, the DEM group obtained significantly lower BNT and MINT scores than the other two groups, which did not differ significantly from each other. Calculations

of CCC revealed poor strength of agreement between T scores of the BNT and MINT for the total sample and each diagnostic group (ranged from 0.47 to 0.69), and RMSD values indicated average differences between T scores ranged from 0.79 to 1.09 standard deviations. With regard to percentage of participants classified as impaired, significant differences were found in the total sample between the BNT and the MINT. Percent agreement ranged from 92-100% for the NCD and MCI groups, while agreement in the DEM group was approximately 75%.

**Conclusions:** As expected, the DEM group demonstrated significantly lower BNT and MINT scores than the MCI and NCD groups. However, there was limited agreement between the two naming measures, particularly for the DEM group. Overall, the MINT classified more participants as impaired, including those without a cognitive disorder.

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**Keywords:** naming, aging disorders

### **H. E. ANDREWS, A. HALPIN, A. BOEVE, L. D'ERRICO, R. K. MACAULAY. Psychometric Properties of the Mindful Attention Awareness Scale (MAAS) in Older Adults: Are We Capturing Attention?**

**Objective:** Developed to measure traits of attention to and awareness of the present, the Mindful Attention Awareness Scale (MAAS) has been validated for use in several populations. However, to our knowledge, no peer-reviewed study has examined the psychometric properties of the MAAS in community-dwelling older adults. While there is a growing body of research linking mindfulness practice with improved measures of cognitive performance and promising neuroimaging findings, few studies have directly investigated the convergent validity of the MAAS by assessing associations between MAAS scores and neuropsychological test performance. The present study investigated psychometric properties of the MAAS in community dwelling older adults. Primary aims of the study were to examine internal item consistency of the MAAS in a diverse older adult population and determine if associations between the MAAS and cognitive measures exist.

**Participants and Methods:** Community-based participatory research approaches were used to enhance recruitment of a socioeconomically diverse sample of 121 older adults. Participants completed clinical interviews and measures of auditory working memory (Digit Span), processing speed, visual attention, and task switching (Trail Making Test), problem solving and concept formation (Wisconsin Card Sorting Task), spatial selective attention and cognitive control (National Institute of Health-Toolbox for the Assessment of Neurological and Behavioral Function [NIH-TB] Flanker Inhibitory Control and Attention Test), and response inhibition (Color-Word Interference Test and Color Naming Test on the Delis-Kaplan Executive Function System). Pearson's correlations and hierarchical multiple regression analyses were conducted to examine associations among the relevant variables.

**Results:** Chronbach's alpha coefficient ( $\alpha = .786$ ) suggested adequate internal item consistency for the MAAS. Higher MAAS scores were significantly associated with older age ( $r = .279, p = .002$ ) and higher levels of education ( $r = .193, p = .034$ ). MAAS scores were a significant predictor of Flanker scores, even after accounting for the effect of age and level of education ( $p < .001$ ). No other significant associations with MAAS scores and cognitive variables were found.

**Conclusions:** This study expands the external validity of the MAAS to community-dwelling older adults. Notably, higher MAAS scores were associated with better spatial selective attention and cognitive control even when accounting for age and education. These results are consistent

with previous imaging studies that have found correlations between dispositional mindfulness and increased gray matter in the prefrontal cortex, insula, and bilateral temporoparietal junction. Findings from this study provide preliminary support that the MAAS has convergent validity with cognitive inhibition.

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**Keywords:** psychometrics, aging (normal), cognitive functioning

**C. NOWINSKI, M. VARELA DIAZ, A. J. KAAT, M. WEINER, L. OMBERG, S. AMAGAI, L. BUI, Z. HOSSEINIAN, M. A. NOVACK, S. PILA, A. PRATRAP, J. SLOTKIN, J. N. STOEGER, J. KING, D. RENTZ, M. KELLEN, L. MANGRAVITE, R. GERSHON. Mobile Toolbox: Remote Assessment for Measuring Cognitive Change Across the Lifespan.**

**Objective:** Differentiating typical from pathological cognitive change across the adult lifespan is essential for both preventing and treating cognitive decline. However, the field lacks assessment tools that can be easily deployed in diverse research designs and populations. To address this need, we are developing the “Mobile Toolbox” (MTB), a smartphone-based app that provides researchers with a suite of measures to remotely assess cognitive ability, as well as emotional health, across the lifespan. This approach will allow researchers to reach a more diverse population without having to bring participants into clinical settings, a need that is becoming increasingly important in a COVID-19 world.

**Participants and Methods:** The MTB consists of a library of cognitive and emotion tests, including validated adapted versions of NIH Toolbox measures, plus a complete research platform for app creation, study management, data collection, and data management. Clinical researchers will be able to use this system to design smartphone-based test batteries, deploy and manage mobile data collection in their research studies, and aggregate and analyze results in the context of large-scale norming data. The MTB assessment library is intended to be a dynamic repository designed to expand with time. That is, components will be open source to allow researchers and developers to integrate externally developed tests, including those assessing variables such as mood and fatigue that might influence cognitive test performance. All MTB measures have been created or adapted for a mobile interface. The assessments are being validated against gold standard measures in healthy adults ages 20-85. The measures will be normed and 3-month, 12-month and 24-month change scores calculated in an age-stratified (20-85), national sample matching the 2020 US Census data for gender, race, ethnicity, SES and education level. Additional validation and longitudinal evaluation will be conducted in healthy and clinical samples, including persons at risk for Mild Cognitive Impairment or Alzheimer’s disease, cognitively impaired, and those with Parkinson’s disease.

**Results:** This section will present the Mobile Toolbox research platform and demonstrate examples of assessments.

**Conclusions:** Remote assessments provide a novel approach to engage hard-to-enroll participants and those from diverse populations. The Mobile Toolbox will provide researchers and clinicians with the modern tools they need to capture cognitive abilities. This assessment tool will not only be an asset to the study of cognitive change, but will allow for greater generalizability of findings by meeting potential participants where they are—on their smartphones.

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**Keywords:** assessment, cognitive functioning, dementia - Alzheimer's disease

**M. WIGGINS, C. DION, S. AMINI, R. DAVIS, D. PENNEY, C. PRICE. Normative Data for Digital Maze Test (dMaze) Performance in a Sample of Cognitively-Well Older Adults.**

**Objective:** Maze completion is a classic neuropsychological assessment of higher order function. A novel, digital version of a maze test (dMaze; Davis et al., 2014) was recently created but not yet validated. The dMaze consists of 3 difficulty levels of decision-making (easy, intermediate, and advanced) and within each difficulty level a no-choice condition (no decision points along the path) and a choice condition (decision points along the path); the solution is the same for the no-choice and choice conditions of each level. The present study aims to: 1) provide descriptive normative data for dMaze performance in a sample of cognitively-well older adults; and 2) based on the processing speed theory of aging (Salthouse, 1996), compare time-based performance to a subgroup of older adults with mild cognitive impairment (MCI).

**Participants and Methods:** 56 non-demented older adults screened for cognitive impairments and with minimal brain burden (age:  $68.10 \pm 5.51$ ; education:  $15.71 \pm 2.39$ ; 46% female; 93% white) completed dMaze, as did a subset of 10 individuals who met cognitive criteria for mild cognitive impairment (age:  $67.70 \pm 3.62$ ; education:  $15.75 \pm 3.77$ ; 60% female; 70% white). dMaze variables of interest for each difficulty level include: 1) calibration time, 2) choice and no-choice time to completion, 3) choice and no-choice total ink length drawn on page, and 4) choice and no-choice total ink length adjusting for the correct path length. Descriptive statistics were used to provide normative data. Independent samples t-tests examined group differences in calibration time and total time to completion (choice and no-choice), with dMaze variables being square root transformed to achieve normality.

**Results:** Descriptive statistics are as follows: *Time to Completion (seconds):* easy (no choice  $43.81 \pm 16.60$ ; choice  $54.07 \pm 20.5$ ), intermediate (no choice  $39.65 \pm 15.74$ ; choice  $59.06 \pm 23.66$ ), advanced (no choice  $35.47 \pm 13.24$ ; choice  $53.06 \pm 20.03$ ). *Calibration Time (seconds):* easy ( $3.32 \pm 1.92$ ), intermediate ( $2.62 \pm 0.83$ ); advanced ( $2.45 \pm 0.90$ ). *Ink Length (millimeters):* easy (no choice  $760.94 \pm 30.35$ ; choice  $797.56 \pm 63.61$ ), intermediate (no choice  $736.49 \pm 87.52$ ; choice  $786.76 \pm 89.16$ ), advanced (no choice  $710.86 \pm 36.90$ ; choice  $776.42 \pm 87.37$ ). *Ink Length correcting for Path Length (millimeters):* easy (no choice  $7.32 \pm 0.29$ ; choice  $7.67 \pm 0.61$ ), intermediate (no choice  $7.36 \pm 0.88$ ; choice  $7.87 \pm 0.89$ ), advanced (no choice  $7.51 \pm 0.89$ ; choice  $7.92 \pm 0.89$ ). *MCI vs Non-MCI Group Comparisons:* Individuals with MCI had longer total time to completions on the easy choice (73 vs 54 seconds), intermediate choice (75 vs 59 seconds), easy no-choice (69 vs 43 seconds), and intermediate no-choice conditions (52 vs 39 seconds; all  $p < .05$ ). There were no differences between groups on the advanced condition time to completion scores or in calibration time (all  $p > .05$ ).

**Conclusions:** We provide normative reference for dMaze performance in a well-characterized sample of cognitively-well older adults. We also demonstrate that individuals with MCI had longer total time to completion on easy and intermediate choice and no-choice conditions of the dMaze, relative to cognitively-well older adults. Interestingly, we found between group differences on simpler no-choice mazes yet a lack of differences on the advanced mazes (containing more choice points of higher complexity). This suggests that dMaze features other than decision making difficulty may be sensitive to cognitive impairment in MCI.

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**Keywords:** aging (normal), cognitive functioning, neuropsychological assessment

**P. M. LOGAN, J. E. KAMPER. When there's a WMS there's a way: Investigating the differential utility of the WMS-IV Logical Memory I Adult versus Older Adult versions in a mixed clinical sample of 65-69 year-old veterans.**

**Objective:** The WMS-IV Logical Memory task includes normative data for 65-69 year-olds on both the Older Adult and Adult formats. Thus, clinicians may choose to use either version for this age group. The nature of each task is slightly different; the Adult LM I test is notably longer, has increased linguistic complexity, and has fewer learning trials than the Older Adult LM I test. The Adult LM I test is arguably a more working memory intensive task, and thus may measure slightly different cognitive processes. In clinical samples (e.g., among individuals susceptible to working memory or executive overload), this could lead to normatively worse LM I performances than they would otherwise have. The present study compared Adult and Older Adult LM I performances in a sample of 65-69 year-old veterans. It was predicted that veterans completing the Adult LM I task would perform normatively worse than veterans completing the Older Adult LM I.

**Participants and Methods:** Participants were 55 veterans (78% white/non-Hispanic and 93% male) aged between 65-69 years-old who completed the Older Adult LM I ( $n = 32$ ) or Adult LM I ( $n = 23$ ) test as part of a comprehensive neuropsychological evaluation at a large outpatient neuropsychology clinic. This sample excluded 6 participants whose performance was below conservative thresholds on embedded PVT measures. Assessments were conducted for clinical purposes, and measures were therefore chosen based on clinical judgement/practice. The present study was retrospective—archival data was used.

**Results:** An independent samples  $t$ -test indicated that LM I SSs did not significantly differ between the Older Adult version ( $M = 7.59$ ) and Adult version ( $M = 7.61$ ). Participants who completed the Adult version had significantly more years of education (13.4 vs. 11.9) and significantly better working memory performances (WAIS-IV DSB SS: 9.27 vs. 7.69; WAIS-IV DSS SS: 8.83 vs. 7.00) than participants who completed the Older Adult version. ANCOVAs controlling for education and working memory were not significant but were underpowered.

**Conclusions:** Contrary to predictions, LM I performance was not significantly different among 65-69 year-olds who completed the Adult version versus those who completed the Older Adult version. At face value, this could indicate that choosing which LM version in this age group is irrelevant: their performances were normatively the same, regardless of task difficulty. Caution is warranted, though, as the participants were not randomly assigned to LM version. Selection effects were present, as individuals who were administered the Adult version had more years of education and better working memory than individuals who were administered the Older Adult version. Further study using random assignment in clinical samples—or with larger samples with sufficient power to adjust for covariates—is warranted.

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**Keywords:** memory disorders, psychometrics, neuropsychological assessment

**L. M. CAMPBELL, E. PARRISH, A. HEATON, J. SWENDSEN, C. A. DEPP, R. C. MOORE. The Relationship Between Contextual Factors, Performance, and Validity of Smartphone-Based Mobile Cognitive Tests of Executive Function and Learning.**

**Objective:** Smartphone-based mobile cognitive tests (MCT) are new assessment tools developed to aid in longitudinal tracking of cognitive functioning and assessing cognitive performance in natural environments. However, we currently have little research examining how contextual factors such as distractions, interruptions, presence of other people, and location impacts MCT performance. Therefore, we examined how these contextual factors relate to MCT performance and convergent validity with lab-based neuropsychological tests.

**Participants and Methods:** Eighty-four adults (54 persons with HIV, 30 HIV-negative adults) aged 50-74 (Mean age=59, 70% male, 67% non-Hispanic white) completed in-person neuropsychological testing, including a test of executive functioning (Stroop Color Word Interference Test) and verbal list-learning (Hopkins Verbal Learning Test-Revised [HVLTR]). Participants also completed the UCSD Performance-Based Skills Assessment-Brief (UPSA-B). Following the in-person assessment, participants completed MCTs of inhibition (mobile Color Word Interference Test [mCWIT]; score=time to complete) and verbal list-learning (mobile Verbal Learning Test [mVLT]; score=total words correctly recalled over three learning trials) for 14 days. Participants also self-reported if they were distracted or interrupted (combined), if they were with other people, and their current location (home vs. not at home). Matched-pairs Wilcoxon tests were used to examine how context impacted average test performance, and Spearman correlations were used to understand how different contexts impacted convergent validity of the MCTs with lab-based tests.

**Results:** Presence of a distraction negatively impacted mCWIT performance (no distraction:  $M=22.3$  seconds, distraction:  $M=24.7$  seconds,  $p<0.01$ ). However, the presence of others (alone:  $M=22.2$  seconds, with people:  $M=23.3$  seconds,  $p=0.07$ ) or being away from home (home:  $M=22.6$  seconds, not at home:  $M=21.9$  seconds,  $p=0.07$ ) did not significantly impact mCWIT performance. On the mVLT, presence of a distraction (no distraction:  $M=21.2$  words, distraction:  $M=18.6$  words,  $p<0.01$ ), being with others (alone:  $M=20.6$  words, with people:  $M=19.3$  words,  $p<0.01$ ), or being away from home (at home:  $M=20.8$  words, not at home:  $M=19.6$  words,  $p<0.01$ ) negatively impacted performance. Performance on the mCWIT was more highly correlated with the in-person Color Word Interference Test when not distracted ( $\rho=-0.68$  vs. distracted  $\rho=-0.56$ ), but was not significantly impacted by being away from home ( $\rho=-0.64$  vs. home  $\rho=-0.70$ ) or presence of others ( $\rho=-0.67$  vs. alone  $\rho=-0.66$ ). UPSA-B performance was more highly correlated with mCWIT performance when not distracted ( $\rho=-0.32$  vs. distracted  $\rho=-0.12$ ) but the correlation did not differ when home vs. not at home or alone vs. with people. The relationship between the mVLT and in-person HVLTR was less impacted by contextual factors (no distraction  $\rho=0.56$  vs. distraction  $\rho=0.52$ ; alone  $\rho=0.49$  vs. with others  $\rho=0.50$ ; home  $\rho=0.55$  vs. not at home  $\rho=0.49$ ). Interestingly, mVLT performance was somewhat more correlated with UPSA-B performance when participants were not at home ( $\rho=0.38$ ) as compared to when they were at home ( $\rho=0.28$ ), but was not as impacted by distractions ( $\rho=0.30$  vs. no distractions  $\rho=0.31$ ) or presence of others ( $\rho=0.34$  vs. alone  $\rho=0.29$ ).

**Conclusions:** Contextual factors impact MCT performance and convergent validity with in-lab neuropsychological testing, but these contextual factors vary by mobile task. Additionally, some contextual factors such as current location may provide better insight into real-world functioning. Correspondence: *Laura Campbell, SDSU/UC San Diego Joint Doctoral Program in Clinical Psychology, San Diego, CA, 92103, United States. Email: l4campbe@health.ucsd.edu*

**Keywords:** ecological validity, test validity, test development

**Y. SERRANO, J. E. CARON, J. C. YOUNG, A. GOULD, H. PEDERSEN. Comparing an RBANS Logistic Regression to the RBANS Effort Index (EI) in two independent Veteran samples..**

**Objective:** Silverberg, Wertheimer, and Fichtenberg (2007) created the RBANS-Effort Index (EI) believing it would hold up better to cross-validation in different groups than other methods such as logistic regression (LR), which may have better ability to discriminate between credible and non-credible performance. Unfortunately, the EI has not held up to cross-validation as well as expected. So, if a LR model withstands cross-validation in different settings and discriminates better, it would be preferable. As such, this study compared the classification accuracy of LR derived from subtests of RBANS to the EI to 1) see how accurately each classified credible and non-credible effort, and 2) see how well their respective classification rates held up to cross-validation in a second (independent) Veteran sample.

**Participants and Methods:** Retrospective data was obtained from two Department of Veterans Affairs (VA) neuropsychology clinics. A forward stepwise procedure was used to create the LR at one site (a VA in the Midsouth) using 65 participants with credible ( $n = 24$ ) or non-credible ( $n = 41$ ) RBANS performances. This LR equation was then applied to another group of participants in the Northeast (credible = 114; non-credible = 89). RBANS performances were considered non-credible when two or more performance validity tests (PVTs) were failed during a neuropsychological examination using the RBANS. Performances were considered credible if two or more PVTs were administered during an assessment and none were failed. The LR classification performance was compared to EI at both sites to see which performed better and which held up to cross-validation.

**Results:** For the sample used to create the LR, the LR slightly outperformed the EI (AUC was 0.86 for LR and 0.78 for EI). Using a probability cut score of .50 produced 81.5% accurate classification with excellent sensitivity (.85) but less than optimal specificity (.75). Raising the cutoff to .80 increased specificity to an acceptable .88, but sensitivity dropped considerably (.56). In the same sample, an EI cutoff of  $>3$  was needed to achieve adequate specificity (.88), but sensitivity was low (.39). When LR and EI were examined in a new sample, the LR and EI performed similarly to the original sample, and to each other. The LR AUC was 0.79, and the EI AUC was 0.76. Optimal classification required adjusting cut scores to .80 for the LR and  $>3$  for the EI, just like the first site. Using these cut scores, LR demonstrated good specificity (.90) but poor sensitivity (.42). The RBANS-EI demonstrated almost the exact same specificity (.92) and sensitivity (.40) as the LR.

**Conclusions:** The LR held up equally well to cross-validation as the EI. Both demonstrated acceptable specificity but poor sensitivity. Neither one demonstrated it was significantly better than the other, but LR may be preferable for Veterans from the Midsouth area. However, it is possible that the two samples used in this study were too similar to effectively cross-validate the LR. Further research should validate the LR in non-Veteran samples to see if it withstands more rigorous cross-validation using increasingly diverse populations.

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**Keywords:** effort, assessment, psychometrics

**S. RIZER, S. CHAPMAN, M. BARKER, K. RADLER, D. IGLESIAS HERNANDEZ, N. DELGADO, M. MCGURN, E. D. LOUIS, S. COSENTINO. Consistency of Remote and In-Person Cognitive Assessment in Older Adults with Essential Tremor.**

**Objective:** The COVID-19 pandemic has prompted many studies to restructure their assessment protocols in order to conduct remote evaluations that accommodate social distancing and quarantine guidelines. As part of this process, traditional paper and pencil neuropsychological assessments are administered online. Studies are now needed to determine the extent to which online assessment is consistent with in-person assessment. The current study leveraged data from an ongoing longitudinal study of older adults with Essential Tremor (ET) to examine the consistency of memory, executive function, attention and language tests administered online in comparison to in-person assessment approximately 18-months prior.

**Participants and Methods:** Participants included 19 older adults enrolled in an ongoing, prospective, longitudinal study of cognition in ET (mean age = 72 (10.1), education in years = 15.2 (2.5), 65% female; 100% Caucasian). Memory was assessed with the California Verbal Learning Test II (CVLT-II; Total Recall and Long-delay Free Recall), and the Logical Memory subtest of the Wechsler Memory Scales – Revised (WMS-R; Immediate and Delayed). Executive functions were measured with the Delis-Kaplan Executive Function System test (D-KEFS) Verbal Fluency test (letter, category, switching fluency and accuracy scores), Color-Word (CW) (naming, reading, inhibition, inhibition/ switching scores), Twenty Questions (initial abstraction, total questions, and weighted achievement), and Digit Span Backwards (total correct). Attention tests included Oral Symbol Digit Modalities Test (OSDMT) (total correct) and Digit Span Forward (total correct). The only available language test was the Boston Naming Test (BNT) (sum total correct). Intraclass correlation coefficients (ICCs), used to measure reliability, were calculated to examine the consistency of scores at both visits. Following Koo & Li (2016), ICCs were interpreted as:  $>.90$  excellent,  $.75-.9$  good,  $.5-.74$  moderate, and  $<.50$  poor reliability.

**Results:** ICCs for memory tests ranged from  $.79$  to  $.87$ . Executive function ICCs showed greater variability. Digits Backwards, Twenty Questions (initial abstraction and total questions), and CW reading showed poor reliability ranging from  $-.22$  to  $.48$ . Moderate reliability was observed for Twenty Questions achievement ( $.56$ ), Category Fluency ( $.69$ ), and CW Inhibition ( $.66$ ). Verbal Fluency (Letter, Switching Fluency and Accuracy) and CW naming showed good reliability (range= $.85$  -  $.88$ ), while CW switching showed the highest reliability ( $.98$ ). Attention tests showed moderate reliability (range= $.63$  -  $.70$ ). BNT showed good reliability ( $.77$ ).

**Conclusions:** The majority of remote neuropsychological tests had good to excellent reliability when compared to in-person data from approximately 18 months prior. In terms of domains, memory and language assessments showed high ICCs, while executive function and attention had more mixed results. Importantly, as this study was not prospectively designed to assess reliability formally, and 18-months intervened between visits, low ICCs cannot be interpreted as reflecting poor reliability. It may be that such tests are more sensitive to changes among older adults and such changes decrease ICC values. However, good to excellent reliability coefficients despite the intervening 18-months, provide preliminary evidence that remote evaluations produce quite consistent results to that obtained with in-person assessments. Future studies are needed to formally evaluate the reliability and validity of remote assessments.

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**Keywords:** computerized neuropsychological testing, test reliability, neuropsychological assessment

**S. LAVIGNE, H. A. CLARK, K. A. MARTINEZ, J. QUATTLEBAUM, P. MARTIN, R. W. SCHROEDER. Preliminary Support for Increased Cutoff Scores on the Test of Memory Malingered when Accounting for Educational Attainment Level.**

**Objective:** A significant amount of research has been devoted to the Test of Memory Malingered (TOMM), the most frequently used performance validity test (PVT) in neuropsychology. At the same time, little to no research has examined whether cutoff scores can be adjusted to further improve classification accuracy rates when taking into account an examinee's educational attainment, a demographic that has been associated with premorbid cognitive capability. The current study sought to determine if cutoffs can be increased when educational attainment is considered.

**Participants and Methods:** Participants included 216 adult outpatients (mean age=47.1) who were minimally administered the TOMM and at least four additional PVTs, which were used as criterion PVTs. 150 individuals were valid performers (they passed all criterion PVTs) and 66 were invalid performers (they failed two or more criterion PVTs). Four participant groups were then established based on examinee educational attainment. These groups included 1) individuals with less than 12 years of formal education (<12y; n=21), 2) those who completed high school (12y; n=72), 3) individuals with 13 to 16 years of formal education (13-16y; n=97), and 4) those with 17+ years of education (17+y; n=26). Frequency analyses were utilized to determine specificity and sensitivity rates for TOMM Trial 2 (T2) and Retention when separated by educational attainment group.

**Results:** For T2 and Retention cutoffs of <45, specificity rates were 92% or above in all education level groups. While maintaining specificity at 90% in the <12y group, the T2 cutoff could be increased to <47 (sensitivity increased from 37.5% to 50.0%) and the Retention cutoff could be increased to <46 (sensitivity maintained at 50.0%). In the 12y group, the T2 cutoff could be increased to <47 (sensitivity increased from 32.0% to 44.0%) but the Retention cutoff needed to remain at <45 (sensitivity was 31.8%). In the 13-16y group, the T2 cutoff could be increased to <49 (sensitivity increased from 48.1% to 59.3%) and the Retention cutoff could also be increased to <49 (sensitivity increased from 59.3% to 70.4%). Finally, in the 17+y group, the T2 cutoff could be increased to <49 (sensitivity increased from 16.7% to 33.3%) and the Retention cutoff could be increased to <50 (sensitivity maintained at 50.0%).

**Conclusions:** These results continue to demonstrate that TOMM Trial 2 and Retention are robust performance validity measures regardless of examinee education level. The findings also indicate that T2 and Retention cutoffs may be able to be increased, particularly for individuals with education levels above high school, while still maintaining adequate specificity. By increasing the cutoffs, the sensitivity of the test can be increased. Further research should cross-validate these findings to ensure that the cutoffs identified in the current study generalize to other clinical samples.

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**Keywords:** malingering, psychometrics

**S. P. REISE, K. WIDAMAN, R. M. BAUER, D. L. DRANE, D. LORING, L. UMFLEET, D. WAHLSTROM, K. ENRIQUEZ, E. F. WONG, A. S. HUBBARD, R. M. BILDER. Item Response Theory Analyses of Matrix Reasoning: Towards a New Short Form or Adaptive Test?**

**Objective:** The Matrix Reasoning (MR) subtest of the Wechsler Adult Intelligence Scale, 4<sup>th</sup> Edition is among the most widely used tests in clinical psychology and neuropsychology to assess nonverbal reasoning ability. Prior psychometric examination of similar tests (Raven's Progressive Matrices) suggests that modern psychometric theory including item response theory (IRT) can optimize efficiency by streamlining the number of needed items, but to our knowledge, MR has not benefited from similar examination. The current study applied IRT to MR in a clinical sample from teaching clinics in the United States.

**Participants and Methods:** We examined results from 549 patients who were administered MR at one of four sites in the National Neuropsychology Network. The sample comprised women (52.5%) and men (47.5%) with median age = 53 (range 18 to 90) who were evaluated between 8/1/2019-7/31/2020. The mean raw score on MR was 15.4 (SD 5.6) and the mean scaled score was 9.9 (SD 3.2). MR includes two introductory "practice" items and 26 test items. In the standard administration, stimuli are administered in order of progressive estimated difficulty until the examinee fails 3 consecutive items. The IRT analyses examined item and test information characteristics using a two-parameter logistic model, and then applied computational simulations to determine which adaptively-administered sequence of items would maximize test information.

**Results:** More than half of the sample ( $n = 282$  or 51%) required administration of 23 items following the standard administration protocol. IRT analyses demonstrated that the first 5 MR items were passed without error by almost all participants ( $P[\text{correct}] = .97$ ). Because these items did not contribute to performance variability across subjects, they were dropped from subsequent analyses. The most difficult remaining items convey limited information at trait levels higher than 1.5 SD above the mean, suggesting that precision at the highest levels of ability could be improved. Considerable overlap among the other MR items indicated that an optimal short form or adaptive test version of the MR subtest could be developed with precision close to the entire test. Using only 10 items, a simulated computerized adaptive test (CAT) algorithm generated scores with extremely high correlations ( $r = .99$ ) with a trait value ( $\theta$ ) that would be derived from the entire 26-item test.

**Conclusions:** To our knowledge this is the first study to examine latent trait characteristics of MR using IRT to simulate adaptive administration. IRT approaches revealed limitations of both easy and difficult MR items and provide psychometric support for the development of an MR short form or adaptive test. Further gains in precision may be possible by examining nominal response models to examine what additional information can be derived from examination of different incorrect response selections. This work reflects a proof-of-principle illustrating how analysis of existing instruments can be used to generate objective strategies for the revision of existing tests to increase their efficiency and thereby increase precision of measurement, decrease time of assessment, or both. These strategies ultimately aim to improve the precision and accessibility of neuropsychological assessments.

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**Keywords:** psychometrics, visuospatial functions, fluid intelligence

**P. E. CHIN, J. W. TAYLOR, A. GUALTIERI, J. MORGENLANDER, D. C. KOLTAL.**  
**Gender Differences on Neuropsychological Measures in a Highly Educated Physician Population.**

**Objective:** This study examined gender-based differences on neuropsychological measures in a sample of highly educated physician medical providers, to determine if previously known associations between gender and cognition are found amongst highly educated men and women.

**Participants and Methods:** The sample was comprised of 103 unimpaired, practicing physicians who participated in a project to develop normative standards for ‘highly educated aging treaters’ (HEATs). The sample was composed of physicians aged 60 to 78 ( $M=65.0$ ;  $sd=4.6$ ), who were recruited from three major medical centers across central North Carolina in 2018-2019. Reflecting typical medical school gender distributions for this age group, our sample consisted of 79 men and 24 women (77% and 23%, respectively). The sample was fairly homogeneous in race, with 99 participants identifying as Caucasian. All participants had an educational background in medicine (MD, MD/PhD, or DO) and agreed to complete a comprehensive battery of neuropsychological measures typically administered by neuropsychologists for the purpose of creating a robust comparative dataset.

**Results:** Linear regression analyses were conducted to examine the predictive value of age and gender on measures of visuospatial skill, language, verbal and visual memory, and executive processing. Controlling for age, gender effects were seen on the California Verbal Learning Test-II (CVLT-II) total learning and 20’ delayed free recall trials, as well as Judgement of Line Orientation (JOLO) scores and Rey-Osterrieth Complex Figure Test (ROCFT) delayed recall. Specifically, gender was a significant predictor of CVLT-II total learning and free recall trials (each  $p \leq .002$ ) with women performing better than men, while gender was an independent predictor on JOLO and the ROCFT delayed recall trial with men demonstrating the advantage (each  $p \leq .008$ ).

**Conclusions:** These findings support historical research on gender differences in performance on verbal versus visuospatial neuropsychological measures, even amongst this highly educated population. While this study showed traditional male/female processing advantages, in addition to potential biological differences careful consideration of possible social and environmental contributions is warranted. With increased advocacy for gender and racial equality in education and medicine, one future direction of this study is to examine generational differences of verbal and visuospatial advantages on neuropsychological measures.

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**Keywords:** neuropsychological assessment, demographic effects on test performance

#### **D. C. KOLTAI, P. E. CHIN, A. GUALTIERI, J. W. TAYLOR, J. MORGENLANDER. Normative Neuropsychological Standards for Physicians Practicing Medicine.**

**Objective:** The objective of the Highly Educated Aging Treaters study (HEATs) was to create a comprehensive normative dataset for unimpaired physicians practicing clinical medicine. The goal was to create regression-based normative formulas for a co-normed comprehensive test battery, therefore allowing direct comparison of deviation from expectation across measures for this sample. This study occurs within the context of an increasingly robust aging workforce, awareness of capacity concerns, and minimal inclusion of the highest educated population in existing normative standards.

**Participants and Methods:** Physicians in active clinical practice were recruited to complete a comprehensive battery of neuropsychological measures typically administered by neuropsychologists for the purpose of creating a robust comparative dataset. Eligibility was restricted to physicians (MD, MD+PhD, DO) in active clinical practice who were aged 60 and

over and without a positive history of neurologic illness or injury. Participants were recruited from three major medical centers in central North Carolina. The test battery was completed in one or two sessions, as participants' schedules permitted.

**Results:** The sample of 103 unimpaired physicians ranged in age from 60 to 78 (mean=65.0; sd=4.6). Reflecting medical school distributions for this age group, 79 participants were men and 24 were women (77% and 23%, respectively). The sample was fairly homogeneous in race, with 99 participants identifying as Caucasian. Data were obtained for measures across neurocognitive domains, including tests of intellect, verbal and visual memory, executive function and processing speed, language, visual-spatial function, and fine motor dexterity. Regression based-norms were calculated, which control precisely for age and gender as required for each measure. Specifically, some measures require correction for age and gender, some for only age or gender, and some do not require demographic correction. The potential impact of occupational group will also be discussed across evaluation and management (E&M) physicians, minor office procedure physicians, major invasive procedure physicians, and surgeons. Important distinctions between this HEATs sample and the general population are confirmed (HEATs FSIQ mean=126.6, sd=10.0 relative to WAIS-IV standardization sample; and HEATs FSIQ demographically corrected WAIS-IV T=57.3, sd=8.0).

**Conclusions:** We have successfully created regression-based normative standards for a comprehensive test battery for physicians. The impact of age and gender can be demonstrated and controlled. We confirm that the mean performance of this group is often close to two standard deviations above that of the general population, and importantly, well above current comparative demographic norms that have limited participation from the most highly educated sector of the population. These normative standards provide an objective tool for clinical diagnostic and capacity assessments. Future work is needed to augment and rebalance the dataset to be maximally applicable across racial groups, and work is anticipated to explore the relationship between these standards and competence evaluation outcomes.

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**Keywords:** aging (normal), neuropsychological assessment

### **A. L. FERNANDEZ, G. E. JAUREGUI. Reading Fluency as a Measure of the Educational Level.**

**Objective:** education exerts a powerful influence on the performance on neuropsychological tests. To date, the number of years that a person attended to school has been the preferred method to operationalize the educational level (EL). However, this method is currently under debate because it does not consider the quality of education and researchers advocate for alternative methods. Data are presented on the use of reading fluency (RF) as a proxy for quality of education.

**Participants and Methods:** fifty-six participants covering a wide age range (18 to 87 years), as well as a wide range of schooling (from 1 to 19 years) were administered a neuropsychological scale along with a RF task. The neuropsychological scale includes 8 subtests with several measures that cover 5 domains: attention, memory, language, executive functions and constructional praxis. The RF task consisted of a short paragraph describing the weather of a city. The score is the words read correctly per minute.

**Results:** results showed that RF had a higher correlation (.53) than years of school (.38) with the scores of the neuropsychological scale. Some participants with same number of years of school showed a very disparate performance on the neuropsychological scale.

**Conclusions:** reading fluency is a practical, short and easy to use in different languages task that stands as a promising tool for the assessment of EL.

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**Keywords:** reading (normal), psychometrics, academic achievement

#### **F. SPARADEO, A. KARP, D. PETROCELLI. Cognivue: An effective tool in the detection of subtle cognitive impairment .**

The use of cognitive screening devices is popular however debates continue on both sensitivity and specificity of these devices. The use of cognitive screening devices recently has become more common among many healthcare professionals. Due to the COVID-19 crisis, telemedicine approaches to cognitive screening have also been developed. In general screening measures are useful in identifying severe cognitive impairment, but often insensitive to mild/subtle forms of cognitive impairment. Sensitive screening measures of cognitive functioning are needed to determine the presence/absence of subtle cognitive impairment in various diagnostic groups. A sensitive screening method can be useful in identifying patients who will need more thorough neuropsychological evaluation or other clinical services (e.g. imaging). Recently, an automated cerebral assessment technique was developed for the objective detection of cognitive impairment in people above the age of 55. The measure (Cognivue) is the first computerized cognitive assessment device given FDA clearance and is stated to be a method of detection of cognitive impairment that may signal the early phases of progressive dementia. It is described as a measure of cognitive functioning that is also predictive of future functional decline. Cognivue was created to provide healthcare practitioners with rapid and sensitive quantitative assessment of an individual's cerebral function. Cognivue is related to psychophysics in that it engages an individual in continuous stimulus-response paradigms that demand intervening cerebrocortical processes.

**Objective:** It was hypothesized that Cognivue is a sensitive screening measure in people diagnosed with mTBI and adult ADHD as well as patients who self-identify as experiencing cognitive decline (CD) and these patients would perform significantly worse on Cognivue than normal controls (NC). It was also hypothesized that psychiatric patients (PP) would not demonstrate impairment on Cognivue, since Cognivue is an early detection system for the presence of cerebrally based impairment.

**Participants and Method:** Participants were referred to a neuropsychology practice for assessment. All participants were administered the Cognivue task prior to neuropsychological assessment. Cognivue technology is a non-invasive computerized assessment device. The viability of Cognivue in detection of cognitive difficulty related to dementia has been supported by a number of recent investigations. The data generated was entered into a spreadsheet and mean scores on the Cognivue test (11 measures) were compared using ANOVA and Bonferroni follow-up tests. The subject samples were as follows: NC (N=21), mTBI (N=41), ADHD (N=40), CD (N=39) and PP (N=26).

**Results:** ANOVA results indicated Cognivue performance in mTBI, ADHD and self-identified patients was significantly worse than normal controls and psychiatric patients on all measures. Psychiatric patients performed no worse than normal controls.

**Conclusions:** This investigation demonstrates that Cognivue not only identifies the presence of impairment in pre-dementia patients (as previously reported) but also in patients with mild TBI, adult ADHD and recently self-identified cognitive decline. Cognivue is a quick (20 minutes), sensitive and useful screening tool in determining the presence of cognitive impairment. Future research will focus on determining whether, in addition to sensitivity, Cognivue profiles have specificity related to diagnostic groups (e.g. mTBI, dementia, ADHD) and also whether failure on Cognivue also predicts declining function over time in the diagnostic groups evaluated for this study.

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**Keywords:** assessment, test development, brain disorder

**A. J. KARSTENS, H. TIBONI, T. R. MAYNARD, G. TREMONT, B. R. OTT. Feasibility of a Remote Cognitive and Dietary Assessment During the COVID-19 Outbreak .**

**Objective:** Remote administration of neuropsychological tests is beneficial for obtaining clinical and research data. In the wake of the COVID-19 pandemic, this need was extended to the public at large when legal and institutional jurisdiction required quarantining and social distancing. This pilot study determines feasibility of a remote neuropsychological and dietary assessment protocol administered via phone and web-based platforms.

**Participants and Methods:** Participants were females recruited from a longitudinal cohort of adults at-risk for dementia, the Rhode Island Alzheimer's Prevention Registry, who had prior *APOE* genotype testing and completed a dietary screener. Exclusionary screening occurred via a REDCap survey: ongoing cancer treatment, major dietary restrictions or changes (e.g., Ketogenic diet, liquid diet), formal weight-loss treatment or surgical procedures. Access to a phone, computer/tablet, Wifi, and a quiet space for testing were necessary for inclusion. Upon screening, participants were asked whether the pandemic influenced their dietary habits on visual sliding scale very little (0) to very much (100), and whether they were attempting weight-loss. Body mass index (BMI) was calculated using baseline height and self-reported weight. A tailored neuropsychological battery was administered via phone (Free and Cued Selective Recall Test, WMS-IV Logical Memory Older Adult form, Letter Number Sequencing, Mental Control, Symbol Digit Modalities Test–Oral version, and Category Fluency–Animals, Fruits, Vegetables) and visual stimuli was presented using RedCap. Free recall and recognition portions of memory tests were administered at 1 week follow-up. Upon enrollment, all participants completed the telephone battery, and were instructed to complete testing independently via RedCap in 1 week and to complete at least 12 ASA-24 daily dietary assessments over 4 weeks.

**Results:** Participant recruitment was stepwise to enroll *APOE4*-carriers ( $n=20$ ) and *APOE4*-noncarriers ( $n=24$ ). Of those contacted ( $n=149$ ), 61 were screened: 44 enrolled, 9 never enrolled, 4 ineligible, 1 dropped out, and 3 had incomplete screeners. Participants were female older adults (age  $M=63.02$ ,  $SD=7.65$ ), college educated ( $M=17.09$   $SD=2.03$ ), predominately self-identified White (White  $n=39$ , 88.6%; Black  $n=3$ , 6.8%; Latina  $n=1$ , 2.3%; Other  $n=1$ , 2.3%), and were mildly overweight (BMI  $M=25.88$ ,  $SD=5.09$ ). On average, participants endorsed minimal dietary changes during the pandemic ( $M=26.40$ ,  $SD=23.19$ ). On screening, 47.7% ( $n=21$ ) were attempting weight-loss; <10lbs ( $n=10$ ), 15-25lbs ( $n=4$ ), and >25lbs ( $n=7$ ). 43 participants (98%) completed the follow-up memory testing via RedCap. 28 participants (63%) completed 12 or more ASA-24 entries. On average, participants completed more than the requisite number ( $M = 18.45$ ,  $SD = 11.91$ ). The battery was adapted well to the phone/REDCap platform, though the

Letter Number Sequencing subtest was susceptible to auditory interference. Participants positively reported learning about their health from the feedback or losing weight. Participants found the dietary assessment platform time consuming, inefficient, at times confusing, and many wished it were a phone application.

**Conclusions:** Our results support the feasibility of remote cognitive and dietary assessment to be used in older adults. Of note, our sample was highly educated, highly motivated, and was proficient in the use of internet/email. Participant feedback is useful for tailoring test batteries and assessment platforms for the targeted population.

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**Keywords:** assessment, computerized neuropsychological testing, aging (normal)

**S. D. PATRICK, G. SANDERS, A. J. BOULTON, D. S. TULSKY. Measurement Invariance of Mental, Physical, and Social Health across Injury Type using the PROMIS Self-Reported Health Measures.**

**Objective:** The National Institutes of Health Patient-Reported Outcome Measurement Information System (PROMIS) enables clinicians to assess three key dimensions of wellbeing -- physical health, emotional health, and social health. An ideal model of wellbeing could apply similarly across groups of individuals with differing conditions and contexts. A comprehensive assessment of wellbeing is particularly important for persons with neurologic disabilities. Spinal cord injury (SCI) and traumatic brain injury (TBI) are acquired neurologic disabilities associated with disruptions to wellbeing; however, the relative consequences of those disabilities differs across the three domains of wellbeing. The comparability of the three-factor model proposed by the PROMIS for adults with SCI and TBI has not been tested. The present study assessed the measurement invariance of physical, mental, and social health among adults with TBI and SCI, utilizing the PROMIS domains of health.

**Participants and Methods:** Participants were 632 adults with spinal cord injury (SCI;  $n = 337$ ) and traumatic brain injury (TBI;  $n = 295$ ) who completed PROMIS scales. The Physical Health domain was composed of Physical Function, Pain Interference, and Fatigue scales. The Mental Health domain included the Depression, Anxiety, and Anger scales. Social Health was assessed using the Emotional Support scale. Structural equation modeling (SEM) was conducted using robust maximum likelihood to estimate model fit. To assess measurement invariance, SCI and TBI groups were analyzed separately. Model fit was determined using recommended cutoffs for chi-square ( $\chi^2$ ), Comparative Fit Index (CF), Tucker Lewis Index (TLI), root mean square error of approximation (RMSEA), and root mean square residual (SRMR).

**Results:** SCI endorsed significantly worse wellbeing than TBI on Pain Interference and Physical Functioning, with medium and large effect sizes; small effects ( $d < .20$ ) were observed on the remaining scales. Moreover, interrelationships among the scales were remarkably similar for the two groups except for physical function and pain interference, whose correlations were very small in the SCI group and very large in the TBI group. The model met the levels of configural invariance and metric invariance though fit statistics were mixed for both. The model did not meet the level of scalar invariance for multiple indexes. Overall, the PROMIS model did not meet the requirements for measurement invariance.

**Conclusions:** The tripartite model of wellbeing incorporating Physical, Emotional, and Social health proposed by PROMIS does not function similarly for adults with TBI and SCI. The model has the same basic structure for TBI and SCI, and each scale contributes to each factor of the

health to a similar degree; however, scale intercepts differ across the two groups independent of differences in the overall domain. Measurement differences likely reflect the differing natures of TBI and SCI: TBI is more often associated with cognitive issues whereas SCI frequently involves more serious physical limitations. Accordingly, the PROMIS indicated that the relationship between physical functioning and pain interference appears to function differently in wellbeing for adults with SCI versus TBI. Overall, the findings support the PROMIS as a measure of wellbeing in adults with diverse disabilities.

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**Keywords:** psychometrics, assessment, test validity

**S. RASKIN, C. LAURA, A. CAMUY, V. VELEZ, C. PEDRO. Measuring the Effects of Acculturation on Prospective Memory in Spanish-Speaking Latinos/as/xs.**

**Objective:** The goals of the current study were two-fold. First, to provide information on the psychometric properties of the Spanish Memory for Intentions Test (MIST). Second, to investigate the role of acculturation on prospective memory, working memory, autobiographical memory, and episodic future thought.

**Participants and Methods:** Fifty healthy individuals from Puerto Rico, Central American and South America between the ages of 18-50 participated in this study. All participants were administered the MIST, the Digit Span test as a measure of working memory, the Comprehensive Assessment of Prospective Memory (CAPM) (a self-report measure of prospective memory), the Thinking About Life Experiences (TALE) test (a measure involving autobiographical memory), and a measure of episodic future thought. In addition, they were given the Spanish Abbreviated Multidimensional Acculturation Scale.

**Results:** The Spanish MIST demonstrated adequate psychometric properties with good inter-item reliability and split-half reliability. However, performance on several of the scales of the Spanish MIST correlated significantly with years speaking Spanish, the recognition item correlated significantly with years speaking English, and most of the individual scales significantly correlated with self-reported US acculturation. In addition, the scales of the MIST were positively significantly correlated with Digit Span score and the measure of future thought, but not with the CAPM. Scores on the measure of future thought also correlated significantly positively with self-reported US acculturation.

**Conclusions:** The Spanish MIST shows promise as a measure of prospective memory in Spanish-speaking populations. A larger study is needed to provide appropriate local norms and measurement of multivariate base rates for individual countries. In addition, more research is needed to understand the influence of acculturation on the MIST and the measure of future thought. The relationship between the MIST and the measure of working memory underscores the need for adequate working memory to successfully complete a future intention. The relationship of the MIST to the measure of future thought also highlights the aspect of prospective memory that is impacted by the ability to imagine performing a task in the future.

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**Keywords:** acculturation, memory: prospective, psychometrics

**J. SCHAFFER, C. F. EUBANKS. Examining the Therapeutic Alliance in a Neuropsychological Assessment Setting.**

**Objective:** The concept of the therapeutic alliance has been widely researched regarding its importance and relevance to psychotherapy outcomes and has been demonstrated to account for 7.5% of the variance in treatment outcomes. To date, little research has been conducted on the relevance and application of the therapeutic alliance within a neuropsychological assessment setting. The objective of the present study is to explore the applicability and importance of the concept of the therapeutic alliance within a neuropsychological assessment setting.

**Participants and Methods:** A brief self-report measure of the alliance (WAI-NP), adapted for use in an assessment setting, was completed by 141 examiner participants in relation to the most recent patient they saw within the context of a neuropsychological assessment. Pearson and point-biserial correlations examined the relationship between the WAI-NP and examiner and patient demographic variables as well as exam specific variables (e.g., time spent in the evaluation). Five variables emerged as significantly correlated to the WAI-NP and were entered into a hierarchical regression.

**Results:** The internal consistency of the total WAI-NP scale was  $\alpha = .63$ . Contrary to predictions, there was no significant relationship between time spent in assessment activities and the alliance. However, other demographic and exam-related variables that emerged as significant predictors of the alliance included examiner level of training ( $r_{pb}=0.23$ ,  $p=0.007$ ), patient occupation ( $r_{pb}=0.18$ ,  $p=0.031$ ), and examiner familiarity with the alliance ( $r=0.28$ ,  $p=0.001$ ). Examiner familiarity with the alliance was also correlated with time spent in assessment activities ( $r=0.19$ ,  $p=0.028$ ).

**Conclusions:** Findings suggest that examiner familiarity with the alliance may have an impact on neuropsychological assessments and that there might be points of intervention for enhancing alliance and in turn, improving neuropsychological assessments. Future research should examine the directionality of the relationship between knowledge of the alliance and time spent in assessment activities and alliance ratings.

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**Keywords:** assessment

### **K. LENGU, M. T. PADGETT, T. TYSZKOWSKI, B. M. HAMPSTEAD, R. SPENCER.** **Examining the Validity of the Executive Error Index for the RBANS in Older Adults with MRI Volumetry.**

**Objective:** The RBANS does not contain a formal index for executive functioning, however qualitative aspects of performance may provide potentially important data. The present study examined the validity of the RBANS Executive Error (EE) index in a mixed sample of cognitively unimpaired older adults ( $n = 45$ ), those with amnesic mild cognitive impairment ( $n = 136$ ), and those with dementia of the Alzheimer's type ( $n = 13$ ). **Participants and Methods:** We used receiver operating characteristic (ROC) area under the curve (AUC) analyses to describe the diagnostic accuracy of this index. We also examined the relationship between the RBANS EE index and relevant brain volumes using NeuroQuant-based MRI volumetry. **Results:** ROC analyses indicated the EE index discriminated between older adults with and without cognitive impairment at an acceptable level ( $AUC = 0.757$ ). The EE index significantly correlated with inferior frontal volume (Spearman's  $\rho = -0.247$ ,  $p = 0.012$ ), hippocampal volume (Spearman's  $\rho = -0.205$ ,  $p = 0.038$ ) and inferior lateral ventricle size (Spearman's  $\rho = 0.212$ ,  $p = 0.031$ ), but not with superior frontal (Spearman's  $\rho = 0.028$ ,  $p > 0.500$ ) or middle frontal lobe volumes

(Spearman's  $\rho = 0.073$ ,  $p > 0.500$ ). Conclusions: These findings provide preliminary support for using the embedded RBANS EE index in older adults.

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**Keywords:** aging disorders, neuroimaging: structural, psychometrics

**N. D. EVANGELISTA, V. DOMINGUEZ, A. O'SHEA, K. CALFEE, C. HARDCASTLE, J. N. KRAFT, H. K. HAUSMAN, E. M. BOUTZOUKAS, A. ALBIZU, E. J. VAN ETTEN, P. K. BHARADWAJ, S. G. SMITH, H. SONG, G. A. HISHAW, S. DEKOSKY, S. WU, E. S. PORGES, G. E. ALEXANDER, R. A. COHEN, M. MARSISKE, A. J. WOODS.**  
**Evidence of Potential Race/Ethnicity Bias in the Montreal Cognitive Assessment (MoCA).**

**Introduction:** The Montreal Cognitive Assessment (MoCA) is a widely accepted screening measure for cognitive impairment and is included as a measure of global cognition in the National Alzheimer's Coordinating Center Uniform Data Set 3 (UDS3). The MoCA was designed to rapidly assess 8 cognitive domains using single question items, as opposed to other UDS3 measures, comprised of multiple tests within each domain. However, the MoCA cutoff score indicating mild cognitive impairment (MCI) may not accurately reflect the cognitive status of those belonging to particular racial/ethnic groups. MoCA domain performance may also vary by race/ethnicity. There is a need to evaluate potential racial/ethnic differences in MoCA total and domain performance to determine its validity as a cognitive screening tool in underrepresented racial/ethnic groups.

**Participants and Methods:** 455 older adults ages 65-88 completed the Wechsler Test of Adult Reading (WTAR) and the UDS3. Race/ethnicity was self-identified as Black Non-Hispanic (BNH;  $n=32$ ), Hispanic ( $n=38$ ), or White Non-Hispanic (WNH;  $n=385$ ). All analyses were adjusted for age, sex, and education. Binary logistic regression evaluated whether race/ethnicity predicted the probability of falling below MoCA cognitive impairment cutoff criteria (total score  $< 26/30$ ). Separate ANCOVAs then evaluated race/ethnicity group differences in MoCA total and domain scores, as well as domain scores on the UDS3.

**Results:** Race/ethnicity significantly predicted the probability of falling below the MoCA cutoff score ( $p < .001$ ). Relative to WNH, BNH older adults had significantly greater probability of falling below the cutoff ( $p = .001$ ). Probabilities for Hispanic older adults were not significantly different from BNH or WNH older adults ( $p's > .05$ ). ANCOVA revealed race/ethnicity group differences in total MoCA score ( $p < .001$ ), consistent with the performance patterns from the preceding analyses (BNH  $<$  WNH and Hispanic). Race/ethnicity significantly predicted performance for visuospatial/executive function, attention, and delayed recall MoCA domains ( $p's < .05$ ; BNH  $<$  WNH and Hispanic). Delayed recall performance was significantly lower for Hispanic relative to WNH older adults ( $p's < .05$ ). However, race/ethnicity significantly predicted executive function performance ( $p < .001$ ) but no other UDS3 domains ( $p's > .05$ ). The addition of WTAR score as a covariate resulted in non-significant race/ethnicity group differences in visuospatial/executive function, attention, and the probability of falling below the cutoff score ( $p's > .05$ ).

**Conclusion:** Relative to Hispanic and WNH, BNH older adults had significantly lower MoCA total and domain scores reflecting fronto-executive and memory performance. Further, race/ethnicity significantly predicted executive function but no other UDS3 domains. Given the comprehensive nature of UDS3 domains, our findings suggest potential bias in MoCA measures of visuospatial abilities, attention, and delayed recall. Controlling for premorbid

intelligence attenuated group differences in the probability of falling below the MoCA cutoff for cognitive impairment and in visuospatial/executive function and attention domain scores, suggesting potential race/ethnicity differences in education quality may influence differences in cognitive performance. The psychometric properties of the MoCA may thus warrant further exploration among underrepresented racial/ethnic groups. Further characterization of racial/ethnic differences in age-related cognitive declines is needed for the development of ecologically valid cognitive screening measures. Importantly, this would help ensure early and accurate detection of MCI and subsequent targeted interventions for underrepresented racial/ethnic populations.

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**Keywords:** cognitive screening, aging (normal), ethnicity

**R. VAN PATTEN, G. L. IVERSON, M. A. MUZEAU, H. A. VANRAVENHORST-BELL.**  
**Test-Retest Reliability of Mobile Cognitive and Balance Testing Administered Virtually in Healthy Adults.**

**Objective:** Remote mobile testing of cognition and balance is an expanding area of research, particularly in the context of the COVID-19 pandemic. A wide variety of mobile tests are available, but psychometric data supporting these measures are relatively sparse. Such tests have applications in a wide variety of clinical populations, from ongoing symptom tracking in children with neurodevelopmental disorders such as ADHD, to acute concussion assessment across the lifespan, to early detection of neurodegenerative diseases such as Parkinson's disease. In the current study, we examined the test-retest reliability of Sway Medical, a mobile platform for the assessment of cognition and balance.

**Participants and Methods:** Fifty-five healthy adults from the U.S. Midwest completed the Sway protocol remotely, using video-based virtual connections, on their personal phones. They completed Sway cognitive and balance assessments once per week for three consecutive weeks. The testing protocol required approximately 20 minutes per session. The cognitive assessment included a simple reaction time test ("Reaction Time"), a visuospatial working memory test ("Working Memory"), a go/no-go test ("Impulse Control"), and a rapid visual processing test ("Inspection Time"). For Reaction Time and Impulse Control, the examinee responded by rapidly moving the smart device in any direction when a target was presented on the screen (device movement was detected by accelerometry). For Working Memory and Inspection Time, the examinee touched the screen to respond to stimuli. For each cognitive test except Working Memory, both millisecond response times and an overall Sway composite score were available. For the Working Memory test, only the Sway composite score was analyzed. The balance assessment was represented in a single score, comprised of data from eyes closed feet together, tandem (left foot front, right foot front), and single leg balance (left leg, right leg). During balance testing, the Sway software uses accelerometry to detect stability deviations while examinees hold their phone firmly against their chest.

**Results:** The mean age of the sample was 26.69 years (SD=9.89; range=18-58). Their mean body mass index was 25.71 (SD=5.46; range=19-45). Of the 55 adults, 38 (69.10%) were women and 49 (89.09%) used an iPhone for the testing. Nearly all Spearman bivariate intercorrelations for the three assessment time points ranged from .48-.73. Friedman's ANOVAs examining systematic error (i.e., practice effects) for the eight tests were all nonsignificant (all  $ps > .31$ ). Intraclass correlations using mean-rating, absolute-agreement, 2-way mixed effects models [95%

Confidence Intervals (lower, upper)] were as follows: Reaction Time (milliseconds) .83 (.73, .89), Reaction Time (Sway score) .83 (.73, .89), Inspection Time (milliseconds) .75 (.61, .85), Inspection Time (Sway score) .75 (.61, .85), Impulse Control (milliseconds) .68 (.49, .80), Impulse Control (Sway score) .80 (.68, .88), and Memory .88 (.81, .92), Balance .88 (.81, .92).

**Conclusions:** Test-retest reliability measured at three time points, spaced one week apart, was good for cognitive and balance testing in this virtual remote testing study. The Sway platform offers promising repeated assessment of cognition and balance in adult populations in a virtual setting. Additional reliability and validity data in specific clinical groups are needed.

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**Keywords:** computerized neuropsychological testing, test reliability, psychometrics

**J. HANSEN, E. S. WANDINGER, L. WOOD, M. R. UDALA, J. L. SCOTT, M. LIBBEN, H. MILLER. Is the Verbal Concept Attainment Test (VCAT) an Effective Test to Measure Executive Functioning?**

**Objective:** Psychologists are interested in patients' executive functioning because it has many facets that are strongly linked to intelligence. The most common tests used to measure executive functioning are the Booklet Category Test, Stroop Test, Wisconsin Card Sorting Test (WCST), Trail Making Test (TMT), and the Tower of London. These tests of executive functioning largely rely on nonverbal stimuli; therefore, there is a lack of validated measures that assess verbal abstract reasoning. The Verbal Concept Attainment Test (VCAT) is an executive function measure that assesses the verbal aspect of abstract reasoning. Initial research has suggested that the VCAT would be a valid measure for assessing verbal aspects of executive functioning; however, the application of the VCAT to a traumatic brain injury (TBI) population is yet to be examined. Thus, the objective of the present study is to validate the VCAT for use as a measure of verbal executive functioning in TBI patients by examining the VCAT's correlation with validated non-verbal measures of executive functioning.

**Participants and Methods:** The participants were referred to a private clinic in Western Canada for neuropsychological assessment to investigate potential TBI. The data were collected retrospectively and contain VCAT scores as well as scores from several other executive functioning measures that have been previously validated for use in TBI populations.

**Results:** The VCAT showed high correlations with commonly-used, non-verbal executive functioning measures, such as the WCST ( $r = 0.394$ ).

**Conclusion:** The present study suggests that the VCAT can be used as a valid measure of verbal executive functioning in TBI populations. Future research is warranted to determine if this finding can be generalized to other populations.

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**Keywords:** neuropsychological assessment, cognitive neuroscience, traumatic brain injury

**C. NGUYEN, L. MAI, B. TRAN, L. VO, A. NGUYEN, T. NGUYEN, A. NGUYEN. Systematic Review of Neuropsychological Tests and Normative Neuropsychological Data for the Vietnamese-Speaking Population.**

**Objective:** Among the Asian population, Vietnamese Americans comprise 11% or approximately 1.6 million, making Vietnamese Americans the fourth largest Asian heritage in

the United States. An estimated 75% of Vietnamese older adults do not speak fluent English. The combination of poor English proficiency, health illiteracy, and a shortage of Vietnamese providers has been a major obstacle in the provision of specialty healthcare services such as neuropsychological evaluation. Here, we conduct a systematic review of neuropsychological tests and normative neuropsychological data among the Vietnamese-speaking population.

**Methods:** A systematic review was performed using health-related databases (e.g., PsychINFO, PubMed) and Google Scholar search engine, without publication year restrictions and with additional manual review of articles through citations. Studies eligible for inclusion focused on neuropsychological tests conducted with the Vietnamese American population. Neuropsychological tests were organized by name of measure, cognitive domain, administration method, education level, age, sex, and availability for public use.

**Results:** Although there have been Vietnamese translation efforts, the majority of these neuropsychological tests do not contain normative data for a Vietnamese sample. While a few memory tests and cognitive batteries seem suitable for non-English speakers and have Vietnamese norms (e.g., Cross-Cultural Neuropsychological Test Battery), results suggest some tests are more sensitive at discriminating between healthy controls and cognitively impaired individuals. Most neuropsychological tests were developed and normed on North American samples with 12 or more years of education and application to individuals from culturally diverse backgrounds can be problematic for diagnostic interpretation. Specifically, socio-culture differences influence neuropsychological performance, such that individuals of Asian heritage perform differently when compared to Caucasian individuals on tests of language, attention, procession speed, constructional skills and executive functioning. Other common weaknesses include difficulty in procuring tests and inaccessibility of test translations. For example, some of the most widely recognized test batteries offer commercially available translations and validation for select languages but efforts to utilize the tests for cross-cultural research can be difficult due to expensive licensing fees.

**Conclusions:** The well-documented challenges in neuropsychological assessment of ethnic/racial minorities include test construction, concurrent/construct validity, translation, validation of tests, and utilization of appropriate norms. Further research is needed to develop instruments with more precision. Hence, we propose the development of a culturally-sensitive neuropsychological test battery for the Vietnamese population. The conceptual structure of the Vietnamese Battery of Neuropsychological Assessment will be discussed.

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**Keywords:** neuropsychological assessment, cross-cultural issues, multiculturalism

**N. A. HAWLEY, J. H. PIZER, M. A. MYERS, S. L. AITA, B. D. HILL. Development of an embedded measure of Grit for the Personality Assessment Inventory.**

**Objective:** Grit is personality trait associated with perseverance and passion for long-term goals (Duckworth & Quinn, 2009). Grit has theoretical utility for studies of neuropsychological rehabilitation and also fits into the larger concept of positive effort moderating neuropsychological test performance. This study sought to create an index of Grit for the Personality Assessment Inventory (PAI) as this is commonly used in neuropsychological evaluations and research.

**Participants and Methods:** This study had a total of 410 participants (mean age 19.75 (4.417), 28% male 72% female). Participants were administered both the PAI and

Duckworth's 12 item Grit Scale. Correlations between PAI item level responses and the Grit Scale total score were used to identify PAI items that were related to Grit. Next, 36 PAI candidate items and Grit Scale total score were then entered into an EFA analysis (principle axis factoring with varimax rotation). An iterative approach was utilized where factor loadings less than .25 were removed. This was done 4 times to arrive at a final factor solution that contained the PAI items that were used to create the Grit Index for the PAI.

**Results:** The final EFA factor solution resulted in 8 items from the PAI loading onto a single factor with Grit Scale total score. These items were summed together to form the PAI Grit Index. The PAI Grit Index correlated with Grit Scale total score at  $r=.4$ ,  $p=.05$ .

**Conclusions:** We were able to develop an index of the personality trait Grit for the PAI. Grit fits well into the broader concept of positive neuropsychology. This study represents an example of developing measures to integrate positive neuropsychology aspects into clinical practice and research.

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**Keywords:** personality

### **H. M. KERSTING, M. HALL. Assessing the Predictive Value of Visual-Motor Abilities on Intellectual Functioning.**

Assessing the Predictive Value of Visual-Motor Abilities on Intellectual Functioning

**Objective:** Visual-motor integration requires incorporation of visual perception with fine motoric movement. The Beery Buktenica Developmental Test of Visual-Motor Integration (VMI) is widely used to evaluate visuomotor coordination. While the relationship between perceptual abilities and academic attainment is well documented, investigations assessing the relationship between visual-perceptual skills and intellectual functioning remain sparse. Consequently, the present study sought to assess whether performance on the VMI was predictive of Full Scale IQ, which was determined from the Wechsler Intelligence Scale for Children–5<sup>th</sup> edition (WISC-5).

**Participants and Methods:** Data from 120 participants ( $M = 10.76$ ,  $SD = 2.567$ ), were examined and regression analyses indicated VMI performance is a significant predictor of Full Scale IQ. Post-hoc analyses further revealed that VMI scores were most predictive of the WISC-5 Visual Spatial (VSI) index  $R^2 = .476$ ,  $F(1,116)$ ,  $p < .00$ .

**Results:** Vocabulary tests are known to correlate with verbal IQ measures and may be used to estimate pre-existing verbal intellectual ability; results from the current study suggest that VMI may provide useful information regarding nonverbal IQ.

**Conclusions:** In order to improve predictive validity, future research should examine how specific VMI scores correspond to specific VSI scores. Overall, findings suggest that visual-motor and intellectual development are fundamentally interconnected.

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**Keywords:** intellectual functioning, visuospatial functions, intelligence

### **A. M. VON BUTTLAR, T. ZABEL, A. E. PRITCHARD, A. D. CANNON. Inequivalence of the Second and Third Editions of the Adaptive Behavior Assessment System in Mixed Clinical Samples.**

**Objective:** Adaptive functioning is an important area of assessment with implications for differential diagnosis, educational placement, service eligibility, and criminal sentencing. While periodic normative and content updates of adaptive functioning measures are necessary to keep measures relevant, knowledge of equivalence between versions is also required if adaptive measures are to be used to track the stability of adaptive functioning skills over time. The purpose of this study was to examine the equivalence of the Second and Third editions of the Adaptive Behavior Assessment System (ABAS) in a mixed clinical sample.

**Participants and Methods:** This research presents two studies which used between- and within-group comparison designs. In Study 1, ABAS-2 scores for children assessed between 2014-2015 ( $n=1035$ ; mean age=10.24 years,  $SD=3.44$ ) were compared to ABAS-3 scores for children assessed between 2015-2016 ( $n=1291$ ; mean age=10.51 years,  $SD=3.70$ ). Study 2 examined a separate sample of clinically-referred children ( $n=572$ ) for whom caregiver ratings had been obtained on both the ABAS-2 (mean age=9.65 years,  $SD=2.80$ ) and ABAS-3 (mean age=13.33 years,  $SD=2.95$ ) in the course of repeated assessment.

**Results:** For Study 1, while no IQ score differences were observed between the ABAS-2 group (mean  $VCI=93.67$ ,  $SD=16.95$ ) and the ABAS-3 group (mean  $VCI=93.08$ ,  $SD=17.42$ ), ABAS-2 scores were significantly lower than ABAS-3 scores on the Conceptual, Practical, and General Adaptive Composite (GAC) scales. In Study 2, a similar pattern was observed (ABAS-2 < ABAS-3 on the Conceptual, Practical, and GAC scales). The largest effect sizes were noted on the Practical Composite.

**Conclusions:** ABAS-3 scores may be higher than ABAS-2 scores in clinical populations. Knowledge of these potential discrepancies will be critical when interpreting standard score changes across ABAS versions in the course of clinical, educational, and forensic assessment.

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**Keywords:** adaptive functioning, intellectual disability, psychometrics

### **S. LESICA, J. GERHART, R. L. SKEEL. Depression as a Mediator of the Effects of Acculturation on Cognitive Functioning in a Sample of Elderly Hispanics: Sacramento Area Latino Study of Aging (SALSA).**

**Objective:** The present study examined the relationship between acculturation levels, depressive symptoms and cognitive functioning in a sample of elderly Hispanics from the Sacramento Area Latino Study of Aging (SALSA).

**Participants and Methods:** SALSA was an epidemiological study of health and cognition in Hispanics residing in California's Sacramento Valley, mostly from Mexico, age 60 and over. Participants with publicly available cognitive functioning scores were selected from the SALSA public database ( $N = 663$ ). Global cognition was assessed using the Modified Mini-Mental State Examination (3MS; Teng & Chui, 1987), acculturation was assessed through a modified version of the Acculturation Rating Scale for Mexican Americans-II (ARSMA-II; Cuellar et al., 1995) and depression was assessed using the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977). Analyses tested the hypothesis that depression acts as a mediator in the relationship between acculturation and cognitive functioning, using Hayes' (2017) PROCESS macro modeling tool for the SPSS software.

**Results:** Results indicated that depressive symptoms partially mediated the relationship between acculturation and cognitive functioning. Unstandardized coefficients were reported as suggested by Hayes, 2017. The unstandardized regression coefficient between acculturation and cognitive

functioning was significant ( $B = 3.45$ ,  $SE = .38$ ,  $p < .001$ ), as was the unstandardized regression coefficient between depression and cognitive functioning ( $B = -.22$ ,  $SE = .04$ ,  $p < .001$ ) and between acculturation and depression ( $B = -1.9$ ,  $SE = .37$ ,  $p < .001$ ). The bootstrapped, unstandardized, indirect effect of depression in the relationship between acculturation and cognitive functioning was .42 and was significant at  $\alpha = .05$ . The 95% confidence intervals ranged from .21 to .68.

**Conclusions:** Overall, the study provides insight into the potential mechanism through which acculturation contributes to variance of cognitive functioning in older Latinos.

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**Keywords:** acculturation, cognitive functioning, depression

### **E. A. KAPOULEA, R. READY. Loneliness and CVD Risk Factors in Adults from the United States and Japan.**

**Objective:** Loneliness is a widespread public health concern associated with elevated risk for cardiovascular disease (CVD). The Cognitive Model of Loneliness suggests that loneliness increases risk for CVD via overactivation of the hypothalamic-pituitary-adrenal [HPA] axis. However, this model does not consider how sociocultural factors (e.g., nationality) influence the experience or consequences of loneliness. We suspect that collectivistic values of social harmony may make loneliness less prevalent; however, when loneliness is experienced, its outcomes are worse in collectivistic groups due to an unfulfilled expectation for social cohesion. Thus, there is reason to suspect that cultural values of collectivism and individualism determine the prevalence of loneliness and its consequences by shaping our expectations for social relationships. However, few studies have examined associations between loneliness and health in East-Asia. The current study will determine whether loneliness differs between adults in the U.S. and Japan. We hypothesize that Japanese adults – due to collectivistic values – will be less lonely relative to U.S. adults. Next, we will determine if loneliness is associated with more adverse CVD outcomes (e.g., metabolic dysregulation biomarkers [MDBs], immune dysregulation biomarkers [IDBs], and sleep) in Japan versus the U.S. We hypothesize that nationality will moderate the associations between loneliness such that Japanese adults will show stronger associations than U.S. adults.

**Participants and Methods:** The U.S. ( $n = 529$ ) and the Japanese ( $n = 296$ ) sample (both aged 36 to 78) completed the baseline and biomarker appointments of the Midlife in the United States (MIDUS) Refresher and Midlife in Japan (MIDJA) 2 studies, respectively. Participants completed the Pittsburgh Sleep Quality Inventory (PSQI), a physical exam and blood samples. Participants were categorized as ‘not lonely’ and ‘lonely’ based on how often they felt lonely in the past week.

A logistic regression determined whether groups differed in loneliness based on nationality. We performed confirmatory factor analyses to extract latent constructs from MDBs (e.g., body mass index, waist circumference, high-density lipoprotein cholesterol, systolic blood pressure), IDBs (e.g., interleukin-6, c-reactive protein, fibrinogen), and sleep from the PSQI items. We tested path models using structural equation modeling to test whether nationality moderates the associations between loneliness, and MDBs, IDBs, and sleep.

**Results:** Japanese adults were less lonely than U.S. adults ( $p < .001$ ). Nationality did not moderate the associations between loneliness and MDBs, IDBs, and sleep. Loneliness predicted

poor sleep quality ( $p < .001$ ). After the inclusion of covariates (whether the participant smoked, number of medical conditions, and anxiety), the association was no longer significant.

**Conclusions:** Japanese adults reported less loneliness than U.S. adults, supporting our first hypothesis. Results suggest that nationality does not moderate the associations between loneliness and health outcomes. Thus, our expectations - based on ideas of collectivistic versus individualistic cultures - were not confirmed. A logical next step in this line of work may be to determine how loneliness is conceptualized in Japan versus the U.S. through mixed-methods approaches. We also advise including a direct measure of individualism and collectivism to determine these constructs' influence on loneliness prevalence and associated outcomes.

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**Keywords:** cross-cultural issues, cardiovascular disease, social processes

**P. A. AMOFA, G. SMITH, S. A. LEVY. Health Concerns and Determinants of Aging Research Participation Among North Florida African Americans.**

**Objective:** To describe health concerns of African Americans as they age, and what influences their participation in aging research.

**Participants and Methods:** Fifty participants attended focus groups and completed questionnaires to identify barriers to research participation and attitudes towards dementia screening. Bivariate correlations explored associations between barriers to research participation and attitudes towards dementia screening.

**Results:** Cancer, hereditary conditions, vascular conditions, memory disorders, and psychological disorders were the greatest health concerns. Time demands, mistrust, lack of knowledge about potential research, and stigma were identified as barriers for research participation. Incentives, better understanding of how proposed research will benefit the community, lifestyle modification studies, active presence of principal researchers/clinicians, and community investment were identified as factors to improve participation. Questionnaires revealed mistrust and religious beliefs as the primary barriers amongst others. Attitudes towards dementia screening reflected perceived stigma, suffering, and subsequent loss of independence. Higher barriers to participation associated with perceived stigma and loss of independence related to dementia screening.

**Conclusions:** Successfully recruiting African Americans for aging research remains a challenge. This study identifies barriers to participation and offers suggestions for planning and recruitment.

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**Keywords:** aging disorders, dementia - Alzheimer's disease, cross-cultural issues

**S. REHMAN, O. OBARO. Barriers to Pursuing Neuropsychology as Immigrants.**

**Abstract:** The United States is becoming racially, ethnically, and linguistically diverse at a fast pace. However, the number of neuropsychologists from diverse backgrounds including immigrants remain underrepresented. As a result, the discipline of neuropsychology is challenged to take appropriate measures to reflect these changing demographics. This review discusses the recent influx of immigrants from Latin America and Asia and addresses the challenges faced by professional immigrants to become a part of the workforce in neuropsychology. We propose revamping admission requirements for doctoral and training programs so that non-native English speakers can be recruited and retained.

**Objective:** Our review aims to propose suggestions to pave the way for candidates from diverse and immigrant backgrounds to pursue education and training in neuropsychology.

**Scope of the Problem:** Neuropsychologists from diverse backgrounds are underrepresented in the workforce (Elbulok-Charcape, Rabin, Spadaccini & Barr, 2014). Pew Research Center (2016) reports that by 2055, the United States will not have a single racial majority. This change is mainly prompted by the immigration of about 59 million individuals from Latin America and Asia. This figure also reflects the number of culturally and ethnically diverse non-native English speakers. These new immigrants often include professionals who hold advanced academic degrees and are trained in their countries of origin. However, it is estimated that about 2 million highly skilled immigrants are underemployed or must accept low-skilled jobs because of the lack of information about licensing requirements or having limited English language proficiency (National Council of State Legislators, 2018).

**Findings:** The Houston Conference (HC) developed a model for academic and clinical neuropsychology (Reitan, Hom, Voorde, Stanczak, & Wolfson, 2004). The sixth and seventh sections of the guidelines stipulate the acquisition of specific knowledge areas and skill set. These can be achieved through multiple pathways. However, it is noteworthy that entry into this specialization is restricted to the graduates of academic and predoctoral training programs accredited by the American Psychological Association (APA) and Canadian Psychological Association (CPA) only (The Houston Conference [HC], 1997). Admission to an accredited program is quite competitive, and almost all institutions require high competency on Graduate Record Examination (GRE) (Northwestern University, n.d.). A qualitative study at Louisiana State University found that the content and context of the GRE verbal section is biased against international students and they struggle to meet the minimum score requirements. Often, this very prerequisite becomes a sole disqualifier for admission to an accredited program for non-native English speakers and immigrant students (Mupinga & Mupinga, 2005).

**Conclusion:** The 2008 Multicultural Problem Solving Summit recommended an early and individualized mentoring system for the successful recruitment and retention of ethnic minorities in neuropsychology (Byrd et al., 2010). This very aim also ties with the thirteenth section of the HC guidelines that endorse active involvement in enrolling individuals from diverse backgrounds at all levels of education in clinical neuropsychology (HC, 1997).

These early barriers contribute towards increasing disparity between the growing number of immigrant patients and the availability of multicultural and multilingual neuropsychologists.

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**Keywords:** minority issues, bilingualism, cross-cultural issues

**R. CERVANTES, D. W. LOPEZ-HERNANDEZ, A. BUENO, W. OLMOS, J. KNIGHT, P. Y. LITVIN, S. SARAIVIA, N. GRAUB, K. E. SMITH, A. J. BAEZ, E. TORRES, I. MUNOZ, M. J. WRIGHT, D. J. HARDY, A. L. FERNANDEZ. The Effect of Acculturation on the Cordoba Naming Test in Mexicans.**

**Introduction:** The Córdoba Naming Test (CNT) is a confrontation naming test that was created to address issues related to administering traditional confrontation naming tests (e.g., Boston Naming Test) to Spanish-speakers. Prior research has demonstrated that acculturation can impact cognitive performance. We evaluated how acculturation influenced Mexicans on the CNT.

**Methods:** The sample consisted of 21 Mexican-Americans residing in the United States, 25 Mexicans residing in the United States (MRUS), and 14 Mexicans residing in Mexico (MRM).

All participants did not endorse any current or past neurological and/or psychological illness. Furthermore, everyone completed the Abbreviated Multidimensional Acculturation Scale (AMAS) composed of cultural identity, language, and cultural competence subscales. A series of ANCOVAs and linear regressions were conducted to evaluate CNT differences.

**Results:** Groups were not well matched in years of education completed (i.e., MRM had more years of education compared to MRUS) and age (MRUS were older than Mexican-Americans and MRM). ANCOVAs, controlling for education and age, revealed the MRM outperformed both the MRUS and Mexican-American groups on the CNT,  $p=.000$ ,  $h_p^2=.54$ . On the AMAS, Mexican-Americans demonstrated better United States competence,  $p=.000$ ,  $h_p^2=.45$ , and English language competence,  $p=.000$ ,  $h_p^2=.45$ , compared to MRM and MRUS groups. The MRM demonstrated better Spanish language,  $p=.032$ ,  $h_p^2=.12$ , and Latino competence,  $p=.014$ ,  $h_p^2=.15$ , compared to the Mexican-American group. Additionally, Mexican-Americans reported higher levels of United States identity compared to the MRUS and MRM groups, and so did the MRUS relative to the MRM group,  $p=.000$ ,  $h_p^2=.75$ . Linear regressions revealed that a significant correlation between CNT performance and Latino competence in MRM group,  $r=.70$ ,  $p=.006$ . Finally, we found a significant correlation between CNT performance and Latino identity in Mexican-Americans,  $r=.049$ ,  $p=.025$ .

**Conclusion:** We found that not only MRM outperformed both Mexican-Americans and MRUS on the CNT, but acculturation, in particular Latino competence was associated with better CNT performance. Our data suggests the importance of language and acculturation issues when being assessed the CNT in a Mexican population residing in the United States.

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**Keywords:** acculturation, multiculturalism, diversity

**S. PENNA, J. N. IKANGA, V. SEZIBERA, C. CASSADY, A. Y. STRINGER. The Emory Brain Share Project: A Pilot Collaboration with the University of Rwanda to Develop a Training Program in Neuropsychology.**

**Objective:** We present results of the pilot phase of the Emory Brain Share Project, a collaboration between Emory University and the University of Rwanda. Our ultimate goal is to train the first generation of neuropsychologists in Rwanda to address the specific cultural and medical needs of the community. In 2018, Emory neuropsychology faculty were approached by psychology faculty at the University of Rwanda to develop a training program in neuropsychology for Rwanda. We received funding to launch the project with the development of two online courses in neuropsychology; one course in adult neuropsychology, and a companion course in adult neuropsychological assessment for use in Rwanda. Both of these courses were modeled after typical neuropsychological assessment courses in graduate programs in the United States, but modified given the online-format, and cultural differences between countries.

**Participants and Methods:** 18 students participated in the course. Students were Rwandan psychologists who were chosen by the Rwandan psychology faculty. There were 9 men and 9 women. The Emory faculty launched the course with a week-long in-person intensive lecture and practice sessions with participating students. The following 10 weeks were online. Given the current state of the IT infrastructure in Rwanda, lectures were pre-recorded. Additionally, the course director held live-streaming office hours weekly for discussion and to address questions. Questions were also emailed to the professor during non-office hour times. Following

the course completion, students responded to an anonymous survey about their experience with course content, course administration, and ideas for future directions. Emory faculty also met with relevant officials in Rwanda to gain the support of potential masters' degree and practicum placements.

**Results:** All 18 participants completed the course with a passing grade. Regarding course content, all students found the course extremely beneficial and relevant to their understanding of psychology. Regarding course administration, students strongly felt that the in-person introduction to the course was extremely beneficial both for their understanding of the topic, and to establish collaborative relationships with other students. Despite English being the official language of instruction in Rwanda, most of the students had been educated in French, and requested French subtitles for lectures. There were also issues with the live-streaming portion of the class due to internet connectivity issues. Regarding future goals, the need for scholarships in order to pursue a master's degree, and improvement in internet for live-streaming was emphasized. The Emory/Rwanda instructional team met with the Vice Chancellor for the University of Rwanda and Minister of Education and received approval to develop the Masters program. Further, the study team received approval for practicum sites at area hospitals.

**Conclusion:** The results from the pilot study indicate strong support for development of neuropsychology in Rwanda. We obtained the necessary institutional support and there is clear enthusiasm from the psychology community to pursue training. Finally, barriers to course administration have been identified including the need for a hybrid model for learning, need for subtitles in lectures and financial assistance for students.

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**Keywords:** cross-cultural issues, multiculturalism, assessment

**J. PURNELL, S. AMALFE, I. GOSNELL, A. SHTRAKHMAN, M. A. CORNWELL.**  
**Moving Away from a Binary Perspective: Evaluating the Use of Normative Data in the Neuropsychological Assessment of Transgender and Gender Non-Confirming Individuals.**

**Objective:** Neuropsychology has begun to consider the multifaceted variables in transgender and gender non-conforming (TGNC) patients. This is especially important given that neuropsychologists have historically relied on standardization data normed by gender for diagnostic considerations. Unfortunately, the paucity of available research on neuropsychological assessment in TGNC individuals may compel examiners to select norms that are not reflective of the patient's gender identity. While worthwhile, these approaches still take a binary perspective on gender that may influence test performance secondary to neuroanatomical and hormonal differences, as well as multiple psychosocial factors. The purpose of this theoretical investigation is to identify factors that may contribute to variability in performance in aspects of neuropsychological functioning that have putative differences across genders, namely, verbal, visual, motor, and processing speed abilities. To this end, the current research will provide additional considerations and recommendations aimed at minimizing the potential for inaccurate and unreliable data in assessing in TGNC individuals.

**Participants and Methods:** An extensive literature review was conducted evaluating observed gender differences in normative data for specific neuropsychological domains, as well as the current neuroscience literature examining TGNC populations, the impact of HRT on mood and cognition, and current research on neuropsychological testing with TGNC individuals.

**Results:** The extant literature postulates gender differences in aspects of neurocognition secondary to HRT or biological predisposition, while others have described a *gender-role mediation* hypothesis (Nash, 1979) to explain performance variability on specific neurocognitive measures.

**Conclusions:** Comprehensive understanding of gender identity, as well as shared and unique life experiences of TGNC individuals, including cultural gender-based mores and expectations, are essential in the practice of neuropsychology. Re-conceptualizing our standardization practices through a non-binary perspective is critical for accurate, reliable, and ecologically valid diagnostic decision-making. Further, considerations accounting for changes in mood that may impact cognition in TGNC individuals, the impact of minority stress, and changes in gender role expectations should be implemented at all phases of the neuropsychological evaluation process, including interview, test battery and normative data selection, conceptualization, and recommendations.

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**Keywords:** diversity, psychometrics, transdisciplinary research

**K. K. CHAN, S. COSENTINO, A. M. BRICKMAN. Training the Next Generation of Brain-Behavior Scientists from Diverse Backgrounds through the Summer of Translational Aging Research for Undergraduates (STAR U) Program .**

**Objective:** The Summer of Translational Aging Research for Undergraduates (STAR U) is an NIH-funded 8-week program designed to increase the number of scientists from diverse and underrepresented backgrounds researching brain aging. The program provides 10-12 students per year with: 1) individual, tailored research mentorships in the neuroscience of aging; 2) a range of translational learning opportunities such as seminars, lectures, and skills-based workshops; and 3) professional networking and social experiences. Long term, the STAR U program's goal is to enhance the field of aging and age-related health disparities by infusing it with well-trained scientists from diverse backgrounds. The purpose of this presentation is to describe the program and program outcomes based on initial survey data from the first cohort of undergraduate scholars.

**Methods:** The STAR U program recruited student scholars by reaching out to 85 undergraduate institutions, non-profits, and scientific societies, including 245 key individuals. Additionally, much of the recruitment was through word of mouth and social media. Applications included a personal statement, transcripts, letters of recommendation, and a CV. Of the 202 applications received in 2019, 10 students were selected as finalists.

Each student was placed in a lab with a faculty mentor and worked on a research project related to aging. Students also engaged in seminars featuring research topics in aging/neuroscience, professional development workshops, discussions focused on navigating academia as students from diverse backgrounds, and social events that fostered a sense of community. Beyond the summer, we continued engaging with alumni by providing opportunities and funding to present their research at scientific conferences, hosting alumni events, and maintaining a sense of community through ongoing check-ins.

**Program Metrics**

We collected pre and post-program survey data, which contained qualitative evaluations of students' experiences in the program, questions related to specific aspects of the program, and post graduate plans.

**Results:** Survey results indicated that the program played an overall positive role in the students' scientific development, with one hundred percent of respondents indicating that STAR U played an "Extremely Significant" or "Significant" role in influencing a research career in science. Seventy-five percent indicated that they were "Extremely Likely" or "Likely" to pursue a career in aging after participating in STAR U. Themes that emerged from qualitative responses included increased awareness of various research careers, the importance of mentorship and a sense of community, and self-confidence in pursuing a research career.

**Conclusions:** While STAR U is still in its early stages, survey feedback indicates the promising impact that undergraduate training programs in brain-behavior research can play in increasing diversity in the field. Further efforts to support students beyond the program as they navigate barriers moving forward are imperative for ensuring the success of early scholars from diverse and underrepresented backgrounds. In addition, tracking long-term educational and professional outcomes will help us better understand program impact.

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**Keywords:** inclusion, diversity, academic achievement

### **M. R. FURTADO, I. RIOS. The Crisis in Neuropsychology: Steps Towards Maintaining Relevance.**

**Objective:** By the year 2050, the majority of the American population will be "un-testable". Furthermore, our discipline will find itself becoming irrelevant as the population becomes increasingly diverse, multicultural, and multilingual. This crisis in neuropsychology has been years in the making and our field now finds itself at a crossroad. The presenters will discuss recent literature on neuropsychology and culture as well as professional initiatives in the field to address the disconnect between available assessment tools and the increasing diverse population in the United States.

**Methods:** A literature review was conducted of recently published peer-reviewed publications on diversity within the field of neuropsychology and its impact on the instruments and norms produced for the assessment and diagnosis of the population at large.

**Results:** With some exceptions, minorities in this field have predominantly carried the responsibility of pointing to the lack of assessment tools for our diverse population, researching and publishing about culture and diversity, and engaging in collaboration to bring the subjects of diversity and cultural competency to light. As Cory (2020) points out, there is certainly a disconnect between our assessment tools and the increasingly diverse population we serve.

Furthermore, cognitive function has been implicated as a critical predictor and outcome of gaps in health care across the lifespan. Accurate assessment, which involves culture, language, education, socioeconomic status, normative standards, deeper understanding of cultural influences in brain pathology, the educational materials we provide, and the recommendations we make, is of the utmost importance to competently address these health disparities.

In order to address and remedy this critical situation, neuropsychologists must make a personal commitment to educate themselves regarding the systemic root of this problem. Individually and institutionally, neuropsychologists must engage in the recruitment and training of future peers with diverse backgrounds. This can be achieved by lobbying, defending, and encouraging the integration, participation, and contribution of international students and scholars within the scientific and clinical field of neuropsychology. As a discipline, we must conduct, encourage, and support research with diverse subjects. These steps, among other actions, to be discussed

during the presentation, will move this field forward towards continuing to be relevant in the face of change.

**Conclusions:** Much work still needs to be done to fulfill our responsibility to deliver culturally-informed neuropsychological care. As neuropsychologists we must examine our biases as individuals as well as the inherent biases within our field, and act responsibly in the face of challenge and change. A non-negotiable responsibility as neuropsychologists lies in our ability to challenge the underpinnings of “the best I can do”; we must ethically evaluate the best course of action to serve our diverse population given the tools and access at our disposal. Together we can move towards establishing our field as an integral and methodologically sound component of health care using the appropriate tools and knowledge to serve our diverse communities to the best of our individual and collective abilities.

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**Keywords:** cross-cultural issues, multiculturalism, assessment

**A. BOEVE, M. FAGAN, A. LEWIS, A. HALPIN, L. D'ERRICO, R. K. MACAULAY.**  
**Does Sleep Quality Modify the Relationship Between Socioeconomic Status and Verbal Memory in Older Adults?**

**Objective:** Socioeconomic status (SES) has been shown to be a strong predictor of poor sleep quality and lower memory performance in older adults, both of which negatively impact overall health and well-being. However, the mechanisms underlying these relationships remain unclear, and research regarding the relationship between sleep quality and memory functioning is mixed. As such, the present study aimed to better characterize associations among SES, perceived sleep quality, and verbal memory in a group of socioeconomically diverse community-dwelling older adults by exploring the interrelationships between these variables.

**Participants and Methods:** One hundred and fifteen community-dwelling older adults underwent neuropsychological testing and clinical interviews as part of a larger study. Participants self-reported yearly income represented an aspect of SES. Sleep quality estimates were derived from the Pittsburgh Sleep Quality Index. The Rey Auditory Verbal Learning Test evaluated immediate and delayed verbal memory. Correlational analyses investigated the associations among income, sleep quality, immediate and delayed verbal memory, and relevant demographics of age and education. Hierarchical multiple regression analysis evaluated the independent contribution of income on sleep quality based on these relevant relationships,

**Results:** As expected, correlational analyses found significant associations among age, education, income levels, and memory function. No significant associations with income and sleep quality on memory were found. Sleep quality decreased with age and lower income. Hierarchical regression analysis revealed that income level significantly accounted for 19% of the variance in self-reported sleep quality, beyond the influence of age. Education was not a significant predictor of sleep quality and was thus removed from the final model.

**Conclusions:** Consistent with prior work, older age and lower income levels were associated with lower sleep quality in older adults. However, we did not find a direct association with income and sleep quality on memory function. Future research is warranted to investigate mechanisms that underlie the relationship between lower income and poor sleep quality, such as higher levels of perceived stress, to see if they influence poor sleep quality in older age. Identifying mechanisms that underlie this association may lead to improved intervention targets for sleep difficulties in older individuals with lower income levels.

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**Keywords:** sleep, brain function, multiculturalism

**B. L. SCHUBERT, K. L. BESSETTE, R. E. EASTER, M. C. AGUIRRE, A. K. DILLAHUNT, S. B. FRANSEN, M. WESTLUND SCHREINER, J. STANGE, S. DELDONNO, S. A. LANGENECKER. The Role of Minority Status on the Relationship between Childhood Experiences of Physical Abuse and Working Memory.**

**Objective:** Childhood experiences of physical abuse affect working memory (WM) in adults. Additionally, physical abuse may be more prevalent in minority populations. We examined the relationship between childhood experiences of physical abuse and working memory in a community sample of young adults. We further investigated whether this relationship was moderated by minority status (Hispanic, Asian, African-American, etc.). We hypothesized that minority status would moderate the relationship between physical abuse and working memory.

**Participants and Methods:** To test these hypotheses, 153 participants (49.0% White, 16.3% African-American, 15.8% Hispanic, 12.9% Asian, 4.5% More than one race, 1.5% race not reported; 82.2% not Hispanic or Latino, 17.8% Hispanic or Latino ethnicity) with or without a history of mood disorders (74.8% remitted/euthymic mood disorder) from a community sample. Participants completed the Childhood Trauma Questionnaire (CTQ) and Wechsler Adult Intelligence Scale–Fourth Edition, Digit Span and Letter-Number Sequencing. We grouped participants based on non-minority (48.8%) and minority (51.2%) status using race and ethnicity. Then, we ran a principal components analysis (PCA) on raw scores from digit span backward (DSB), sequencing (DSS), and letter-number sequencing (LNS), as well as longest digit span backwards (LDSB), sequencing (LDSS) and letter-number sequence (LLNS) to reduce heterogeneity and examine similarities across measures of WM in this sample. We then used hierarchical linear models to examine whether minority status moderated the effect of physical abuse on WM components from the PCA.

**Results:** This analysis suggested two WM components based upon eigenvalues  $>1$ . Based upon factor loadings  $\geq .4$ , DSB, LDSB, LNS, and LLNS loaded heavily on WM1. Whereas DSS and LDSS loaded onto WM2, suggesting a more complex WM component.

Hierarchical linear models first included WM1 as the outcome variable with minority status, childhood experiences of physical abuse, and their interactions as predictor variables. The overall model was not significant, ( $R^2=.04$ ,  $F(3,149)=2.10$ ,  $p=.10$ ). Results indicate that neither minority status nor physical abuse predict WM1.

The second analysis had WM2 as the outcome variable and minority status, childhood experiences of physical abuse, and their interactions as predictor variables. The overall model was significant ( $R^2=.13$ ,  $F(3,149)=7.35$ ,  $p<.001$ ). All predictors were significant ( $p < .02$ ). Minority status significantly improved model fit ( $\Delta R^2=.04$ ,  $F(1,149)=6.15$ ,  $p=.01$ ). Minority status moderated the association between childhood experiences of physical abuse and WM2 ( $B=.15(.06)$ ,  $p < .003$ ), such that the simple effect of reports of greater physical abuse in non-minorities predicted worse WM2 ( $B=-.16(.05)$ ,  $p=.003$ ). The simple effect of minority status and physical abuse was not significant ( $B=-.01(.03)$ ,  $p=.58$ ).

**Conclusions:** Our findings suggest that childhood experiences of physical abuse may negatively influence only those aspects of working memory that may require greater cognitive resources or executive functioning in non-minority populations. However, minority populations were collapsed together for statistical power, thus further work is needed to examine the differential

effects of childhood experiences of physical abuse on WM in specific minority populations. Future directions can also examine minority and race relationships between childhood experiences of physical abuse and working memory separately.

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**Keywords:** childhood maltreatment, minority issues, working memory

**N. ORTEGA, C. R. PAGÁN, K. GORENSTEIN, J. RAZANI. Factors of Acculturation and its Relationship to Working Memory in Ethnically Diverse Individuals.**

**Objective:** Previous research has shown the more an ethnically diverse individual is acculturated to the dominant culture, the higher their performance will be on neuropsychological tests. The purpose of this study was to examine the relationship between four areas of acculturation and working memory tests in a group of ethnically diverse individuals.

**Participants and Methods:** A total of 80 participants (Hispanic:  $n = 44$ ; Asian:  $n = 14$ ; Middle Eastern:  $n = 21$ ; Other:  $n = 1$ ) were recruited from the greater Los Angeles area. Participants were administered a demographic questionnaire, an acculturation measure, and the following working memory tests: Color Trails Test part 2 (CTT-2), Trails Making Test B (TMT-B), Stroop C, Digit Span, and Digit Symbol. Outcome measures were time of completion for TMT-B, CTT-2, and Stroop C, and raw scores for Digit Span and Digit Symbol. An adapted version of the 20-item Acculturation Rating Scale for Mexican Americans (ARMSA) questionnaire provided the four factors which included a) Preferences: language familiarity, usage, and preference, b) Ethnic Identity: generation removed, c) Exposure: reading, writing, and general cultural heritage and exposure, the ethnicity of friends and associates, and food preference d) Ethnic Interaction: the extent of direct contact with the country of origin and reading and writing language.

**Results:** Correlation analysis revealed that Exposure correlated with Digit Symbol ( $r = .28, p = .01$ ), CTT-2 ( $r = -.40, p = .01$ ), Digit Span ( $r = .25, p = .02$ ), and Stroop C ( $r = -.23, p = .04$ ), but not TMT-B. Ethnic Interaction correlated with Digit Symbol ( $r = .28, p = .01$ ) and CTT-2 ( $r = -.39, p = .02$ ). Finally, Preferences was correlated with Digit Symbol ( $r = .27, p = .02$ ). Ethnic Identity was not significantly correlated with any of the working memory tests. A series of multiple regression analyses revealed a significant model for Digit Symbol,  $R^2 = .31, F(6, 72) = 5.32, p < .001$ , with age emerging as the only significant predictors, while the regression model for CTT-2, also significant,  $R^2 = .37, F(6, 32) = 3.14, p = .02$ , found age and Ethnic Identity as predictors in the model. The regression model was also nearly significant for Stroop C,  $R^2 = .13, F(6, 73) = 2.07, p = .07$ , with age and Exposure as significant predictors; regression analysis was also nearly significant for TMT-B,  $R^2 = .17, F(6, 58) = 1.93, p = .09$ , with age, years of education outside of the U.S. and Exposure as significant predictors. Finally, the regression model was not statistically significant for Digit Span,  $F(6, 73) = 1.76, p = .12$ .

**Conclusions:** Taken together, these findings suggest that while demographic factors account for performance of working memory tests, other cultural factors and specific areas of acculturation, particularly exposure to the dominant culture, are also important predictors of performance on these tests. It is clear that we need to better understand how specific aspects of acculturation affect test performance of ethnically diverse immigrants.

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**Keywords:** acculturation, bilingualism, working memory

**M. N. MARTINEZ, S. TORRES, A. P. OCHOA LOPEZ, L. D. MEDINA. Body Mass Index (BMI) and Cognition in Urban- and Rural-Dwelling Mexican Middle-Age and Older Adults.**

**Objective:** Unhealthy levels of BMI have been associated with decreased cognitive function and risk for dementia. Despite being considered a marker of wellness, BMI is only a proxy of health and may predict outcomes differently across ethnographically diverse groups, such as Hispanic/Latin American individuals, which have been found to be at higher risk for cognitive decline than other groups. Prior research suggests a negative relationship between BMI and cognitive status in Mexican participants. However, the generalizability of these results has been restricted due to methodological issues, including the use of a limited cognitive battery and small convenience samples. The latter is of concern given that cognitive differences have been identified between rural-dwelling and urban-dwelling respondents in Mexico. The purpose of this study was to examine the relationship between BMI and cognition in a large representative Mexican sample.

**Participants and Methods:** A sample of 2,029 rural- and urban-dwelling participants (59% female;  $M$  age=68.1±9.01, range: 54-104 years;  $M$  years of education=5.33±4.45) from the Mexican Health and Aging Study (MHAS) completed a comprehensive cognitive battery and a physiological exam as part of a larger epidemiological study. A cognitive composite score was calculated as a function of the test battery. BMI ( $M$ =28.39±5.17, range=11.76-52.68) was calculated based on mean height and weight across two measurements. Controlling for age, sex, and years of education as covariates, the relationship between BMI, residential locality size (proxy for urban versus rural residence), and cognitive ability was estimated using linear regression in the whole sample and in a subsample of healthy participants without a significant medical history.

**Results:** In this large Mexican sample, there was a small positive effect of BMI ( $\beta$ =0.10, 95% CI: 0.01, 0.03,  $p$ =0.001, partial  $R^2$ =0.01) on cognition, while there was no effect of locality size or interaction (both  $p$ 's>0.05). In healthy individuals without significant health conditions (e.g., hypertension, diabetes), there was a positive simple main effect of BMI ( $\beta$ =0.19, 95% CI:0.01, 0.06,  $p$ =0.04, partial  $R^2$ =0.02) and of locality size ( $\beta$ =0.44, 95% CI: 0.04, 0.71,  $p$ =0.03, partial  $R^2$ =0.01) on cognition; a significant interaction between these variables ( $\beta$ =-0.62, 95% CI: -0.03, 0.01,  $p$ <0.01, partial  $R^2$ = 0.02) indicated that the association between BMI and cognition was greater in rural-dwelling individuals compared to urban-dwelling individuals.

**Conclusions:** Our findings suggest a significant, albeit small, association between higher BMI and better cognitive performance, independent of locality size. In healthy individuals, higher BMI was uniquely associated with worse cognitive performance among rural participants. The relevance of locality in this relationship may be associated with urban-rural differences in factors like access to care, nutritional quality, health behaviors, and cultural factors. These results demonstrate that health status and locality play important roles in the complex association between BMI and cognitive performance.

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**Keywords:** cognitive, diversity, neuropsychological outcome

**J. H. PIZER, M. A. MYERS, N. A. HAWLEY, M. HARRELL, B. D. HILL. Cognitive Intra-Individual Variability Varies by Race/Ethnicity.**

**Objective:** Cognitive intra-individual variability (IIV) measures an individual's dispersion or fluctuation in cognitive functioning across neuropsychological domains. Some research suggests IIV is a measure of neuropathology and can predict clinical outcomes. However, no one has shown systematically how IIV may be affected by demographic factors. This study evaluated the effect of race/ethnicity on cognitive IIV.

**Participants and Methods:** Archival data from 3,803 participants who had completed a neuropsychological evaluation were utilized in this study. The sample was 50.4% male, 89.5% Caucasian ( $n = 3,405$ ), 6.4% African American ( $n = 245$ ), 2.1% Native American ( $n = 80$ ), 1.4% Hispanic ( $n = 55$ ), and 0.5% Asian American ( $n = 18$ ). The mean ages were: Caucasians 52.3 years ( $SD = 17.5$ ), African Americans 51.5 years ( $SD = 19.4$ ), Native Americans 46.2 years ( $SD = 17.6$ ), Hispanics 41.4 years ( $SD = 15.0$ ), and Asian Americans 40.1 years ( $SD = 16.8$ ). All participants completed Trail Making Test (parts A and B), Controlled Oral Word Association Test, Animal Naming, and Paced Auditory Serial Addition Test. Normed T scores was utilized for all analyses (Heaton norms). Cognitive IIV was calculated as the standard deviation of the overall test battery mean (OTBM  $SD$ ) for each individual across the above tests. Mean OTBM: Caucasians 37.6 ( $SD = 11.1$ ), African Americans 38.4 ( $SD = 10.1$ ), Native Americans 42.4 ( $SD = 12.4$ ), Hispanics 44.8 ( $SD = 10.8$ ), and Asian Americans 38.2 ( $SD = 9.6$ ). Mean OTBM  $SD$ : Caucasians 8.3 ( $SD = 5.1$ ), African Americans 7.6 ( $SD = 4.9$ ), Native Americans 7.5 ( $SD = 5.2$ ), Hispanics 8.5 ( $SD = 5.6$ ), and Asian Americans 5.8 ( $SD = 3.2$ ).

**Results:** One-way analyses of variance (ANOVA) was performed with race/ethnicity as the group factor and OTBM and OTBM  $SD$  as dependent variables. Assumption of normality and HOV were met. Given the unequal sample sizes, Kruskal–Wallis nonparametric test was utilized and significant main effects were found for OTBM ( $p < .001$ ) and OTBM  $SD$  ( $p = .049$ ). Thus, we felt comfortable interpreting the results of the one-way ANOVAs. Significant main effects were found for OTBM,  $F(4, 3798) = 11.729$ ,  $p < .001$ , and OTBM  $SD$ ,  $F(4, 3796) = 2.558$ ,  $p = .037$ . The average OTBM for this sample was 37.9 ( $SD = 11.1$ ). Fisher's least significant difference post hoc analyses found that for OTBM, Native Americans and Hispanics were significantly different from other groups but Caucasians, African Americans, and Asian Americans were not significantly different from each other. For cognitive IIV (OTBM  $SD$ ), there was a significant difference between Caucasians and African Americans as well as between Caucasians and Asian Americans. No other groups differed.

**Conclusions:** These findings support that cognitive IIV may differ between Caucasians and some minority groups even when they have similar levels of overall performance. Further research is needed to ascertain why variation within cognitive performance significantly varies across some racial/ethnic groups but not others. This study was limited by relatively small sample sizes for the racial/ethnic minority groups and replication in larger minority samples is required.

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**Keywords:** minority issues, normative data, cognitive

**B. CERNY, K. J. JENNETTE, Z. J. RESCH, G. P. OVSIEW, N. M. DURKIN, W. SONG, N. H. PLISKIN, J. R. SOBLE. Predictive Value of Victoria Symptom Validity Test Response Latency over Response Accuracy in Determining Performance Validity Status.**

**Objective:** Response latencies have gained increased attention in the performance validity test (PVT) literature as process indices that may supplement traditional response accuracy

scores. The Victoria Symptom Validity Test (VSVT) is a freestanding PVT that measures response accuracy and latency during standard administration. However, the utility of the latency scores in predicting performance validity over and above response accuracy cut-scores remains under-explored. This study examined whether VSVT response latency indices provide increased predictive value for identifying invalid performance beyond accuracy scores.

**Participants and Methods:** This cross-sectional study used a known-groups design and included data from 163 mixed clinical patients who completed the VSVT and at least four independent criterion PVTs during outpatient evaluation (121 valid/42 invalid). Invalid status was determined by failure of two or more independent criterion PVTs. The sample was 48% female/52% male, 44% White, 26% Black, 19% Hispanic, 8% Asian, and 4% other ethnic/racial identity. Mean age was 39 ( $SD=13.5$ ) and mean education was 14.5 years ( $SD=2.8$ ). A two-block binary logistic regression was used to investigate the ability of the VSVT Total Items Correct (Block 1) and Total Mean Response Latency (Block 2) to predict validity status.

**Results:** The model with VSVT Total Items Correct (Block 1) was significant ( $X^2=39.09$ ,  $p<.001$ ; Nagelkerke  $R^2=.31$ ), with 81.6% overall classification accuracy. In this model, Total Items Correct was a significant predictor ( $\beta=-0.17$ ;  $SE=0.31$ ;  $p<.001$ ) of validity group membership. When Total Mean Response Latency was entered in Block 2, the overall model remained significant ( $X^2=41.19$ ,  $p<.001$ ; Nagelkerke  $R^2=.36$ ), although overall classification accuracy was unchanged at 81.6%. Both Total Items Correct ( $\beta=-0.12$ ;  $SE=0.36$ ;  $p=.001$ ) and Mean Response Latency ( $\beta=0.58$ ;  $SE=0.24$ ;  $p<.05$ ) were significant predictors.

**Conclusions:** Both VSVT Total Items Correct and Total Mean Response Latency significantly predicted validity status, although the latter did not improve overall classification accuracy beyond accuracy alone. Continued research on response latency indices as a supplement to traditional accuracy scores is warranted.

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**Keywords:** malingering, neuropsychological assessment

### **E. SULLIVAN-BACA, Z. TAIWO, J. GRABYAN, T. WEBBER. Validity of Collateral Informant Report in the Context of Patient Performance Validity Test and Symptom Validity Test Failure.**

**Objective:** A trustworthy collateral report can lend crucial information to the conceptualization of a patient's cognitive and functional abilities. However, just as patient scores on performance validity tests (PVTs) or symptom validity tests (SVTs) provide insight into the credibility of test results, it is important to understand credibility of collateral report. Notably, despite the importance of valid collateral information, there is a dearth of literature on how patient PVT and SVT results are reflected in collateral reports of patient functioning. Thus, the present study aimed to investigate the relationship between collateral report of patient functioning and patient PVT and SVT data in order to better guide efforts for determining validity of collateral informant report.

**Participants and Methods:** Participants included 79 Veterans evaluated during a 4-day admission for investigation of possible epilepsy via video electroencephalogram, and their 79 collateral informants. Noncredible PVT performance was defined as failure on two or more of the following measures: the Word Memory Test (WMT) Immediate Recall, Delayed Recall, or Consistency  $\leq 82.5\%$ ; Test of Memory Malingering (TOMM) Trial 1  $\leq 41$ ; and Wechsler Adult Intelligence Test-Fourth Edition (WAIS-IV) Digit Span subtest age-corrected scaled score  $\leq 5$ .

SVT measures included VRIN-r, TRIN-r, F-r, and Fp-r scales on the Minnesota Multiphasic Personality Inventory-Second Edition-Revised Form (MMPI-2-RF) along with the Structured Inventory of Malingered Symptomology (SIMS). SVT invalidity was indexed when two of the following three thresholds were surpassed: VRIN-r or TRIN-r  $\geq 80$ ; F-r = 120 or Fp-r  $\geq 100$ ; and SIMS total score  $\geq 21$ . Collateral informants completed the Patient Competency Rating Scale (PCRS), Dementia Severity Rating Scale (DSRS), and Activities of Daily Living Scale (ADLS).

Independent sample t-tests evaluated differences in collateral reports on the PCRS, ADLS, and DSRS based on examinee SVT and PVT validity status.

**Results:** A total of 60 participants exhibited valid PVT performance, while 19 were considered PVT failures. Examinee PVT failure was associated with significantly lower scores across the three collateral report measures: PCRS ( $t(77) = 2.24, p < .05$ ), DSRS ( $t(77) = 3.40, p < .01$ ), and ADLS ( $t(77) = 2.09, p < .05$ ). Effect sizes (Cohen's  $d$ ) for patient PVT failure on collateral report of functioning ranged from .51 for ADLS to .84 for DSRS. On SVT measures, 65 participants had valid performance, while 14 performed in the invalid range. Examinee SVT invalidity was not significantly associated with any collateral report measures ( $ps > .05$ ), with negligible effect sizes ( $d = .15-.18$ ) across the collateral reports of patient functioning.

**Conclusions:** Patient PVT failure was associated with collateral report of lower perceived competence, reduced participation in activities of daily living, and lower cognitive functioning in the patient. This finding suggests collateral reports for patients with invalid PVT performance should be interpreted with caution. However, such caution may not be necessary in those with SVT failure. These results provide an avenue into further investigation of how to determine the credibility of collateral reports, which may translate to various clinical settings, but especially those where PVT invalidity or malingered neurocognitive disorder are more common.

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**Keywords:** malingering

**B. POTTER, H. M. CONKLIN, V. M. CRABTREE, J. M. ASHFORD, Y. LI, Y. GUO, M. S. WISE, E. S. WRIGHT, T. E. MERCHANT. Investigating the Utility of Embedded Validity Indicators among Children Treated for Brain Tumors: Impact of Sleepiness and Cognitive Impairment associated with Craniopharyngioma.**

**Objective:** Survivors of pediatric craniopharyngioma experience significant cognitive deficits that negatively affect quality of life. Sleep problems are a frequent complication in this population, and variable arousal can negatively impact cognitive assessment. Sleepiness influences motivation, undermines optimal performance, that can lead to questionable validity of test results. It is unclear whether the well-established cognitive deficits in children with craniopharyngioma are exacerbated by sub-optimal effort and/or sleepiness. Accordingly, we investigated embedded and symptom validity indicators and sleepiness, in a sample of pediatric craniopharyngioma patients.

**Participants and Methods:** Participants [ $N = 104$ ;  $10.0 \pm 4.5$  years; 48.6% Male] completed baseline cognitive and sleep [ $n = 83$ ] assessments following surgery, but prior to proton therapy. One year following proton therapy, participants [ $n = 96$ ] completed follow up cognitive testing. Reliable Digit Span (RDS), Digit Span Total (DST), Omissions from the CPT-II (OMI), Perseveration from the CPT-II (PER), and Discrimination from the CVLT-C (DIS) have been previously established as embedded effort indicators and were used in this study. Parent rating symptom validity indicators were obtained from the BRIEF (Negativity Index) and BASC-II (F

Index). The sleep history was reviewed by a sleep medicine physician and participants were studied with nocturnal polysomnography and the Multiple Sleep Latency Test (MSLT), which is an objective measure of daytime sleepiness and sleep-onset REM periods.

**Results:** At baseline, effort indicators detected a range of 0 to 30% of participants who demonstrated sub-optimal performance with symptom validity indicators elevated in only 2%. Wilcoxon signed rank tests (effort indicators) and McNemar's test (symptom validity indicators) failed to reveal change in rate of sub-optimal performance from baseline to one year ( $p > .10$ ). Wilcoxon rank sum tests revealed a significant relationship between presence of excessive sleepiness due to hypersomnia due to medical disorder or narcolepsy and poor performance on three embedded validity indicators ( $p < .05$  for RDS, DST, OMI). Linear mixed models revealed a significant or trending relationship between estimated IQ and validity indicators at baseline (DIS  $p < .001$ ; OMI  $p = .07$ ) and one year ( $p < .05$  DST and OMI).

**Conclusions:** Symptom validity indicators on parent measures do not appear to be a significant area of concern in this population. Embedded validity indicators identified a range from 0 to 30% of the cohort as demonstrating possible sub-optimal effort on cognitive testing at baseline, with stable findings one year following proton therapy. RDS noted highest possible suboptimal effort; however, RDS has been criticized as overestimating sub-optimal effort in pediatric populations, especially in samples with neurological involvement. The presence of objective sleepiness was strongly associated with indicators of suboptimal effort, stressing the need to consider sleepiness when interpreting cognitive performance in children with craniopharyngioma. The impact of IQ also needs to be considered when interpreting effort indices for these children. Embedded validity indicators should be used with caution in pediatric craniopharyngioma. Future research should investigate different cut scores and combinations of validity indicators to best differentiate suboptimal performance due to effort versus variable arousal and/or global cognitive impairment.

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**Keywords:** effort, medical disorders/illness, sleep disorders

### **A. ROBINSON, M. CALAMIA. Performance on the Victoria Symptom Validity Test and b Test in a Sample of Adults Referred for Psychoeducational Testing.**

**Objective:** Although the use of performance validity tests (PVTs) has been frequently researched and recommended for use in specific contexts (e.g., forensic assessment), less attention has been paid to psychoeducational settings in which patients may have motivation to perform poorly (e.g., to gain access to academic accommodations or stimulant medication). We aimed to establish base rates of PVT failure on two popular PVTs in individuals seeking psychoeducational testing evaluations at a university clinic. In addition, we also examined how using different cut-off scores influenced base rate failures.

**Participants and Methods:** Participants were 122 students and community members seeking a psychoeducational testing evaluation at a university clinic in the South. Participants were administered the b Test and the Victoria Symptom Validity Test (VSVT). Failure rates were calculated based on recommendations in the test manuals as well as available research. Cutoff scores for the b test were 82 (Roberson et al., 2013), 90 (Boone et al., 2002), and 130 (Boone et al., 2002). Cutoff scores for the VSVT difficult condition were 16 (Slick et al., 1997), 19 (Frazier et al., 2007), and 21 (Grote et al., 2000).

**Results:** 13.9% of the sample failed when using the Specific Learning Disorder (SLD) cutoff of 130, 14.0% of the sample failed the b Test when using the established non-clinical cutoff of 90, and 14.8% of the sample failed the b Test when using the cutoff of 82. When using the recommended cutoff score of 16 for the VSVT difficult condition 11.5% of the sample failed. 21.3% failed the difficult condition when using a cutoff score of 19 and 30.3% of the sample failed the difficult condition when using a cutoff score of 21.

**Conclusions:** A significant minority of patients presenting for psychoeducational testing fail performance validity measures even at conservative cutoffs. The use of more conservative compared to more liberal cutoffs has a greater effect on rates of failure on the VSVT than the b Test. Careful consideration should be taken when choosing PVTs and cutoffs in psychoeducational evaluations. Future research should further evaluate the influence of cutoffs on base rates of different PVTs as well as noncredible responding on self-report measures in those completing psychoeducational testing evaluations.

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**Keywords:** malingering, neuropsychological assessment

### **A. CLARK, R. BRANSON. Utilizing Embedded Indicators from the Wisconsin Card Sorting Task to Detect Suboptimal Effort in College Students.**

**Objective:** Standard neuropsychological assessments play an important role in identifying cognitive deficits in individuals following an acquired brain injury (ABI). However, effort can account for more inconsistency in neuropsychological test performance than the severity of the ABI (Fox, 2011). Both stand alone and embedded measures of suboptimal effort exist, but little research has examined the utility of executive function (EF) based measures of effort. The present study examined whether patterns of performance on standard assessments of EF, like the Wisconsin Card Sorting Test (WCST), could identify suboptimal effort in undergraduate students malingering brain injury.

**Participants and Methods:** Undergraduate student participants were randomly assigned to either *Do Your Best* (DYB;  $n = 57$ ) or *Simulate Brain Injury* (SBI;  $n = 57$ ). The SBI participants read a short description of the symptoms of brain injury and were instructed to complete the study while pretending they had suffered such an injury in their recent past. After reading brief, group-specific instructions, all 114 participants completed a battery of neuropsychological assessments, including the Test of Memory Malingering (ToMM), Word Choice Test (WCT), Digit Span, Verbal Fluency, and WCST.

**Results:** While the SBI participants did not differ significantly from the DYB group in age, education, or sex, they completed fewer categories ( $p < .001$ ), made significantly more total errors ( $p < .001$ ), more perseverative errors ( $p < .001$ ), and failed to maintain set more often ( $p < .001$ ) on the WCST. Despite those group differences, no participants in the SBI group exceeded any established neuropsychological cutoff scores for the WCST. However, with the number of perseverative errors and failure to maintain set as independent variables, and group status (DYB vs. SBI) as the dependent variable, we did find an overall classification rate of 67.5%,  $\chi^2(1, n = 113) = 24.67, p < .001$ . Therefore, using the performance indicators of perseverative errors and failure to maintain set, 6.75 out of 10 participants in the SBI group were correctly classified as malingering.

**Conclusions:** These results contribute to the current literature, which indicates that standard neuropsychological assessments of EF have additional utility for detecting suboptimal effort in

possible ABI. Specifically, we suggest that examining a client's pattern of perseverative errors and failure to maintain set on the WCST can be indicative of poor effort. However, caution should be taken when drawing conclusions from studies involving healthy undergraduate participants who are asked to simulate a brain injury, as they have no *true* incentive to put forth poor effort.

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**Keywords:** malingering, executive functions, brain injury

### **T. R. MAYNARD, G. TREMONT. Characterization of a Sentenced Prison Population Referred for Neuropsychological Evaluation.**

**Objective:** The United States continues to have the highest imprisonment rate in the world. Incarcerated older adults are markedly increasing and the prison population is at high risk for developmental, neurologic, and psychiatric disorders, emphasizing the need for neuropsychological evaluation in these settings. Currently, neuropsychological evaluation is not a widely available service among state prison systems. This study characterized a sentenced state prison population and examined characteristics associated with failed performance validity tests (PVT).

**Participants and Methods:** Archival data were used to identify inmates referred for neuropsychological evaluation by mental health providers through the Rhode Island Department of Corrections ( $n = 78$ ; 4 females). Two cases were excluded because of incomplete evaluations. All evaluations included two stand-alone performance validity measures: Test of Memory Malingering (TOMM) and Word Memory Test (WMT). Inmates also received detailed neuropsychological evaluation. Frequency and descriptive statistical analyses characterized inmate demographics, cognitive medical history, psychiatric history, reason for incarceration, neuropsychological test performance, and performance validity test (PVT) results. We compared inmates who failed PVTs to those who passed on key variables.

**Results:** Over the course of 13 years, 78 sentenced inmates were referred for neuropsychological evaluations. Ages ranged from 20-89 ( $M = 47.3$ ,  $SD = 15.3$ ) and average education level was 10.3 years ( $SD = 3.14$ ). Inmates were predominantly White (67%), followed by Black (14%), Hispanic (13%), and Asian (1%). Assault and battery, theft and sexual assault were the most common criminal charges. 58% of inmates reported at least one head injury in their medical history, while 51% reported a diagnosed neurodevelopmental disorder or disability. Psychosis was also noted in 30% of inmates. Alcohol abuse (54%) and substance abuse (68%) were commonly reported. 31% of inmates failed trial 2 and/or retention from the TOMM whereas 68% failed one of the trials on the WMT. Overall, 55% of inmates were determined to have suboptimal effort based on either a failed TOMM and/or two failed WMT indices. The only demographic, criminal, or medical history variable that was associated with failing PVTs was a history of attention deficit hyperactivity disorder (ADHD). Examining only individuals passing PVTs, the most prominent area of impairment was learning and memory ( $M z\text{-score} = -2.14$ ,  $SD = 1.00$ ), followed by language ( $M z\text{-score} = -1.15$ ,  $SD = 1.04$ ), visuospatial skills ( $M z\text{-score} = -1.05$ ,  $SD = 1.73$ ), attention ( $M z\text{-score} = -0.75$ ,  $SD = 1.03$ ), and executive functioning ( $M z\text{-score} = .76$ ,  $SD = 1.17$ ).

**Conclusions:** This study showed that a state prison population had significant risk factors for cognitive impairment, including history of psychiatric, neurologic, and developmental disorders. Memory and language impairments were the most common deficits seen on testing. Even among

these sentenced inmates who had no obvious potential for secondary gain, there was a high rate of PVT failure. No demographic or criminal history variables were associated with failing PVTs, although reported history of ADHD was associated with greater likelihood of failure on PVTs, possibly due to medication-seeking behavior. Taken together, the sentenced prison population can benefit from the availability of neuropsychological services, although routine assessment of effort is necessary.

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**Keywords:** forensic neuropsychology, effort, neuropsychological assessment

**M. SIMONS, M. NITTA, J. HOELZLE. Embedded Performance Validity Test Functioning in the Delis-Kaplan Executive Functioning System (D-KEFS) Trail-Making and Color-Word Interference Subtests.**

**Objective:** There have been recent efforts to develop and validate embedded performance validity indicators for Delis-Kaplan Executive Function System (D-KEFS) subtests (Erdodi et al, 2018; Erdodi et al, 2018; Eglit et al, 2019). This research will evaluate the ability of established and novel performance validity indicators within the Trail Making Test (TMT) and Color-Word Interference Test (CWIT) to differentiate between college students trying their best or feigning cognitive symptoms associated with attention-deficit/hyperactivity disorder (ADHD).

**Participants and Methods:** Undergraduate research participants [N= 372, 71.5% female, age  $M= 19.03$  (1.13)] completed neuropsychological tasks, and existing free-standing and embedded performance validity tests (PVTs). Participants were asked to try their best to complete measures or feign symptoms associated with ADHD. Receiver operating characteristic (ROC) curves identified optimal TMT and CWIT scaled score, error score, and contrast scores that differentiated between groups; diagnostic classification statistics were generated for multiple cut scores. Embedded D-KEFS validity indicators were compared to Reliable Digit Span (RDS) and the Victoria Symptom Validity Test (VSVT).

**Results:** The areas under the ROC curves (AUCs) suggests that across trials TMT and CWIT scaled scores discriminate between groups (TMT AUC range = .66 to .76; CWIT AUC range = .69 to .73). Subtest error and contrast scores do not discriminate between groups (Error score AUC range = .40 to .58; Contrast score AUC range = .44 to .53). A cut off scaled score  $\leq 8$  on CWIT Condition 3 (Inhibition) and TMT Condition 1 (Visual Scanning) optimally balanced sensitivity (SN) and specificity (SP) (CWIT Condition 3 SN = .42, SP = .93; TMT Condition 1 SN = .42, SP = .96). RDS similarly differentiated between groups at an established cut off score (RDS AUC= .64, SN= .35, SP=.92). Notably, the VSVT exhibited much greater ability to differentiate between groups at a validated cut off score (VSVT AUC = .81, SN = .67, specificity= .96).

**Conclusions:** Consistent with prior research, embedded TMT and CWIT validity indicators differentiated between young adults feigning symptoms of ADHD or not. While TMT and CWIT were as effective at differentiating groups as RDS, adequate sensitivity/specificity was attained only at a cut off scaled score of  $\leq 8$ , which reflects low average/average performance. The unusually high cut off score is problematic and likely reflects unique features associated with the sample. TMT and CWIT cutting scores proposed across studies differ and suggest clinicians and researchers should carefully consider whether or not to interpret TMT and CWIT performances as a potential indicators of task engagement.

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**Keywords:** executive functions, attention deficit hyperactivity disorder, malingering

**S. M. TIERNEY, T. CHOUDHURY , S. M. LIPPA, N. PASTOREK, B. MILLER, J. ROMESSER, A. SIM, J. LINCK. Varying “Failure Criteria” on Commonly Used Performance Validity Tests Influences Interpretation of Cognitive Outcomes.**

**Objective:** With widespread acknowledgment that invalid performance threatens the integrity and utility of neuropsychological assessment, performance validity testing has become increasingly prevalent in neuropsychological evaluations. However, the application and consideration of performance validity tests (PVTs) varies greatly in research, as well as clinical practice. The current study examined the effects of differing commonly used PVT failure criteria on the relationship between posttraumatic stress disorder (PTSD) and cognitive outcomes.

**Participants and Methods:** Two hundred and twenty Veterans with history of mild TBI presenting for clinical neuropsychological evaluation at one of four VA medical centers were administered several neuropsychological tests as part of a standardized battery. Normative T-scores of select tests were averaged into three composites of cognitive domains thought to be affected by PTSD: memory, attention/processing speed, and executive functioning. Separate one way analyses of variance were used to assess differences among the PTSD (n = 155 ) versus No PTSD groups (n= 65) across the three composites. Analyses were repeated, excluding participants based on combinations of “failure criteria” on the California Verbal Learning Test-second edition (CVLT-II) Forced Choice, Reliable Digit Span, Test of Memory Malingering (TOMM) Trial 2, and the Word Memory Test (WMT).

**Results:** When no PVT ‘s were considered (n=220), results of one-way ANOVA suggest that individuals with PTSD perform significantly worse across all three cognitive domains: memory ( $p = .01$ , Cohen’s  $d = 0.4$ ); attention/processing speed ( $p < .01$ , Cohen’s  $d = 0.5$ ); and executive function ( $p < .01$ , Cohen’s  $d = 0.4$ ). When individuals who failed both embedded PVT’s were excluded (n = 14), the PTSD group performed worse on attention ( $p < .05$ , Cohen’s  $d = 0.4$ ) and executive functioning composites ( $p < .01$ , Cohen’s  $d = 0.4$ ), but there were no differences on the memory tasks ( $p > .05$ ). Excluding participants based on failure of TOMM trial 2 alone (n = 48) showed similar results to using no PVT, such that those with PTSD performed significantly worse across memory ( $p < .05$ , Cohen’s  $d = 0.4$ ), attention ( $p < .01$ , Cohen’s  $d = 0.6$ ), and executive functioning ( $p < .05$ , Cohen’s  $d = 0.4$ ) domains. When failure on WMT alone (n = 118) was considered, results showed no differences between the PTSD and No PTSD groups across the assessed cognitive composites (all  $ps > .05$ ).

**Conclusions:** Results indicate that methods of defining PVT failure can greatly influence the observed relations between important clinical variables often investigated in neuropsychology. Findings highlight the importance of considering performance validity when interpreting cognitive data for research and clinical practice alike, and warrant future investigation of ways the current results may apply to other conditions.

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**Keywords:** test validity, neuropsychological outcome, neuropsychological assessment

**J. W. LACE, R. GALIOTO. Disability-Seeking and VSVT are Better Predictors of Neuropsychological Test Performance than Lesion Burden and Atrophy in Multiple Sclerosis Patients.**

**Background:** Extensive research has investigated the relationship of performance validity tests (PVTs) to overall neuropsychological test performance in various samples. Over half of the variance in cognitive test scores may be accounted for by PVTs, meaningfully more than that which is explained by bona fide neurological insult (Fox, 2011; Green et al., 2007). Despite recent literature discussing PVTs in the context of multiple sclerosis (MS; Galioto et al., 2020; Graver & Green, 2020), no research has yet determined the extent to which PVTs may or may not contribute to overall test performance beyond neurological disease burden (e.g., white matter lesions, global cerebral atrophy) in this population. **Participants and Methods:** Participant data were obtained from a de-identified, archival dataset of MS patients with neuroimaging referred for comprehensive neuropsychological assessment between 2017 and 2020 at a large, Midwestern medical center. Only those currently seeking ( $n = 35$ ) or never seeking disability status ( $n = 37$ ) were selected ( $N = 72$ ; 75% female; 85% White; Mage = 46.7 years; Meducation = 14.5). A Mean Performance Index (MPI) was calculated as the mean of WAIS-IV Digit Span, Symbol Digit Modalities Test Oral, Brief Visuospatial Memory Test-Revised (BVM-T-R) Total, BVM-T-R Delayed Recall, California Verbal Learning Test, Second Edition (CVLT-II) Total Recall, and CVLT-II Delayed Recall (all expressed as T scores), consistent with measures reported by Galioto and colleagues (2020). A hierarchical, multiple regression analysis was performed, with MPI as the outcome variable. Dichotomous (0 = none or mild; 1 = moderate or severe) neuroimaging disease burden variables (i.e., white matter lesions and global cerebral atrophy) were entered as predictors in the first step, and disability-seeking status (0 = not seeking; 1 = seeking) and Victoria Symptom Validity Test Hard Trial (VSVT-H) raw score were entered as predictors in the second step; no VSVT-H scores were identified as univariate outliers (i.e.,  $> |3.29|$  SD) **Results:** Results revealed that the first step including neuroimaging disease burden predictor variables significantly predicted 12.3% of MPI variance ( $F[2, 69] = 4.86, p = .011$ ), with only lesion burden marginally surpassing statistical significance ( $p = .031$ ). The second step, including disability status and VSVT-H, was significant, accounting for an additional 25.4% of MPI variance ( $F\text{-Change}[2, 67] = 13.66, p < .001$ ), over two times as much as the first step alone, with disability status and VSVT-H scores both emerging as significant individual predictors ( $ps < .015$ ) in the appropriate direction. The final model significantly accounted for 37.7% of MPI variance. **Conclusions:** Disability-seeking status and VSVT-H scores appeared to explain over twice as much variance in overall neuropsychological test performance as did bona fide neurological disease burden in MS patients referred for neuropsychological evaluation. Together with recent work (Galioto et al., 2020; Graver & Green, 2020), these findings underscore the need for performance validity assessment in clinical neuropsychological evaluations of MS patients given the proportion of variance in cognitive data that may be explained by disability-seeking and test engagement beyond neurological insult. Future work should replicate and extend these findings.

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**Keywords:** effort, multiple sclerosis, test validity

**J. SMOTHERMAN, A. BAIRD, N. WISDOM, A. BOETTCHER. Trails B Completion Time as an Indicator of Performance Validity in Retired Athletes.**

**Objective:** The Trail Making Test is a task assessing attention, processing speed, and flexibility; however, several studies have also explored its utility as a measure of performance validity in neuropsychological evaluations (Iverson et al., 2002; O’Bryant et al., 2010; Powell et al., 2010). This study sought to extend existing literature on Trails B as a Performance Validity Test (PVT) in a sample of retired athletes in a forensic evaluation. It was hypothesized that performance on Trails B would demonstrate adequate predictive accuracy in classifying valid/invalid group membership.

**Methods:** Participants included 265 retired male athletes aged 69 or younger: 17% ( $n = 45$ ) Caucasian and 83% ( $n = 220$ ) African-American. The Slick (1999) criteria for malingering was used to classify participants into credible and non-credible categories. ROC analysis was performed to determine the extent to which Trails B-mediated classifications aligned with Slick-mediated categories of non-malingering and malingering.

**Results:** Differences in Trails B performances between valid ( $m = 93.34$ ,  $sd = 44.21$ ) and invalid ( $m = 145.42$ ,  $sd = 71.34$ ) groups were statistically significant ( $U = 3501.0$ ,  $p < .0001$ ) with a large effect size ( $d = .91$ ). Using a cutoff score of  $> 147$  seconds, raw scores on Trails B demonstrated adequate predictive value for diagnostic classification statistics for players categorized as invalid performers via Slick criteria (ROC: sensitivity = .391, specificity = .903, 95% confidence interval: .67 - .81,  $p < .0001$ ).

**Conclusion:** Means were comparable to previous studies examining Trails B in suspected malingering versus non-malingering groups (e.g., O’Bryant et al., 2010). Findings from this study support the evidence of suppressed performance on Trails B among individuals exhibiting poor effort. However, due to poor sensitivity, this finding should only be considered in conjunction with formal effort measures. Future studies should seek to further clarify the utility of Trails B as an embedded effort measure in similar populations.

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**Keywords:** malingering

### **R. C. THOMPSON, S. M. MARKUSON, N. R. KASWAN, A. L. DENEEN, R. HIRST.** **Utility of a composite score to assess performance validity in a sample of healthy youth athletes.**

**Objective:** The use of embedded validity indicators (EVIs) in addition to stand-alone performance validity tests (PVTs) helps reduce the cognitive burden on the patient and helps clinicians and researchers balance efficiency and comprehensiveness in their evaluations. Erdodi et al. (2019) demonstrated increased sensitivity while maintaining excellent specificity by developing a composite measure of effort across multiple PVTs in adults. The present study evaluated various EVIs across a two-hour neuropsychological battery to develop a composite score of overall performance validity in a sample of youth athletes completing baseline neuropsychological testing.

**Participants and Methods:** A sample of 138 youth athletes aged 8–18 years ( $M_{age} = 12.32$ ,  $M_{FSIQ} = 110$ , 25% female) completed a two-hour baseline assessment as part of a larger sport-related concussion study. The battery included the Wechsler Abbreviate Scale of Intelligence (WASI–2) Matrix Reasoning (MR), Delis–Kaplan Executive Function System (D-KEFS) Trail Making Test (TMT), the Wechsler Intelligence Scale for Children–IV (WISC–IV) Letter–Number Sequencing, WISC–IV Digit Span, Stroop Color and Word Test (SCWT), and Test of Memory Malingering (TOMM). A composite score comprised of 22 EVIs was created using pre-

established cutoff scores for the aforementioned tests based on a review of the literature as well as previous research conducted with this sample of healthy youth athletes. Sensitivity and specificity as well as area under the curve (AUC) using receiver-operator curve (ROC) analysis were calculated for the composite score when predicting pass/fail performance on TOMM Trial 2 (TOMM2; cutoffs: total score <45 and total score <50).

**Results:** When using a cutoff score of >5 failed EVIs, the composite score demonstrated excellent specificity (.90–.92); however, while sensitivity was increased compared to individual EVIs, the composite score demonstrated inadequate sensitivity (.29) when predicting pass/fail performance on TOMM2 <45 and TOMM2 <50 ( $n$  failed=14). Additionally, the composite score adequately categorized performance validity better than chance for both TOMM2 <45 (AUC=.529) and TOMM2 <50 (AUC=.726).

**Conclusions:** The use of a composite score comprised of failed EVIs allowed specificity to be maintained above .90 (Boone, 2013) while modestly increasing sensitivity compared to the sensitivity of individual EVIs in our two-hour neuropsychological evaluation with healthy youth athletes. A composite score provides a clinician or researcher a more comprehensive assessment of performance validity throughout the entire evaluation rather than focusing on a unique point in time or relying on a single test. The present findings may not generalize to the general pediatric population, given that this was a sample of youth athletes with a mean IQ in the high average range. Future research could identify how individual differences such as intellectual ability impact the sensitivity and specificity of established cutoffs used in determining pass/fail performance on EVIs and PVTs regularly used with children. Additionally, future research could attempt to replicate these findings with a non-athlete sample.

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**Keywords:** pediatric neuropsychology, effort

**R. C. THOMPSON, S. M. MARKUSON, N. R. KASWAN, Y. MARKIV, R. HIRST.**  
**Impact of Full-Scale IQ on performance validity testing in a sample of healthy youth athletes.**

**Objective:** Performance validity testing is a key factor in determining the accuracy and utility of test results. The interpretation of performance validity tests (PVTs) is impacted by acute psychiatric distress, moderate-to-severe brain injury, and neuroanatomical and neurocircuitry abnormalities; however, the literature is mixed when describing the impact of FSIQ on performance validity testing with children (Green & Flaro, 2014; Shandera et al. 2010; Ventura et al., 2019). The present study aims to demonstrate that commonly used PVT/EVI cutoff scores disadvantage children with lower FSIQ compared to those with high FSIQ, especially for EVIs derived from tests of processing speed, attention, working memory, and executive function.

**Participants and Methods:** A sample of 138 youth athletes aged 8–18 years ( $M_{age}=12.32$ ,  $M_{FSIQ}=110$ , 25% female) completed a two-hour baseline assessment as part of a larger sport-related concussion study, including Wechsler Abbreviate Scale of Intelligence (WASI-2) Matrix Reasoning (MR), Delis–Kaplan Executive Function System (D–KEFS) Trail Making Test (TMT), Stroop Color and Word Test (SCWT), Test of Memory Malingering (TOMM), and Rey 15-Item Test and Recognition Trail (RFIT). Twenty-two EVIs and two PVTs using pre-established cutoff scores for the aforementioned tests based upon a review of the literature and previous research with this sample of healthy youth athletes, as well as a composite score of EVIs, were included in the present study. Hierarchical multivariate linear regression was used to

analyze whether FSIQ inversely correlates with the number of failed PVTs, EVIs, and a composite score of EVIs, while covarying for age, sex, and ethnicity. Logistic regression was used to determine whether pre-established cutoff scores disadvantage young athletes with lower FSIQ.

**Results:** Hierarchical multivariate linear regression demonstrated that participants with lower FSIQs had higher numbers of failed PVTs and EVIs ( $b = -.544$ ,  $t = -7.721$ ,  $p < .001$ ) when covarying for age and sex. Post-hoc logistic regression demonstrated that FSIQ significantly impacted pass/fail performance on a majority of EVIs, the RFIT combined score, and the composite score of EVIs when using previously published cutoff scores. The number of errors on the first 10 items of TOMM Trial 1 (TOMMe10), TOMM Trials 1 and 2, RFIT recall only, TMT Condition 1, Longest Digit Span Backward, and SCWT Word Reading were not significantly affected by FSIQ.

**Conclusions:** The present findings were consistent with previous research demonstrating that FSIQ significantly affects PVT/EVI failure rates in children with a below average FSIQ. Importantly, the current results highlight that TOMM is highly robust to the effects of FSIQ on performance validity testing with healthy youth athletes, whereas EVIs derived from tests of processing speed, attention, working, and executive function are highly influenced by FSIQ. The present study highlights the importance of clinical judgment in selecting appropriate PVTs/EVIs and when interpreting EVIs derived from commonly used neuropsychological assessments with children who have a below average FSIQ.

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**Keywords:** pediatric neuropsychology, effort, intelligence

### **K. SHEIKH, C. P. PECK. The Golden Stroop Color and Word Test: Cross-Validation of Embedded Validity Measures.**

**Objective:** Prior studies have developed performance validity indicators using different versions of the Stroop task. Lee, Landre, and Sweet (2019) recently investigated the effectiveness of the Golden and Freshwater (2002) Stroop indices for distinguishing valid and invalid test performance. Using residual scores from all three trials, they found that a Word trial (WR) cutoff of  $\leq -33$  and a Color trial (CR) cutoff of  $\leq -22$  to have adequate rates of specificity and sensitivity among their mixed sample of clinical and forensic referrals. The authors conclude the findings to be particularly applicable to neuropsychological outpatient practices. As such, the goal of the current study was to assess the recommended cutoffs for the Golden Stroop indices as embedded measures of performance validity in another outpatient sample.

**Participants and Methods:** A total of 135 archival files of individuals undergoing outpatient neuropsychological exams met inclusion criteria: 1)  $\geq 18$  years-old, 2) Completed at least two criterion PVTs (RDS-r, DCT, TOMM), 3) IQ scores  $> 80$ , and 4) No amnesic diagnoses. Files were classified as “valid” (VF) when there was no incentive to feign and all PVTs were passed ( $n = 113$ ); “Invalid” (IVF) files were classified based on failure of  $\geq 2$  PVTs ( $n = 22$ ). VF demographics: Mean age of 50.6 years ( $SD = 10.7$ ), mean education of 13.6 years ( $SD = 2.6$ ), mean IQ of 102.3 ( $SD = 13.8$ ), 58% female, 88% Caucasian, and 84% right-handed. VF diagnoses: ADHD (35%), mood disorders (21%), MCI (20%), and other psychiatric disorders (23%). IVF demographics: Mean age: 48.2 years ( $SD = 10.6$ ); mean education: 12.3 years ( $SD = 2.2$ ); mean IQ: 94.3 ( $SD = 9.0$ ); 38% female, 86% Caucasian, and 90% right-handed. IVF

diagnoses: ADHD (32%), mood disorders (23%), MCI (23%), and other psychiatric disorders (23%).

**Results:** WR residual score cutoff of  $\leq -33$  produced 90% specificity and 46% sensitivity, while a CR  $\leq -25$  cutoff produced 82% specificity and 55% sensitivity. WR T-scores cutoff of  $\leq 25$  produced 94% specificity and 46% sensitivity; CR T-score cutoff of  $\leq 25$  produced 91% specificity and 41% sensitivity.

**Conclusions:** Our results support the use of the Golden Stroop Test indices, specifically the Word and Color trials, as performance validity indicators in an outpatient sample. Our findings yielded greater specificity and sensitivity rates when using T-score cutoffs rather than residual scores, which was suggested by Lee et al. (2019), and produced excellent discriminability between valid and invalid performances (AUCs  $> .80$ ). Based on this, we recommend using T-score cutoffs of  $\leq 25$  for both WR and CR to optimize classification accuracy when assessing performance validity. Limitations and future directions for research are discussed.

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**Keywords:** test validity

### **K. SHEIKH, K. JOHNSON, B. ACHORN, C. P. PECK. Classification Accuracy of The Boston Naming Test as a Language-Based Embedded Measure of Performance Validity.**

**Objective:** Research and development of embedded performance validity tests (PVTs) within language-based cognitive measures have been largely underrepresented. The Boston Naming Test (BNT) was examined as a potential indicator of noncredible performance in neuropsychological testing (Whiteside et al., 2015). Most notably, Erdodi et al. (2018) proposed a raw score cutoff of  $\leq 50$  and a demographically adjusted T-Score cutoff of  $\leq 37$  as being highly specific (.85-.95) but insensitive (.15-.41) to invalid responding. Empirical support for these promising results, however, remains limited. Therefore, the goal of the current study was to further explore the classification accuracy of the BNT as a measure of performance validity and contribute to existing literature of its clinical utility.

**Participants and Methods:** A total of 144 archived profiles were collected in an outpatient clinic that included patients: 1) Age  $\geq 18$  years; 2) Administered criterion PVTs (Reliable Digit Span [RDS], Dot Counting Test [DCT], and the Test of Memory Malingering [TOMM]); 3) Intelligence quotient (IQ)  $\geq 80$ ; and 4) No dementia diagnoses. ‘Valid’ profiles ( $n = 120$ ) passed all PVTs given, while ‘Invalid’ profiles failed  $\geq 2$  PVTs ( $n = 24$ ). Demographics of valid performers: mean Age: 56.9 years ( $SD = 13.3$ ); mean Education: 14.2 years ( $SD = 2.8$ ); mean IQ: 104.1 ( $SD = 10.8$ ); 62% female, 93% Caucasian, and 89% right-handed. Primary diagnoses were MCI (29%), mood disorders (28%), ADHD (21%), and other psychiatric disorders (22%). Invalid profile demographics: mean Age: 56.8 years ( $SD = 12.5$ ); mean Education: 12.3 years ( $SD = 2.8$ ); mean IQ: 92.8 ( $SD = 10.5$ ); 38% female, 83% Caucasian, and 88% right-handed.

**Results:** Within this sample, a raw score cutoff of  $\leq 50$  produced 91% specificity, 58% sensitivity, and an area under curve (AUC) of .85. Demographically adjusted T-score cutoff of  $\leq 37$  produced 92% specificity, 54% sensitivity, and AUC = .78.

**Conclusions:** Results are consistent with previous studies and support the use of BNT validity cutoffs for mixed outpatient populations. Our investigation replicated findings from Erdodi et al. (2018) for recommended cutoffs yielding adequate specificity to non-credible responding and demonstrating the functional equivalence of raw scores with T-scores. In contrast, we obtained higher rates of sensitivity and classification accuracy of performance validity. As such, the BNT

may be a useful indicator to assist in identifying invalid performances in addition to having high positive predictive power. Limitations and future directions for research are discussed.

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**Keywords:** test validity, effort

**A. BARUCH, N. D. RIEDLER, S. RODMAN, S. SAKMAR, L. J. NEOKRATIS , K. A. LOGAR, C. A. HUSTON, T. GREZMAK, Y. K. BRAW, A. POREH. Detection of Feigning and the Impact of Cultural and Administration Methods on the Poreh Nonverbal Memory Test.**

**Objective:** Malingering estimates following personal injury range from 1% (Hickling et al., 1999) to more than 50% (Resnick, 1997). With such a high occurrence, it is essential to have measures that are valid and reliable across all populations. The Poreh Nonverbal Memory Test (PNMT) is a novel memory test that utilizes visual perceptual stimuli to identify the presence of malingering. The current study aims to identify differences in malingering between participants from the US and Israel, while demonstrating the use of a novel malingering measure that is resistant to these differences.

**Participants and Methods:** 155 participants were recruited from a midwestern US university and 61 from an Israeli University online research participation program. Participants from each university were divided into control and experimental groups, with the US groups consisting of 104 and 51 participants, and the Israeli group consisting of 30 and 31 participants respectively. Participants from both control groups received a script instructing them to provide their best effort in the tasks presented to them. Both experimental groups received a script instructing them to perform as if they had impaired memory. All participants then completed five trials of the Poreh Nonverbal Memory Test (PNMT), two trials of the Test of Memory Malingering (TOMM), the Reliable Digit Span (RDS), the TOMM recall trial and sixth PNMT 'delayed retention' trial.

**Results:** Analysis performed in SPSS 25 displayed significant differences in performance on the TOMM [ $F(2,161) = 9.16, p < .001$ ] between the experimental groups for the US ( $M = 18.39, SD = 11.55$ ) and Israel ( $M = 27.00, SD = 7.81$ ). Conversely, performance on the RDS differed [ $F(1,162) = 76.02, p < .001$ ] between the control groups for the US ( $M = 5.85, SE = .27$ ) and Israel ( $M = 9.77, SE = .36$ ). Analysis of all 9 cards of the PNMT delayed retention trial displayed no significant differences between the US and Israel for either the control or experimental groups. However, differences between the experimental and control groups for both the US and Israel were significant among all 9 cards, each of which attained  $p < .001$ .

**Conclusions:** Interpretation of the TOMM revealed that the Israel experimental group showed more exaggerated malingering than the US experimental group. On the RDS, control groups differed on their best attempted performances but did not malingering differently between countries. These findings suggest that both the TOMM and RDS were influenced by cultural differences. Performance on the PNMT did not differ between countries for either control or experimental groups, indicating that the test is not as sensitive to the cultural or administration differences that the TOMM and RDS were subjected to. However, the PNMT did identify performance differences between the experimental and control groups for both countries. This indicates that the test can still differentiate between malingerers and non-malingerers, despite any cultural or administration differences.

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**Keywords:** assessment, malingering

**K. M. GICAS, C. MEJIA-LANCHEROS, R. WANG, S. HWANG, V. STERGIOPOULOS. Cognitive and Functional Trajectories in Homeless Adults: 6-Year Outcomes From the At Home/Chez Soi Study.**

**Objective:** Cognitive and functional impairment is prevalent among homeless adults. A multitude of ongoing comorbid mental and physical health risks contribute to impairment and decline over time. The extent to which cognition contributes to functional outcomes within a dynamic risk environment is not well understood. The current study investigates the association between cognition and two dimensions of functional outcomes taking into account longitudinal variation in trajectories while adjusting for the influence of risk exposure.

**Participants and Methods:** This study includes 455 participants ( $M_{Age} = 40.4$ , 69.9% male) from the At Home/Chez Soi study, a large Canadian randomized control trial of Housing First for homeless adults with mental illness. Participants recruited from the Toronto site completed up to four clinical evaluations over six years. Scores from a brief cognitive battery were averaged to create a verbal learning and memory (VLM) factor (Hopkins Verbal Learning Test-Revised) and a complex processing speed-cognitive flexibility (CPS-CF) factor (Trail Making Tests A & B, Digit Symbol). Primary outcomes included community functioning (Mulnomah Community Ability Scale) and quality of life (Quality of Life Index - 20 item). Lifetime homelessness, mental health diagnoses, medical comorbidity, and childhood adversity were measured proximal to the baseline evaluations. Linear mixed effects models were employed with cognitive factors entered as time-dependent covariates for each of the outcomes. Risk factors associated with outcomes in a pre-screening step were included as fixed effects in the final models.

**Results:** Community functioning declined over time ( $b = -.370$ ,  $p = .002$ ). Better VLM was associated with better community functioning ( $b = .776$ ,  $p = .011$ ), with a relatively larger positive association between CPS-CF and community functioning ( $b = 1.49$ ,  $p < .001$ ). Lifetime homelessness of 3 or more years ( $b = -2.12$ ,  $p = .001$ ) was associated with worse community functioning at baseline, while major depressive disorder was associated with better baseline functioning ( $b = 1.60$ ,  $p = .026$ ). Age, gender, diagnosis of a psychotic disorder, substance dependence, and childhood adversity did not remain significant in the final model. In the second model, quality of life improved over time ( $b = .602$ ,  $p = .029$ ). LM was not significantly associated with quality of life, whereas a non-significant trend toward better CPS-CF and better quality of life was noted ( $b = 2.00$ ,  $p = .057$ ). Greater childhood adversity ( $b = -1.98$ ,  $p < .001$ ) and major depressive disorder ( $b = -5.01$ ,  $p = .013$ ) were associated with worse quality of life at baseline. Age, gender, lifetime homelessness, medical comorbidity, and substance dependence did not remain significant in the model.

**Conclusions:** Select aspects of cognitive functioning are associated with community functioning over time, but not quality of life among homeless adults. Risk factors also differentially impacted functional outcomes. Overall, this study indicates that different rehabilitative strategies are needed to improve both community functioning and quality of life in homeless individuals. Strengthening cognitive capacity may be required to prevent decline in community functioning, whereas management of risk factors may be most critical for maintaining quality of life.

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**Keywords:** cognitive functioning, neuropsychological outcome, everyday functioning

**S. GONZÁLEZ DE LA TORRE MUÑOZ, G. G. DE LA TORRE, S. DOVAL MORENO, D. LÓPEZ, M. RAMALLO, M. GARCÍA-SEDEÑO. Neurocognitive Impairment in Severe Mental Illness. Assessment of Spanish-Speaking Sample Using the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS).**

**Objective:** RBANS is a brief neuropsychological test, which has been used to detect cognitive disorder in degenerative and no degenerative neurological diseases. It has been proved to be effective in other deficits such as schizophrenia and other psychotic disorders. Patients with SMI present diverse symptoms in each disorder, but all of them share neurocognitive impairment. In addition, these patients present neurobiological vulnerability and social maladjustment. In fact, it has been revealed that a high percentage of people suffering from SMI showed a low performance in different aspects of cognitive processing, such as processing speed, maintenance attention, working memory, verbal learning, cognitive functioning or social cognition. The main objectives of this study were in the first place, to evaluate the presence of neurocognitive symptoms in a Spanish speaking sample of patients with severe mental disorder (SMI). We also did compare this group with another sample of healthy participants. Second goal was to set the different neurocognitive profiles of each evaluated disorder. Finally, we tested the sensitivity of RBANS for detecting the presence of cognitive deficits in these disorders

**Participants and Methods:** We describe an the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) screening in one sample of SMI patients (n= 149) and another of healthy controls (n= 35). Within the SMI sample, three different subsamples were formed: one with 97 patients with schizophrenia, a second with 29 patients with mood disorders, and a third with 23 patients with personality disorder. We performed a comparative study within and between groups.

**Results:** We performed an ANCOVA analysis to look into between- and within-group differences. Significant differences were found for executive functioning, attention, and memory.

**Conclusions:** RBANS is an especially sensitive tool for the detection of memory-related problems because these symptoms are common in dementia and this was the original target population of the battery. In our study, RBANS was able to clearly detect memory problems of all types (short, working, and delayed) in the three disease groups against controls. This study proves the helpfulness of the RBANS in the detection of neurocognitive or neuropsychological problems in psychiatric patients.

We can recommend RBANS not only for the detection of neurocognitive deficits in psychiatric disorders but also as a comparative measure, especially in SMI or chronic mental disorders.

Results are discussed in light of possible applications and implementation of treatment options in the Spanish speaking community.

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**Keywords:** cognitive neuroscience, neuropsychiatry, neurocognition

**W. SABAN, R. B. IVRY. PONT: A Platform for Online Neuropsychological Testing.**

Understanding brain-behavior relations requires the use of convergent methods, including studies involving patients with neurological disorders. However, a major challenge for neuropsychological research arises from the fact that we are dealing with a precious and limited resource: The patients. Not only is it frequently difficult to identify and recruit individuals

appropriate for the question at hand, but their ability to participate in research projects can be limited. As a result, neuropsychological studies typically include small sample sizes (e.g.,  $n=8$ ) and it can take quite a bit of time to complete a single study, let alone a package of studies that might make for a comprehensive story with appropriate controls. As a step towards addressing these issues, we have developed a platform for online neuropsychological testing (PONT). PONT is an online neuropsychological testing protocol that includes five primary steps: 1) Contacting support group leaders to help advertise the project; 2) Having interested individuals initiate contact with us given IRB contact rules; 3) Conducting interactive, remote neuropsychological assessments; 4) Automated administration of the experimental tasks; 5) Obtaining feedback and providing payment. The platform uses a Gorilla interface and is designed to handle a range of experimental protocols (e.g., surveys, reaction time tasks) that can be run on different devices (computer, phone, tablet). To date, we have developed PONT as a tool to accelerate our research program on subcortical contributions to action and cognition, reaching out to Parkinson and ataxia support groups. By contacting approximately 550 support group coordinators, we have recruited around 150 individuals with spinocerebellar ataxia (SCA) and 120 individuals with Parkinson's disease (PD) over the past six months. We have also completed four experiments testing motor (sequence learning) and cognitive (arithmetic) abilities, with an average of 20 SCA, 20 PD, and 25 matched controls in each experiment. The results demonstrate the feasibility and efficiency of conducting online experiments on people with different neurological disorders. Participants like PONT because they can complete the experiments at home and at a time that fits into their personal schedule. We have encountered some limitations with this approach; for example, it is difficult to handle problems that come up when a participant finds a task too difficult or doesn't understand the instructions. Nonetheless, PONT has great potential to significantly increase the sample size in neuropsychological studies, make data collection much more efficient, and increase the impact of neuropsychological research. And, of course, this type of research can thrive during the pandemic. PONT could be a powerful tool to evaluate the involvement of both cortical and subcortical mechanisms in a wide range of motor and cognitive processes.

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**Keywords:** Parkinson's disease, ataxia, neurocognition

**C. TYTLER, K. I. STEWART, I. YAROSLAVSKY, M. KOVACS. Research Domain Criteria: Are the Parts more Informative than the Whole?**

**Objective:** Efforts have been made to articulate transdiagnostic mechanisms for psychopathology across multiple levels of analyses (e.g., neural & behavioral; Research Domain Criteria, RDoC). Substrates supporting negative and positive emotional processing (Negative & Positive Valence Systems, NVS & PVS) may inform transdiagnostic treatment efforts as affective dysfunction is pervasive in psychopathology. Asymmetric activation in the fronto-temporal neural regions and affected parasympathetic nervous system output have been tied to subjective affectivity within both valence systems. However, it remains unclear whether such associations represent co-activation in related independent processes or reflect activity within substrates of unitary constructs. This study tests the construct validity of the NVS and its lower order Loss and Frustrative Non-reward constructs, and those of the PVS (i.e., Initial Response to Reward and Reward Expectancy) using well-validated behavioral, neural, and peripheral nervous system indices (Units of Analyses, UAs) in a large sample of adults and their offspring.

**Participants and Methods:** Adults (N=436, 33% male, M age=25.94 years, Range=18-40) and their offspring (N=158, 54% male, M age=6.47 years, Range=4–12 years), completed an experimental protocol during which baseline activity, PVS response to reward and reward expectancy constructs, and NVS loss and frustrative non-reward constructs were ascertained via validated tasks (Free Breathing Task; Happy Film clips & Gambling Task Winning Trials; Sad Film clips & Gambling Task Losing Trials for adults & receiving a Broken Toy for children). Behavioral indices reflect change in self-reported affect ratings from baseline levels to those following each task. Electroencephalography (EEG) and electrocardiography signals were collected throughout at a sampling rate of 512Hz; asymmetric neural activation reflects change in the alpha-band (8-13Hz), while high-frequency heart rate variability (.15-.40Hz) indexed task-related change in PNS activity (respiratory sinus arrhythmia, RSA) across baseline and task conditions.

**Results:** Contrary to expectation, there was little convergence between UAs within constructs among adults and children ( $|rs| < .25$ , NS), and associations among UAs within a valence system construct did not differ in the magnitude of their associations with UAs of constructs in the opposite valence system. Factorial validity was not supported for lower-order constructs in adults (CFI=.04-.63, RMSEA=.15-.23), nor were valence systems in both samples (CFI=.14-.51, RMSEA=.17-.22). Conversely, RSA and EEG reactivity to positive and negative stimuli were explained by respective latent variables (CFI=.92-.96, RMSEA=.05-.10; RSA reactivity  $\lambda=.37-.87$ ,  $ps < .001$ , EEG reactivity  $\lambda=.37-.92$ ,  $ps < .001$ ). However, affect reactivity was not unitary, showing small associations between responses to hedonic and sadness inducing stimuli among adults ( $r=.10$ ,  $p < .05$ ). Unrelated among adults, increased right fronto-temporal alpha band asymmetry, an index of negative emotionality, was significantly associated with RSA augmentation among children ( $r=-.25$ ,  $p < .001$ ).

**Conclusions:** Our results failed to support construct validity of the two valence systems and their lower-order constructs. Conversely, EEG lateralization and RSA reactivity are unitary constructs, the coherence among which appear to diminish during adulthood. This pattern of findings suggests that neural asymmetry and RSA reactivity may reflect facets of physiological flexibility that become differentiated with age.

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**Keywords:** electroencephalography, emotional processes

**O. A. SANTOS, A. REYES, S. TORRES, J. MAIETTA, A. TAN, W. MCBRIDE, J. T. FOX-FULLER, E. C. DUGGAN. Clinical Neuropsychology Trainee Forum: A Proposal for Impactful Student/Trainee Advocacy .**

**Objective:** Students and trainees are represented in committees across many major neuropsychological organizations; however, mechanisms to facilitate collaboration and reduce duplicated efforts have been limited. We propose the creation of a forum composed of trainee representatives from different neuropsychology organizations: the Clinical Neuropsychology Trainee Forum (CNTF). The CNTF aims to facilitate inter-organizational information exchange and collaboration to coordinate efforts on educational, training, and advocacy issues relevant to trainees. The panel will discuss the results from a survey of neuropsychology trainee leaders on the need for such a forum.

**Methods and Participants:** An online survey was distributed to assess support for the CNTF proposal. Among the 130 trainee leaders contacted from over 12 professional

neuropsychology organizations, 71 completed the survey (55% completion rate). Approximately 69% (n=49) of the respondents were doctoral students, 8.5% (n=6) interns, 19.7% (n=14) postdoctoral fellows, and 2.8% (n=2) indicated “other” as a career stage.

**Results:** Overall, 96% (n=68) of respondents supported the CNTF proposal, while 1.4% (n=1) did not support it, and 2.9% (n=2) did not indicate a preference. Overall, responses in support of the proposal fell within six general themes. Specifically, respondents reported that the development of the CNTF could help: 1) unify future professionals; 2) provide consistent information to students; 3) promote collaboration; 4) increase solidarity in advocacy efforts; 5) improve communications among students; and 6) streamline leadership efforts. Results will be further discussed by the panel along with recommendations for the creation of the CNTF.

**Conclusion:** Survey results demonstrate a strong interest and enthusiasm for the development of the CNTF. By providing a representative voice to neuropsychology trainees’ concerns and initiatives, the CNTF has the potential to foster collaborations among trainees, significantly improve support for student leaders, facilitate the development and involvement of new student organizations within neuropsychology-wide governance, and impact student training and experience.

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**Keywords:** inclusion

### **L. A. DESRUISSEAU, Y. SUCHY. Intra-Individual Variability in Performance as a Marker for Vulnerability to Temporary Executive Depletion due to Burdensome Emotion Regulation.**

**Objective:** Intra-individual variability (IIV) in performance has been identified as a risk factor for future cognitive decline, likely reflecting incipient cognitive vulnerability. In past studies, we have shown that certain contextual stressors, such as engagement in burdensome emotion regulation known as expressive suppression (ES), can result in temporary depletion of executive resources evidenced by transient decrements in performance on measures of executive functioning (EF). The goal of the present study was to examine whether IIV, as a marker of cognitive vulnerability, would also be a marker of vulnerability to EF depletion.

**Participants and Methods:** A total of 249 community-dwelling older adults (ages 59-93, 66% female,  $M_{\text{education}} = 15.2$  years) completed the Push-Turn-Taptap (PTT) task to assess IIV, four tasks from the Delis-Kaplan Executive Function System (D-KEFS) battery as a measure of EF, and the Burden of State Emotion Regulation Questionnaire (B-SERQ) as a measure of ES.

**Results:** In a general linear regression, the interaction term between ES and IIV emerged as a significant predictor of EF accuracy and speed [ $B = -.18$ ,  $t(246) = -3.13$ ,  $p = .002$  and  $B = -.10$ ,  $t(246) = -2.07$ ,  $p = .039$  respectively]. Further exploration of the interaction revealed that participants who reported high ES and demonstrated high IIV (the top tertile of the sample on both measures) exhibited poorer EF performance speed and accuracy.

**Conclusions:** EF performance can be deleteriously affected by certain contextual factors such as burdensome ES. IIV may moderate the association between ES and EF depletion such that only individuals with high IIV appear to be vulnerable to the impact of ES. As such, IIV may act as a marker of vulnerability to temporary EF depletion. However, the present study is correlational and therefore cannot address causality. Experimental manipulation of ES is needed to further elucidate the relationship between ES, IIV, and EF performance.

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**Keywords:** executive functions, aging (normal), everyday functioning

**L. A. DESRUISSEAU, Y. SUCHY. Intra-Individual Variability in Performance Predicts Temporary Executive Depletion due to Experimentally Induced Emotion Regulation.**

**Objective:** Burdensome emotion regulation, or expressive suppression (ES), is associated with subsequent temporary lapses in executive functioning (EF). Our recent study has shown that individuals with high intra-individual variability (IIV) in performance may be most likely to become executively depleted by ES. However, the causality of these associations could not be determined due to the correlational nature of the study. The goal of the present study was to further explore the directionality of the relationships among IIV, ES, and EF to determine if IIV is a marker of vulnerability to future EF lapses induced by ES.

**Participants and Methods:** A total of 92 community-dwelling older adults (ages 60-86, 64% female,  $M_{\text{education}}=16.04$  years) completed the Push-Turn-Taptap (PTT) task to assess baseline IIV, four tasks from the Delis-Kaplan Executive Function System (D-KEFS) as a measure of pre- and post-manipulation EF, and an ES task. In this task, participants in the experimental group were instructed to suppress emotional displays in response to emotionally arousing videos, while those in the control group were instructed to react naturally.

**Results:** In repeated measures ANOVA, we used EF as the dependent variable and time (pre- vs. post-manipulation) as the within-subjects factor. Group (experimental vs. control) and IIV (high vs. low) were used as the between-subjects factors. Results showed an interaction between time, group, and IIV [ $F(1,86)=4.95$ ,  $p=0.03$ ] such that only those individuals who exhibited high baseline IIV were deleteriously affected by engagement in ES.

**Conclusions:** Consistent with past findings, individuals with high IIV seem to be more vulnerable to burdensome effects of ES. Importantly, the present experimental findings are consistent with prior correlational results, suggesting that these relationships hold whether ES is self-reported or experimentally manipulated. Therefore, IIV may in fact be a marker of vulnerability to temporary EF depletion.

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**G. J. LEE, A. HARRISON, J. SUHR. Noncredible Responses Impact Associations Between Executive Functioning and Functional Impairment.**

**Objective:** Executive functioning (EF) involves higher-order cognitive capacities essential for intact functional abilities. However, studies report variable associations between EF and functional impairment, depending on whether EF skills are measured by neuropsychological testing or subjective rating scales. Methods used to assess EF can be further impacted by noncredible performance, which can be measured by performance validity tests (PVTs) and symptom validity tests (SVTs). We investigated the effects of noncredible performance on the associations of objective and subjective EF with perceived functional impairment.

**Participants and Methods:** Archival data from a Canadian assessment center included 4910 postsecondary students who presented for psychodiagnostic assessment. Of the dataset, 47 participants ( $M_{\text{age}} = 22.4 \pm 7.7$ ; 61.7% male) were selected who had all measures of interest for the present analyses. Participants completed EF tests (Wechsler Adult Intelligence Scale-IV

subtests, Delis-Kaplan Executive Function System subtests), self-report EF ratings (Behavior Rating Inventory of Executive Function; BRIEF), self-report functional impairment ratings (Weiss Functional Impairment Rating Scale), PVTs (Word Memory Test, Medical Symptom Validity Test, Victoria Symptom Validity Test), and SVTs (Conners' Adult ADHD Rating Scales, BRIEF) as part of their evaluations. Of the sample, 17 participants failed at least one PVT and 4 participants failed at least one SVT.

**Results:** Bivariate correlational analyses revealed significant relationships between EF tests of working memory, set-shifting, and inhibition with EF ratings of metacognitive skills ( $r_s = .30$  to  $.44$ ,  $p_s < .05$ ). Strength of associations between EF tests and EF ratings increased after excluding participants who failed PVTs and SVTs ( $r_s = .30$  to  $.51$ ). There were moderate associations of functional impairment ratings with performance on EF tests ( $r_s = .20$  to  $.34$ ), with tests of working memory, set-shifting, and inhibition reaching statistical significance ( $p_s < .05$ ). Strength of associations between functional impairment ratings and performance on all EF tests increased after excluding participants who failed PVTs ( $r_s = .31$  to  $.50$ ). There were significant relationships between functional impairment ratings and all EF ratings ( $r_s = .39$  to  $.65$ ,  $p_s < .01$ ). Strength of associations between functional impairment ratings and EF ratings increased after excluding participants who failed SVTs ( $r_s = .43$  to  $.67$ ).

**Conclusions:** Findings indicate that associations between objective EF, subjective EF, and perceived functional impairment increase when accounting for noncredible performance. Therefore, consideration of validity testing outcomes can more accurately determine the relationship between EF and functional abilities. Inclusion of validity testing will likely promote more precise diagnostic decision-making and effective treatment recommendations for individuals with executive dysfunctions.

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**Keywords:** executive functions, activities of daily living, noncredible presentations

### **N. M. MAJEED, M. NG, V. Y. LUA, A. HARTANTO. Musical Experience and Executive Functioning: Evidence from Frequentist and Bayesian Structural Equation Modelling.**

**Objective:** It has been proposed that musical experience has positive effects on one's executive functions (Miendlarzewska & Trost, 2014) due to the many ways in which musical activities engage one's executive functions. Sight-reading, for example, involves playing a new piece of music while concurrently reading ahead in the score, thereby engaging one's task-switching ability (Loehr et al., 2013) and working memory (Kopiez & Lee, 2008). Indeed, research has shown that the active development of musical experience utilises a diverse array of brain regions (Zatorre, 2005) including the frontal lobes (Hallam, 2012), even affecting the structure and function of the brain (e.g., Merrett et al., 2013; Wan & Schlaug, 2010). While an expanding body of studies examining the relationship between musical experience and executive functions has emerged, evidence for such a relationship has been mixed, possibly due to methodological issues including low sample sizes and task impurity problems. The current study thus examined the relationship between musical experience and the three main executive functions of inhibitory control, task-switching, and working memory, while addressing the aforementioned methodological limitations in the existing literature.

**Participants and Methods:** One hundred and seventy-five young adults (67% male, mean age = 22), recruited from a local university in Singapore, participated in a multi-session study. Musical experience was measured using the Ollen Musical Sophistication Index (Ollen, 2006). We

utilised a battery of nine tasks to examine the three subdomains of executive functioning, and robust latent variable analyses to better estimate the latent variables of inhibitory control, task-switching and working memory capacity. Performance on inhibitory control and task-switching were indexed by binned scores (Draheim et al., 2016; Hughes et al., 2014), while performance on working memory was indexed by the partial credit unit score (Conway et al., 2005).

**Results:** Models had excellent fits. We found no evidence of any relationship between musical experience and latent factors of executive functioning in both frequentist and Bayesian structural equation models.

**Conclusions:** These findings suggest that there is no association between musical experience and executive functioning, in line with experimental works by other researchers. The current null findings on the link between music experience and executive functions supplement a growing body of evidence showing that far transfers from learning a specific skill (e.g., learning music, chess, or brain training games) that can generalise to other unrelated domains (e.g., cognitive abilities) are uncommon and limited (Melby-Lervåg et al., 2016). Thus, considering our results and the existing literature, it is unlikely that music experience can confer any benefits to an individual that would boost their inhibitory control, task-switching ability, and working memory capacity. The current study provides important practical and pedagogical implications in questioning the use of music lessons as an effective way to improve executive functioning.

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**Keywords:** executive functions, cognitive functioning, working memory

## **R. E. WONG, S. BURNS, K. KRAUSE, J. POWELL. Preliminary Results on the Potential Relationship Between Role-Playing Video Games and Executive Functioning.**

**Objective:** Studies have demonstrated that video games within the “action” genre results in gamers experiencing enhancements in various executive function skills, including task switching/dual processing, working memory, and attention abilities. Nevertheless, it remains unclear whether these cognitive improvements are also seen in other video game genres, such as Role-Playing Games (RPGs). Therefore, the present study sought to investigate how habitual RPG video game play affects performance on executive function tests.

**Participants and Methods:** A sample of 21 adults were assessed via self-report on demographic variables and gameplay habits, and subsequently administered the Trail Making Tests (TMT), Digit Span (DS) tasks, Delis-Kaplan Executive Function Tower Subtest, and the Stroop Color and Word Test. Participants were then divided into groups of RPG players ( $n=11$ ) and non-RPG players ( $n=10$ ).

**Results:** An independent t-test indicated that those who played RPGs ( $M=53.27$ ,  $SD=15.78$ ) took significantly less time to complete a task-switching exercise (TMT B) compared to the non-RPG group ( $M=74.50$ ,  $SD=20.43$ ;  $t(19)=-2.68$ ,  $p=0.015$ ). No significant differences were found on the TMT A task between those who play RPGs ( $M=20.82$ ,  $SD=6.68$ ) and non-RPG players ( $M=21.30$ ,  $SD=4.88$ ),  $t(19)=-0.187$ ,  $p=0.854$ ). Notably, an additional independent t-test that compared the total number of errors made on TMT B, yielded a non-significant trend, suggesting that RPG players ( $M=0.36$ ,  $SD=0.674$ ) may make less errors on TMT B when compared to non-RPG players ( $M=1.30$ ,  $SD=1.34$ ;  $t(19)=-2.056$ ,  $p=0.054$ ). RPG players ( $M=0.27$ ,  $SD=0.65$ ) did not significantly differ from non-RPG players ( $M=0.60$ ,  $SD=0.843$ ) on the number of errors made on TMT A,  $t(19)=-1.004$ ,  $p=0.328$ ). Additionally, it was found that those who played RPGs ( $M = 5.36$ ,  $SD = 0.674$ ) performed significantly better on the DS backwards task compared

to those who did not play RPGs ( $M = 4.50$ ,  $SD = 1.08$ ;  $t(19) = 2.2$ ,  $p = 0.39$ ). No significant differences were found regarding the DS forward task between those who play RPGs ( $M = 7$ ,  $SD = 0.775$ ) and those who do not ( $M = 7.20$ ,  $SD = 0.789$ ;  $t(19) = -0.586$ ,  $p = 0.565$ ). No significant results were found for performance differences on the Tower or Stroop tests.

**Conclusions:** Altogether, these findings suggest individuals who play RPGs regularly may have better task switching and auditory-verbal working memory abilities when compared to non-RPG players. This finding is similar to previous research suggesting comparable enhancements for gamers who play action games. It seems that even though RPGs may not have the same level of fast-paced processing required for action games, players of RPGs experience cognitive benefit in the areas of task switching and auditory-verbal working memory. It is worth highlighting that the directionality of these findings remain unclear, as preliminary results were limited by the small sample size, lack of heterogeneity in the sample, and the lack of analyses of groups of other sub-types of video game genres. Given these limitations, future research should incorporate a larger, more heterogeneous sample, and further subdivide the participant sample into other video game genres to clarify the role RPGs have on cognitive abilities.

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**Keywords:** executive functions, executive abilities - normal

**C. MITZKOVITZ, S. LESICA, J. ADAY, K. L. MONSKE, C. WINNIE, D. M. WHITT, R. L. SKEEL. The Relationship Between Facets of Impulsivity and Problematic Phone Use.**

**Objective:** The current study investigated the relationship between impulsivity and problematic phone use (PMPU) by measuring multiple facets of impulsivity through behavioral and self-report measures.

**Participants and Methods:** Undergraduates ( $N = 106$ ) provided subjective ratings of phone use and then were administered the Addictive Patterns of Use Scale (APU; Domoff, et al., 2019), Problematic Mobile Phone Use Questionnaire Revised (PMPU-Q-R; Kuss et al., 2018), UPPS-P Impulsive Behavior Scale (Lynam et al., 2006), the Flanker Task (Zelazo et al., 2014) and a delay discounting task using YouTube video clips (Goldsworthy et al., 2016).

**Results:** A positive relationship was observed between total APU and UPPS-P scores,  $r = .364$ . Similarly, a negative relationship was observed between total PMPU-Q-R and UPPS-P scores,  $r = -.490$ . These relationships indicate that participants who reported greater levels of PMPU also reported higher levels of general impulsivity. Flanker task performance was positively correlated with the facets of prohibited phone use,  $r = .241$ , and sensation seeking,  $r = .213$ , on the PMPU-Q-R — indicating a relationship between lower levels of inhibitory control, sensation seeking, and prohibited phone use. Greater discounting on the YouTube task was negatively correlated with the facet of phone dependence on the PMPU-Q-R,  $r = -.197$ —indicating that those with tendencies towards discounting rewards may exhibit greater phone dependence. Hierarchical regression analyses revealed that inhibitory control and delay discounting accounted for 2.9% of variance in APU scores, and this was not significant,  $\Delta R^2 = .029$ ,  $\Delta F(1, 96) = 3.00$ ,  $p = .09$ . General impulsivity assessed by the UPPS-P added 28.1% of variance in the APU total over and above inhibitory control and delay discounting,  $\Delta R^2 = .281$ ,  $\Delta F(5, 91) = 7.86$ ,  $p < .001$ . Similarly, inhibitory control and delay discounting accounted for 2% of variance in PMPU-Q-R, and this was not significant,  $\Delta R^2 = .020$ ,  $\Delta F(1, 96) = 2.08$ ,  $p = .15$ . The UPPS-P scores added 28.1% of variance in performance on the PMPU-Q-R over and above inhibitory control and delay discounting,  $\Delta R^2 = .281$ ,  $\Delta F(5, 91) = 7.67$ ,  $p < .001$ . Supplementary analyses revealed that

the facet of negative urgency added 5.3% of variance in PMPU-Q-R scores over and above the other UPPS-P facets of impulsivity and the two behavioral measures,  $\Delta R^2 = .053$ ,  $\Delta F(1, 91) = 7.27$ ,  $p = .008$ . Similarly, negative urgency added 13.3% of variance in APU total scores over and above the other facets of impulsivity,  $\Delta R^2 = .133$ ,  $\Delta F(1, 91) = 18.63$ ,  $p < .01$ . Results suggest that the impulsivity facet of negative urgency may best capture general PMPU.

**Conclusions:** Both PMPU questionnaires demonstrate positive relationships between PMPU and general impulsivity. Behavioral measures of inhibitory control and delay discounting were found to correlate with prohibited phone use and phone dependence respectively. While general impulsivity screeners may be helpful in identifying individuals with general PMPU, researchers may benefit by focusing more narrowly on negative urgency.

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**Keywords:** disinhibition

### **R. A. DE LA CRUZ, J. MAIETTA, J. Z. CALDWELL, J. B. MILLER, C. G. WONG. Sex Differences in Verbal and Nonverbal Set-shifting.**

**Objective:** Set-shifting is an important aspect of executive functioning that may vary between men and women. Studies have demonstrated slightly higher verbal set-shifting scores in women compared to men, and men have demonstrated better performance on nonverbal set-shifting tasks. In contrast, other research finds little support for sex differences in executive functioning. The current study aims to elucidate patterns of impairment on verbal and nonverbal set-shifting tasks by sex in a clinical sample. We hypothesize that impairment on verbal set-shifting will be less frequent for women than men, with an opposite pattern for nonverbal switching.

**Participants and Methods:** Participants included 1,616 adult patients ( $M_{age}=69.7$ ; 43.8% female) referred for neuropsychological assessment from an outpatient neurology clinic. Variables of interest included: Delis-Kaplan Executive Function Scale (DKEFS)–Verbal Fluency (VF) Category Switching and Trail Making Test (TMT) Number-Letter Switching. Participants' performance was classified as impaired if their age-adjusted scaled score fell  $>1.5$  standard deviations below normative means. Individuals were then grouped into the following categories based on set-shifting performance: 1) not impaired on either test (WNL), 2) impaired on TMT only, 3) impaired on VF only, or 4) impaired on both tests. Chi-square tests were utilized to assess the relationship between sex and impairment groups. Mann-Whitney U Tests were utilized to compare scaled score differences by sex.

**Results:** Overall, verbal set-shifting scaled score performance was significantly worse in men compared to women ( $U=257778$ ,  $p<.001$ ). No sex difference was seen in scaled scores for nonverbal set-shifting ( $U=325527$ ,  $p=.95$ ). For group classification, nonverbal set-shifting impairment occurred most frequently (12.7%) with verbal set-shifting and impairment in both types of set-shifting occurring in 10.8% and 10.3% of participants, respectively. When examining only participants with impaired performance (excluding WNL participants), 37.7% of participants were impaired on nonverbal set-shifting only, 31.9% were impaired on verbal set-shifting only, and 30.4% had impairment on both tests. There was a significant association between sex and impairment groups ( $X^2[2,N=546]=16.61$ ,  $p<.001$ ). Post-hoc analysis (with Bonferroni correction) indicated that women were more likely to be impaired on only the nonverbal set-shifting task ( $p<.001$ ), whereas men were more likely to be impaired on only the verbal set-shifting task ( $p<.05$ ).

**Conclusions:** Females showed impairment on nonverbal set-shifting more often than men, whereas men were impaired on verbal set-shifting more often than women. These findings suggest that set-shifting profiles differ by sex, which align with findings of sex differences in memory, where women are observed to have an advantage in verbal memory. Future research should further explore sex differences in set-shifting performance for diagnostic subgroups, as emerging patterns may provide clinical utility and aid interpretation of set-shifting performance.

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**Keywords:** neuropsychological assessment, executive functions, demographic effects on test performance

**D. Q. BEVERSDORF, M. WALLACE, A. COSTA, B. KILLE, D. DRYSDALE, B. SUTTON, B. N. HERRIOTT, B. J. FERGUSON. Effects of paced breathing on measures of convergent and divergent thinking.**

**Objective:** The ability of the autonomic stress response to impair cognitive flexibility is known. Meditation is known to impact the autonomic nervous system and the stress response. However the effect of paced breathing as a readily implemented proxy to meditation on such cognitive tasks, and the influence of sex-specific sympathetic responses, requires further investigation. Therefore, we wished to determine the effects of paced breathing on performance on convergent and divergent tasks and how the effects differ in males and females.

**Participants and Methods:** To better elucidate the effects of paced breathing on stress-induced cognitive impairments, a paced breathing protocol was administered to 30 healthy participants (mean age:  $22.2 \pm 2.6$  years, 21 females) and performance on cognitive tasks was measured. Convergent thinking tasks required associative problem-solving (compound remote associates, anagrams) while divergent thinking tasks required generation of 'creative' responses (alternate uses task). Participants attended two counterbalanced experimental sessions consisting of either paced or normal breathing followed by cognitive assessments.

**Results:** In females, paced breathing significantly reduced systolic and diastolic blood pressure but did not impact heart rate, perceived stress, or performance on cognitive tasks. Paced breathing did not significantly affect any physiological or cognitive measures in males.

**Conclusions:** These findings support the hypothesis that paced breathing may differentially impact sympathetic activity in males and females. The lack of improvement in perceived stress and cognitive performance suggests paced breathing was not sufficient to ameliorate stress-induced impairments in cognitive flexibility, despite the effects on sympathetic activity in females. While paced breathing did not impact performance as has been previously observed with pharmacological manipulation (propranolol), future studies will need to explore more robust meditation practices, which may have implications for treatment of public speaking and test anxiety.

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**Keywords:** fluid intelligence, anxiety, executive functions

**C. J. ZOLLIECOFFER, H. E. ADAMS, J. E. JARVIS, D. C. OSMON. Pinpointing the D-KEFS Stroop Color Word-Inhibition Construct Validity.**

**Objective:** The Stroop effect (Stroop, 29135) has enjoyed a long history in psychological assessment, and early adoption into neuropsychology as a measure of speeded

word reading, color naming, and color-word interference ability (Golden et al., 1978). Still, despite the well-established history of the Stroop task, its construct validity remains elusive. Thought to reflect executive processes such as inhibition, cognitive flexibility, and working memory (Miyake & Friedman, 2012), the literature has most commonly employed parametric statistical methods to arrive at such conclusions by using a paper-and-pencil version (Spieler, Balota, & Faust, 2000; Ducheck et al., 2013). However, the speeded nature of the task calls for examining its validity using computerized reaction time (RT) tasks to better evaluate construct validity. As a result, the present study examined D-KEFS Stroop Color Word-Inhibition (CW-I) validity using simple, choice, and cognitive control measures of RT and Miyake factors of inhibition, flexibility, and updating/monitoring.

**Participants and Methods:** One hundred and one college students (89 female, 82% white, 8% Hispanic, 2% Black, 8% other) completed the D-KEFS Stroop CW-I trial, simple 0-bit RT, simple 2-Choice RT, complex 2-choice RT, cognitive control RT, computerized Stroop negative priming RT, Local-Global RT & correct, timed 2-back Correct, timed Keep Track-4, Flanker RT & correct, and Stop Signal RT tasks as part of a larger battery of tests completed within the context of a learning disorder neuropsychological evaluation. An adaptive elastic net General Regression (GR) with Weibull model analyzed which variables predicted the D-KEFS Stroop CW-I task using an appropriate LogNormal model of the CW-I trial.

**Results:** GR predicted CW-I well (Generalized  $R^2 = .46$ ) using only two of the 13 variables including Choice IIV (Wald  $C^2 = 20.08$ ,  $p < .0001$ ) and Stroop negative priming (Wald  $C^2 = 12.85$ ,  $p = .0003$ ). Other variables were not zeroed out by the regression (Flanker RT, Keep Track-4 and 2-back Correct) but did not have Variable Importance values above 0.1. Finally, Stop Signal RT was zeroed out by the regression, contributing nothing to the model.

**Conclusions:** The present study sought to examine the construct validity of the D-KEFS Stroop CW-I trial using a combination of RT and Miyake executive function timed measures, and distribution-appropriate indices of RT and executive functioning. Results of the study demonstrated that CW-I requires effortful, voluntary executive control of responding. Moreover, results demonstrate that CW-I is most related to having low intraindividual variability in choice RT. Additionally, results reveal that CW-I is also related to overcoming negative priming, suggesting that cognitive flexibility is critical to managing Stroop interference. Notably, results suggest that CW-I is not related to other executive abilities including updating/monitoring, or stopping an already programmed action.

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**Keywords:** executive functions, reaction time, computerized neuropsychological testing

### **C. PRESLEY, M. A. CONLEY, W. F. GOETTE, J. HART, M. CULLUM. Psycholinguistic Predictors of Item Difficulty on the Boston Naming Test.**

**Objective:** Item difficulty on the Boston Naming Test (BNT) has been associated with a number of psycholinguistic properties, though less is known about the degree in which these properties can predict item difficulty. The aims of this study were (1) to examine the relatedness of psycholinguistic variables in the context of items on the BNT, and (2) to identify psycholinguistic predictors of item difficulty. It was hypothesized that all psycholinguistic variables would have a linear relationship with BNT item difficulty.

**Participants and Methods:** A pooled clinical and normative sample of 519 adults (M age = 65.8; M education = 13.9; Male = 50.1%) from two previous studies (Pedraza et al., 2011;

Tombaugh & Hubley, 1997) was used to calculate a weighted Difficulty Index (percentage of participants who answered correctly) for each BNT item. Psycholinguistic variables were collected from two open sources: The English Lexicon Project and SUBTLEXus. From these data dictionaries, five lexical frequency counts were derived from a variety of corpora (Film/TV Subtitles, Blogs, Twitter, News, and USENET) and transformed into a ranked order from 1-60. Another five psycholinguistic variables (Concreteness, Semantic Diversity, Age of Acquisition, Body-Object Interaction, and Naming Reaction Time) were collected and standardized prior to analyses. Two Pearson correlation matrices (Frequency counts and Psycholinguistic variables) examined variable relatedness. Linear regressions were calculated to predict BNT item difficulty using each lexical frequency count and psycholinguistic variable. A final multiple regression model was performed containing variables that accounted for at least 10% of the variance of BNT item difficulty.

**Results:** Pearson correlations revealed moderate to strong positive relationships between each frequency count (.688 to .854) and weak to moderate relationships across the remaining psycholinguistic variables (-.424 to .565). Eight of 10 psycholinguistic variables accounted for at least 10% of the variance of BNT item difficulty (Film/TV Subtitle frequency, Blog frequency, Twitter frequency, News frequency, Concreteness, Age of Acquisition, Body-Object Interaction, Naming Reaction Time). Due to multicollinearity among frequency counts, only Film/TV subtitle frequency was included in the final model as it accounted for the greatest amount of variance ( $R^2=.379$ ). The final model was significant ( $F=11.55$ ,  $p<.0001$ ), accounting for 52% of BNT item difficulty variance, with the only significant predictors being Film/TV Subtitle frequency and Age of Acquisition.

**Conclusions:** In a combined clinical and normative sample of adults, BNT item difficulty was shown to be linearly related to many, but not all, psycholinguistic variables. Among lexical frequency counts, Film/TV Subtitle frequency appeared to be the best predictor of item difficulty, while Age of Acquisition was the best predictor among the remaining psycholinguistic variables. Findings suggest that the frequency of spoken words and age of lexicon integration are among the best predictors of difficulty in naming visually presented objects. Further research is required to examine if changes in lexical frequency over time influence BNT item difficulty.

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**Keywords:** naming, language, test development

### **C. S. GASS, B. PATTEN. Memory Retrieval Factors in Performance on the Wechsler Memory Scale-IV.**

**Objective:** This study investigates demographic and neuropsychological factors that potentially influence memory retrieval performance on the Wechsler Memory Scale -IV (WMS-IV) Logical Memory (LM) and Visual Reproduction (VR) subtests. Deficient free recall performance on LM-2 and VR-2 can be secondary to poor encoding, deficient storage, dysfunctional retrieval operations, or a combination of these conditions. Although the measurement of these memory components is facilitated by delayed recognition testing, the factors that specifically impede retrieval operations have received little attention.

**Participants and Method:** Participants were 407 outpatient referrals to a memory disorders clinic in a large metropolitan medical center located in the Florida Panhandle. The sample was comprised of 62% women, 87% white non-Hispanic, 10% African-American, with an average age of 60.7 and education 14.9 years. Most (79%) were referred by staff neurologists and

presented with memory complaints. Testing included the LM and VR subtests of the WMS-IV, the MMPI-2 and nine tests within the Halstead-Reitan Battery. We used a 20-item 5-option multiple choice test (Gass, Patten, Penate, & Rhodes, 2020) to provide an enhanced measure of delayed recognition of story details on LM.

Free delayed recall and recognition raw scores were transformed into standard (z) scores. A *Retrieval Efficiency Index* (REI) was computed using the formula: Recognition z-score minus Free Recall z-score, with higher scores indicating greater retrieval inefficiency. Factor analysis was performed separately on the MMPI-2 Content Scales and the neuropsychological tests yielding two Psychopathology factors (Internalizing and Externalizing) and three Neuropsychological Factors (Novel Problem Solving, Processing Speed, and Language Ability).

**Results:** Retrieval efficiency (RE) for Logical Memory details decreased with age,  $r = -.15$ ,  $p = .003$  and increased with Average Impairment Rating,  $r = .17$ ,  $p = .001$ , but was not related to gender or education,  $ps > .05$ . RE was positively associated with Novel Problem Solving (TPT and Category Test),  $r = .24$ ,  $p < .001$ , but not with Processing Speed, Language Ability, or two Psychopathology factors,  $ps > .05$ . The sample was divided into High and Low RE groups. Mean intergroup differences on demographic, cognitive, and psychopathology measures were examined (MANOVA). The overall effect was significant,  $F(9,270)=3.39$ ,  $p = .001$ . Univariate analyses revealed that the high RE group was younger ( $p = .01$ ), more educated ( $p = .008$ ), and had better performance on Novel Problem Solving tests ( $p < .001$ ). Psychopathology was nonsignificant. In the analyses of Visual Reproduction (VR), RE was linearly associated with higher scores on Novel Problem Solving,  $r = .13$ ,  $p = .01$ , but not with demographics, Psychopathology, Processing Speed, or Language Ability. Using the median RE score for VR, High and Low RE groups were compared across mean scores (MANOVA). No main effect emerged for VR RE,  $F(9,289) = 1.61$ ,  $p = .111$ .

**Conclusion:** Retrieval efficiency on the WMS-IV Logical Memory appears to be associated with novel problem solving, age, and education, but not with gender, processing speed, language ability, or level of psychopathology (MMPI-2). Retrieval efficiency on the Visual Reproduction subtest were unrelated to demographic variables, psychopathology, or composite measures of neuropsychological test performance.

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**Keywords:** neuropsychological assessment, memory disorders, cognitive functioning

### **M. L. TURMAN, J. LAWSON, S. C. HADEN. Peritraumatic Cognitive Load, Attention, Working Memory, and Memory within the Distressing Film Paradigm: An Experimental Study.**

**Objective:** The cognitive model of posttraumatic stress disorder (PTSD) maintains that PTSD symptomatology is at least partially generated and sustained by peritraumatic cognitive processes such as attention, working memory, and memory consolidation. Cognitive load, or the amount of cognitive information held in mind and made available for processing, is one important cognitive predictor of PTSD symptomatology within this framework. Mental load (the cognitive capacity needed to complete a task) and mental effort (the cognitive effort exerted during a task) are sub-constructs of cognitive load. Peritraumatic diversion of cognitive resources to processes such as emotion regulation is thought to increase cognitive load and inhibit attention, working memory, and memory consolidation processes, catalyzing the hallmark fragmentation and intrusion processes thought to underpin PTSD. There is a deficit of self-report measures of cognitive load.

To address this gap, an experimental study was conducted in which participants were shown a distressing video clip to activate a peritraumatic condition, and administered an adapted 12-item self-report measure of cognitive load previously used in education settings, including mental load and mental effort subscales, to assess for cognitive load associated with peritraumatic emotion regulation. Data on an alternate measure of cognitive load, as well as measures of peritraumatic distress, attention, working memory, and immediate and delayed recall memory were also obtained.

**Participants and Methods:** 120 adults in the United States completed a web-based study that utilized a previously-validated distressing film paradigm to create a pseudo-peritraumatic condition. The adapted measure was administered in conjunction with the Paas Scale of Cognitive Load, web-adapted versions of the WAIS-IV Digit Span Forwards and Digit Span Backwards tasks, and immediate and delayed cued recall memory questionnaires to assess for distress, cognitive load, attention, working memory, and memory consolidation, respectively.

**Results:** The two subscales of the adapted measure of cognitive load, mental load, and mental effort, yielded acceptable psychometric properties and good internal reliability (mental load  $\alpha = .96$ ; mental effort  $\alpha = .86$ ). Each subscale evidenced strong, statistically significant positive correlations with the subjective units of distress scale (mental load  $r = .70$ ; mental effort  $r = .39$ ), and the Paas Scale of Cognitive Load (mental load  $r = .66$ ; mental effort  $r = .63$ ). The mental load subscale evidenced a statistically significant, weak negative correlation with immediate memory recall ( $r = -.22$ ); the mental effort subscale evidenced a weak, positive correlation with the Digit Span Forward measure ( $r = .19$ ).

**Conclusions:** This experimental study sought to validate an adapted measure of cognitive load specific to peritraumatic emotion regulation by administering the scale to participants after they viewed a distressing film clip. Participants' reports of mental load and mental effort were positively correlated with an existing measure of cognitive load, as well as with the subjective units of distress measurement. Additional statistically significant and non-statistically significant correlations among peritraumatic measures of attention, working memory, and memory recall are also discussed in the context of the cognitive model of PTSD.

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**Keywords:** cognitive processing, executive functions, post-traumatic stress disorder

### **J. E. MAYE, R. VAN PATTEN, L. VELLA, Z. MAHMOOD, J. CLARK, E. W. TWAMLEY. Memory, Fluid Reasoning, and Functional Capacity in Adults Experiencing Homelessness.**

**Objective:** In individuals experiencing homelessness, determinants of functional capacity (i.e., ability to care for oneself) are poorly understood. Identifying potentially modifiable predictors of functional capacity, such as cognitive abilities, may inform treatment targets to address independence and housing stability. This study attempted to identify the strongest neuropsychological predictors of variance in functional performance in a group of adults experiencing homelessness.

**Participants and Methods:** 100 adults living in a homeless shelter (mean age=49; mean education=12 years; 19% female; 35% non-white) completed a brief cognitive screening test (Montreal Cognitive Assessment [MoCA]) from which four composite scores were derived (Memory, Visuospatial/Executive, Attention, and Language), as well as tests of processing speed (WAIS-IV Coding), fluid reasoning (WASI Matrix Reasoning), and premorbid intellectual

functioning (WRAT-4 Reading). Functional capacity focused on finance and communication skills was measured via the UCSD Performance-based Skills Assessment-Brief (UPSA-B). We conducted a hierarchical linear regression to predict variance in UPSA-B performance.

**Results:** In step 1, premorbid intellectual function accounted for 30.1% of the variance in UPSA-B ( $p < .001$ ). In step 2, neuropsychological variables explained an additional 19.8% of variance in UPSA-B performance ( $\Delta R^2 p < .001$ ). MoCA Memory ( $p = .010$ ) and Matrix Reasoning ( $p < .001$ ) were the only significant individual predictors of variance in UPSA-B performance. Together, the model accounted for nearly 50% of the variance in UPSA-B.

**Conclusions:** Beyond the impact of premorbid IQ, better memory and fluid reasoning predicted better functional performance. Although our cross-sectional design does not permit causal inference, it is possible that interventions targeting memory and fluid reasoning may improve functional ability in individuals experiencing homelessness.

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**Keywords:** cognitive functioning, everyday functioning

**M. E. MARVIN, J. BOMYEA, A. D. SPADONI, D. M. SCHIEHSER, A. N. SIMMONS.**  
**Neural Activity and Network Analysis for Understanding Reasoning Using the Matrix Reasoning Task.**

**Objective:** Reasoning is a necessary foundation for high-order cognitive functioning, and requires the ability to manipulate mental representations and understand relationships between objects. Although numerous functional imaging studies have investigated neural responses during reasoning with tasks such as the Matrix Reasoning subtest of the WAIS-IV (MR) or the raven's Progress Matrices test (RPM), there is a paucity of research regarding the functional connections between multiple brain areas that may interact during reasoning tasks. The present study aimed to examine functional activation and connectivity of frontoparietal regions during a Matrix Decision Making Task (MDMT) of participants while undergoing fMRI.

**Participants and Methods:** The MDMT was completed by twenty-one right-handed healthy participants while undergoing fMRI. Voxel-wise whole brain analysis of neural response to the task revealed activation spanning dorsal and lateral prefrontal, occipital, and parietal regions. The analysis utilized Group Iterative Multiple Model Estimation (GIMME), a data-driven approach that estimates the presence and direction of connectivity between specific ROIs.

**Results:** The GIMME revealed connectivity between prefrontal and sensory processing regions. Moreover, the magnitude of connectivity strength between the left precentral gyrus and left dorsal cingulate was positively correlated with MR behavioral performance.

**Conclusions:** Taken together, results are broadly consistent with earlier work demonstrating involvement of regions comprising the central executive network in relational reasoning. These data expand existing knowledge regarding communication of key brain regions during the task, and highlight the potential importance of interconnections in brain regions, rather than activation per se, in predicting behavioral performance.

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**Keywords:** neuroimaging; functional connectivity, brain function, executive functions

**L. ISAAC, J. KLEINER, J. GESS, G. A. JAMES. Frontoparietal and Salience Network Activation Varies with Difficulty on Tower of London Trials.**

**Objective:** Planning and problem-solving are integral parts of daily life and functioning. Previous neuroimaging studies have implicated frontal and parietal brain regions as subserving problem-solving. While these studies report a consensus finding that frontoparietal recruitment scales with task difficulty, there is less consensus whether other regions are recruited to support frontoparietal function. This study sought to independently evaluate the impact of problem-solving task difficulty on brain activity using the Tower of London (TOL) neuropsychological test, a frequently administered assessment of visuospatial planning and problem-solving.

**Participants and Methods:** Participants were recruited through the Cognitive Connectome (“Cognectome”) Project, which paired clinically validated neuropsychological instruments with direct and conceptual replications of these instruments as fMRI tasks. Inclusion criteria for the Cognectome were healthy men and women, aged 18-50 years, with no neurologic or psychiatric history, and who were native English speakers with reading and writing proficiency at least at the 8<sup>th</sup> grade level. A total of 34 Cognectome participants completed the DKEFS Tower Test and the Tower fMRI task. Participants were predominantly Caucasian (59%) and African American (35%), had mean (SD) age of 30 (10) years, self-identified as female (56%) or male (44%), and had a median education of a 4-year undergraduate degree. Imaging data was acquired using a Philips 3T Achieva X-series MRI.

The Tower fMRI task was administered as self-paced trials with 2-, 3-, or 4-move solutions. After standard preprocessing, fMRI data were analyzed via the beta series method (BSM) to model brain activity for each individual trial. Button press responses were modeled as a single regressor spanning all trials. The BSM analyses utilized the Brainnetome atlas (Fan et al., 2016) to simplify analyses and provide functional ROIs and labels. Trial difficulty was calculated using the mean number of moves that exceeded the minimum, and a median split was performed to separate these into “Easy” and “Hard” trials. Mixed-effects linear regression modeled group-level changes in regional brain activity due to trial difficulty.

**Results:** Consistent with past findings, increasing task difficulty elicited greater activity in right parietal (superior and temporoparietal junction) and bilateral frontal (superior and inferior) regions. We also report greater activity with increasing trial difficulty for the anterior cingulate cortex and anterior insula, but decreasing activity for occipital regions.

**Conclusions:** We report increased brain activity commensurate to TOL trial difficulty. Our findings are consistent with previous research, including recruitment of parietal and frontal regions commonly associated with attention selection, shifting, and maintenance. Task difficulty in the parietal region was lateralized on the right, potentially demonstrating increased demands on visual attention without increased requirements of attention related to motor control. We also report increased recruitment of the anterior cingulate cortex and insula, which may be represent recruitment of the “saliency” attentional network. The consistency of these results with prior findings also provides evidence toward the validity of the in-scanner replication. However, we report less recruitment of dorsolateral prefrontal cortex than in previous studies, which may reflect task-specific characteristics (i.e., only utilizing 2, 3, and 4 move problems).

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**Keywords:** neuroimaging: functional, neuroimaging: structural, attention

**A. RUIZ, A. O. HAUSON, C. MÜLLER-COHN, I. RUIZ, N. S. LACKEY, B. CARSON, P. UJJ. Phonemic and Semantic Fluency in Bilinguals Versus Monolinguals.**

**Objective:** Studies on the effect of bilingualism on verbal fluency performance have reported mixed findings, with the majority of research reporting that bilinguals underperform monolinguals. One possible explanation is that semantic fluency reflects language proficiency which is usually less developed in bilinguals. Another explanation is that bilinguals constantly experience a conflict in lexical choice and thus rapid lexical retrieval becomes more effortful and less efficient relative to monolinguals. The purpose of this study was to meta-analytically examine measures of verbal fluency (semantic fluency and phonemic fluency) to compare bilinguals and monolinguals.

**Participants and Methods:** Two researchers independently searched eight databases (e.g., PsycINFO, PubMed). Articles were included if they met the following criteria: experimental primary study; adults (18+ years old); physically healthy; no history of learning disability, cognitive disability, or neurological disorders; at least one monolingual group included; at least one bilingual group included; sufficient neuropsychological data to calculate effect size; bilingual group was not in the process of learning a second language; multilingualism was not the focus of study. Effect sizes were calculated as standardized mean differences using Hedges  $g$  in R-Studio using random-effects model.

**Results:** Phonemic fluency evidenced non-significant group differences ( $g = -.08, p = .56, k = 20$ ) as well as relatively large and significant heterogeneity ( $I^2 = 87.6\%; Q (df = 19) = 127.8, p < .001$ ). Semantic fluency evidenced a small but significant pooled effect size ( $g = .15, p < .05, k = 18$ ) and moderate levels of heterogeneity ( $I^2 = 36.9\%; Q (df = 17) = 27.7, p < .05$ ), suggesting that monolinguals perform marginally better than bilinguals.

**Conclusions:** These results suggest that bilinguals may be at a disadvantage in semantic fluency performance whereas phonemic fluency appears comparable to monolinguals. This is consistent with the hypothesis that the need to manage two language systems affects aspects of verbal fluency in bilinguals differently. Thus, interpretation of neuropsychological tests of language production must consider the effect of bilingualism on performance. Future meta-analyses may benefit from examining potential moderators contributing to heterogeneity such as age, years of education, number of languages spoken, vocabulary, and age of second language acquisition.

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**Keywords:** bilingualism, neuropsychological assessment, language

**S. CHATTERJEE, J. EVANS. Cultural Influences on Visual Object Perception: Investigating the Influences of Eye Movements, Self-Construal, Object Familiarity, and Cultural Relevance on Silhouette Test Performance in Indian and British Participants.**

**Objective:** Clinical neuropsychological tests evaluate conscious behavioral responses on tests that target specific cognitive domains. These standardized tests, mostly created in the U.S.A and Europe, show noticeably varied test responses when presented to individuals from other culturally distinct countries, making evaluations more uncertain. One such test is the Silhouettes Subtest of the Visual Object Space Perception Battery (VOSP). Dutta et al. (2016) showed that Indians performed significantly below their Spanish, Greek, and American counterparts, despite their comparable cognitive abilities. The specific explanation for this disparity remains unclear. We present two studies investigating whether eye movement, object familiarity, cultural

relevance, and/or self-construal (the degree to which a person adheres to individualist or collectivist values), might account for any performance differences.

**Participants and Methods:** In study 1, we tracked the eye movements of 33 British and 33 Indian participants undertaking the Silhouettes Subtest-a task in which participants identify the foreshortened silhouettes of 15 animals and 15 objects. Participants completed the Singelis Self-Construal Scale. In study 2, a further 33 British and 33 Indian participants completed the Silhouettes test along with object familiarity questionnaires. Object features that participants reported they had specifically attended to during the identification process were also recorded.

**Results:** The combined Study 1 and Study 2 total Silhouettes score between Indian and British participants was not significantly different, though the effect size was medium-large ( $d=0.66$ ). The British had significantly greater saccade amplitude and saccade velocity but no other eye movement measures showed differences. At the level of individual objects, the proportion of correct identifications was significantly different for 13 objects. The British outperformed Indian participants on 13 objects whilst the Indians outperformed the British on 2 objects. Both the Indian and British samples showed a substantially lower performance than the original UK normative sample. Indians and British largely overlapped in object features they reported they were attending to during identification. Familiarity with the objects did not explain the Indians' poorer performance, nor was self-construal as collectivist/individualist an influential variable in predicting performance or eye movements.

**Conclusions:** We found no evidence that self-construal, eye moments, or familiarity explain the overall performance difference between Indians and the British on the Silhouettes Subtest of the VOSP. Rather, this difference is more likely due to specific objects that vary in cultural relevance, both in prevalence and depiction. For example, a corkscrew is not a very common object in Indian kitchens and so it would be expected for Indians to not be familiar enough to identify it. Rabbits and frogs are, however, prevalent in India but the depiction of these objects in their shadowed form do not resemble the way in which these objects are typically represented in India. These disparities in ability to identify specific objects between Indians and the British, and between all participants and the original scores suggests that a re-evaluation of the subtest within the Indian context as well as the British context is recommended.

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**Keywords:** visuospatial functions, cross-cultural issues, test development

### **Paper Session 09: Neuroimaging Methods**

**9:00 AM - 10:00 AM**

**J. N. KRAFT, A. ALBIZU, A. O'SHEA, C. HARDCASTLE, N. D. EVANGELISTA, H. K. HAUSMAN, E. M. BOUTZOUKAS, N. NISSIM, E. J. VAN ETTEN, P. K. BHARADWAJ, H. SONG, S. G. SMITH, E. S. PORGES, S. DEKOSKY, G. A. HISHAW, S. WU, M. MARSISKE, R. A. COHEN, G. E. ALEXANDER, A. J. WOODS. Functional Neural Correlates of the Useful Field of View (UFOV) Task in Older Adults.**

**Objective:** Processing speed has been shown to undergo rapid declines in cognitive aging. Although evidence suggests cognitive training (CT) interventions improves performance on the specific training task, near- and far-transfer to tasks involved in cognition and daily living have been limited. One of the only CT tasks that has shown robust transfer effects is Useful Field of

View (UFOV) training. Randomized clinical trials have demonstrated that healthy older adults who underwent UFOV training intervention experienced a 29% reduction of Alzheimer's disease risk and significant declines in motor vehicular crash rates after a 10 year follow-up. Despite its efficacy, little is known about the neural correlates of this paradigm. The current study therefore investigated the functional neural correlates of the UFOV task by evaluating blood-oxygen level dependent (BOLD) activation patterns in healthy older adults.

**Participants and Methods:** A cohort of 233 healthy older adults completed the UFOV task while undergoing task-based functional magnetic resonance imaging (fMRI). During the *stimulus* portion of this task, the participant was required to identify the target in the center of the screen and also attend to the location of a target in the periphery. During the *probe* portion of the UFOV task, the participant performed a forced choice response in which they had to decide if the object in the center of the screen and the location of the target in the periphery were identical to the *stimulus* screen. First level contrasts were performed to model the hemodynamic response within participants. Group level analyses were then performed to evaluate the unique BOLD response associated with the *stimulus* and *probe* components of the task (subtraction: *stimulus*>*probe*, *probe*>*stimulus*) and shared patterns of activation (conjunction: *stimulus*+*probe*>*rest*). Age, education, sex and scanner location were included as covariates in all second-level models. Significant clusters were defined as a contiguous cluster of  $k=10$  voxels, and all clusters were corrected at a false discovery rate (FDR) threshold at  $p<0.05$ .

**Results:** Widespread bilateral activation in the frontal, temporal, superior and inferior parietal, and occipital lobes was observed in the *stimulus*>*probe* contrast; peak intensity  $t(228)=16.0016$ ,  $pFDR<0.05$ , significant voxels=95,175. Conversely, the *probe*>*stimulus* contrast was associated with a unique activation pattern within the inferior temporal gyrus, middle frontal gyrus, parahippocampal gyrus, and inferior frontal gyrus; peak intensity  $t(228)=7.2968$ ,  $pFDR<0.05$ , significant voxels=6,634. When assessing the *stimulus*+*probe*>*rest* conjunction analysis, we observed shared activation patterns within the precentral gyrus, occipital pole, insula, and middle frontal gyrus; peak intensity:  $t(460)=13.92$ ,  $pFDR<0.05$ , significant voxels=32,724.

**Conclusion:** Our data demonstrate greater activation of specific brain regions including the inferior temporal gyrus, parahippocampal gyrus, and inferior frontal gyrus are associated with the recall element of the UFOV task (*probe*>*stimulus*). Conversely, widespread whole-brain activation was associated with the encoding and perceptual components of the task (*stimulus*>*probe*). Additionally, distinct cortical regions within the occipital pole, insula, and middle frontal gyrus are integral for all components of the UFOV task. These results identify essential activation patterns of UFOV task, providing new findings on its neural substrates, which may serve as a foundation for future targeted interventions.

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**Keywords:** neuroimaging; functional, aging (normal), cognitive functioning

### S. STEINBERG, J. MALINS, T. Z. KING. Within-Individual Neural Variability in the N-Back Task: Relation to Reaction Time and Accuracy.

**Objective:** Within fMRI research, most literature has focused on drawing conclusions from average brain activation patterns. Computing the average signal across a time course to capture average activation during a task is an accepted practice, because of the statistical assumption that a measure of central tendency (the mean) is most reflective of a distribution. However, the

brain's natural state is inherently variable; thus, research in the last two decades has suggested that within-individual neural variability (WINV) in the fMRI BOLD signal may be meaningful, and not just "noise." Using a letter n-back task – a commonly used neuropsychological measure to assess working memory (WM) and vigilance – the current study investigates: (1) the relationship between mean signal and WINV across task runs; (2) the overall relationship between WINV and mean reaction time (RT) and mean accuracy on the task; (3) the association between WINV and mean RT and mean accuracy in regions of interest (ROIs) that have been previously linked to WM and vigilance during this task.

**Participants and Methods:** Forty-eight young adults ( $M_{\text{age}} = 22.41$ ,  $SD = 4.47$ , 25 females) from the Atlanta area completed a letter n-back task in an MRI scanner. Functional neuroimaging data was processed in AFNI to compute mean BOLD signal and WINV, operationalized as the standard deviation (SD) of the BOLD signal across task runs. White matter, cerebrospinal fluid, and motion parameters were regressed out from voxel time series. To compute WINV, all runs were concatenated across the residual time series for each stimulus type (0-back, 1-back, 2-back, 3-back, crosshair), and SD was calculated. To compute mean signal, the mean of the residual time series was calculated for each run, and then the average signal was computed across runs for each stimulus type. Nine ROIs were identified based on previous research studies assessing WM and vigilance. Pearson correlations were computed to evaluate the overall associations between: (1) mean signal and WINV on the task; (2) WINV and task performance, defined by RT and accuracy; (3) WINV within ROIs and mean RT and mean accuracy on the task.

**Results:** Mean signal and WINV throughout the n-back task were significantly positively correlated,  $r(3598) = 0.05$ ,  $p = 0.001$ . Overall, WINV was significantly negatively correlated with mean accuracy on the n-back task,  $r(2878) = -0.05$ ,  $p = 0.008$ , but was not significantly correlated with mean RT,  $r(2878) = -0.03$ ,  $p = 0.120$ . No significant correlations were observed between WINV in any identified ROIs and mean RT or mean accuracy on the n-back task (all  $p > 0.05$ ).

**Conclusions:** These findings emphasize the relevance of using WINV methodology as a new perspective in neuropsychological research and assessment. This is the first study to extend WINV to the letter n-back paradigm. Results suggest that WINV may be important to overall accuracy on the task; however, an ROI-based approach for WINV may be too limited. Future studies utilizing whole-brain analyses may be more helpful to understand WINV and its relation to neurocognitive functioning within specific domains such as WM and vigilance.

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**Keywords:** neuroimaging: functional, working memory

**C. HARDCASTLE, J. N. KRAFT, H. K. HAUSMAN, A. O'SHEA, A. ALBIZU, N. D. EVANGELISTA, E. M. BOUTZOUKAS, N. NISSIM, E. J. VAN ETTEN, P. K. BHARADWAJ, H. SONG, S. G. SMITH, E. S. PORGES, S. DEKOSKY, G. A. HISHAW, S. WU, M. MARSISKE, R. A. COHEN, G. E. ALEXANDER, A. J. WOODS.**  
**Frontoparietal Control and Cingulo Opercular Resting State Network Connectivity Predicts Useful Field of View Performance.**

**Objective:** Processing speed, divided attention, and reasoning are necessary for instrumental activities of daily living, yet these cognitive abilities decline with healthy aging. In addition to cognitive decline, functional connectivity of resting state networks (RSN) involved in higher-

order cognitive functioning also change with age (i.e. frontoparietal control network (FPCN), cingulo opercular network (CON), default mode network (DMN), and dorsal attention network (DAN)). Connectivity changes of these networks may be a hallmark of early dementia. The Useful Field of View (UFOV) test is a computerized task assessing divided attention/speed of processing and is related to performance of independent activities of daily living. UFOV as a method of cognitive training (CT) has been shown to reduce risk of dementia. UFOV training in a healthy aging population is also associated with functional connectivity changes in brain areas included in target RSNs. Determining the relationship of baseline UFOV performance and RSN connectivity is necessary in understanding neural mechanisms of CT, and potential for transfer. This study aimed to characterize the relationship of UFOV performance and RSN connectivity of 4 key RSNs involved in higher-order cognitive processes.

**Participants and Methods:** A sample of 283 healthy older adults ( $M = 71.6$ ,  $SD = 5.1$ ) were recruited as part of a larger clinical trial through the University of Florida and the University of Arizona. Participants underwent UFOV assessment via the Double Decision task from Posit Science Brain HQ. Double Decision asks participants to correctly discriminate between 2 target stimuli in the center of the computer screen, while also attending to the location of a novel target in the periphery among 7 distractor stimuli. Task performance is measured by the log<sub>10</sub> transformed milliseconds of average presentation time for correct trials. Smaller values represent faster times. Participants also underwent resting-state functional magnetic resonance imaging (fMRI) after their UFOV assessment. Functional images were processed and average connectivity of four target RSNs (FPCN, CON, DMN, and DAN) were extracted through use of the CONN Toolbox v18b via SPM 12. Multiple linear regressions were performed predicting UFOV performance from RSNs, controlling for sex, education, and scanner.

**Results:** Reduced CON ( $\beta = -.174$ ,  $p = .003$ ) and FPCN ( $\beta = -.168$ ,  $p = .003$ ) connectivity was associated with poorer UFOV performance. DMN and DAN connectivity did not predict UFOV performance, however DAN connectivity was a trend ( $\beta = -.107$ ,  $p = .059$ ).

**Conclusions:** Consistent with previous CT research, faster UFOV performance in healthy older adults was associated with increased connectivity for RSNs involved in executive functioning, attention, and processing speed. Interestingly, UFOV performance was not related to DMN connectivity, which reliably changes with dementia progression. However, connectivity of the FPCN was related to between network connectivity management, and therefore may play a role in resilience against cognitive decline in aging. In sum, these findings further the understanding of RSNs involved in healthy aging and their association with cognitive performance, suggesting target RSNs for intervention.

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**Keywords:** aging (normal), neuroimaging: functional connectivity, cognitive functioning

**S. H. CROWELL, P. THOMAS, B. LANEY, K. HOSKINSON, W. I. MATTSON, E. NELSON, G. KIM. Links Among White Matter Volume in the Mentalizing Network and Theory of Mind Throughout Development.**

**Objective:** The ability to understand, attribute, and interpret the thoughts and emotions of oneself and others, otherwise known as Theory of Mind (ToM), is a crucial component of human interaction. Developmental research supports that ToM develops throughout childhood and into adolescence, but the neural substrates underlying this social cognitive growth are still widely debated. Research suggests an association between white matter microstructure in the

mentalizing network (i.e. temporal pole, dorsal medial cortex, ventral medial prefrontal cortex, temporal parietal junction, precuneus, inferior frontal gyrus, amygdala) and ToM development, but the impact of corresponding volumetric changes remains unexplored. The present study examined the relationship between ToM and white matter volume in the mentalizing network over the course of development.

**Participant and Methods:**

Participants included 44 typically developing children and adolescents ( $M_{\text{age}}=14.06$ ,  $SD=3.28$ ) drawn from an ongoing developmental study of social cognition. Participants completed high-resolution MPRAGE sequences in a Siemens 3T scanner. White matter volume was quantified using FreeSurfer 7.1.0. To measure ToM development, participants completed a shortened version of the Emotional and Emotive Faces Task (EEFT) to evaluate affective ToM. In this task, participants listened to a brief description of a social situation and evaluated how the protagonist of the story feels inside (*feelinside*) vs. how they look on their face (*lookface*).

**Results:** Left temporal pole white matter volume and participant scores on the EEFT were positively correlated,  $r(42) = .32$ ,  $p < .05$ , but not between right temporal pole white matter volume and EEFT scores. Scores on the both the *feelinside* subscale and the *lookface* subscale were not significantly related to participant age. Possible scores on the *feelinside* subscale range from 0 to 15 and 0 to 30 on the *lookface* subscale. The average score on *feelinside* was 13.02 ( $SD=1.68$ ). The average score on *lookface* subscale was  $M=18.84$ ,  $SD=5.6$ . Participant age was negatively related to left and right frontal pole white matter volume,  $r(42) = -.50$ ,  $p < .01$  and  $r(42) = -.46$ ,  $p < .01$ , respectively. Participant age was also found to significantly predict white matter volume in the left and right superior temporal lobes,  $r(42) = -.60$ ,  $p < .01$  and  $r(42) = -.67$ ,  $p < .01$ , respectively.

**Conclusions:** The present study reveals lateralization of white matter in the left temporal pole, known to be implicated in social cognition. Age was a significant predictor of decreased white matter volume in several regions that are thought to be recruited during ToM tasks. These findings may be indicative of synaptic reorganization as children's brains become more efficient at social cognition over the course of development. Further analyses will examine composite white matter volume in the broader mentalizing network and its relation to scores on measures of ToM and social cognition. Future studies should examine these brain-behavior associations, as they may replicate in a larger sample, potentially revealing a relationship with age.

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**Keywords:** social cognition, brain development, neuroimaging: structural connectivity

**B. YEW, S. DUTT, Y. LI, X. SHAO, D. J. WANG, A. GAUBERT, J. K. HO, J. JANG, A. E. BLANKEN, I. SIBLE, A. MARSHALL, D. A. NATION. Contributions of Dynamic Cerebrovascular Function to Cognitive Decline: Validation of a Novel Neuroimaging Approach.**

**Objective:** Cerebrovascular contributions to cognitive decline have been increasingly recognized. Development of preclinical cerebrovascular disease markers has therefore been an important focus of research into prevention of cognitive decline and dementia. Existing markers include measures of dynamic cerebrovascular function, which often evince abnormalities early in the cerebrovascular disease process, and in apolipoprotein  $\epsilon 4$  (*APOE4*) carriers. Measures of dynamic cerebrovascular function are, however, limited by their invasiveness, poor tolerance in older adults, and indirect measurement of microvascular cerebral blood flow (CBF). Breath

holding and deep breathing elicit alterations in end-tidal carbon dioxide (etCO<sub>2</sub>), which drive cerebral hemodynamic changes. Pseudocontinuous arterial spin-labeling (pCASL) response to breathing alterations thus represents a noninvasive, well-tolerated, and direct index of microvascular CBF dynamics. In the present study, we developed and validated a novel neuroimaging paradigm utilizing pCASL response to breathing manipulations for preclinical assessment of dynamic cerebrovascular function.

**Participants and Methods:** Community-dwelling younger ( $n = 27$ ) and older ( $n = 40$ ) adults with no history of stroke or dementia performed visually-guided breath holds and deep breathing while undergoing pCASL MRI. Continuous blood pressure and capnography were simultaneously collected and synchronized with pCASL-derived CBF. Cerebrovascular resistance index (CVRI) was calculated by dividing mean arterial blood pressure by CBF. Older adults also completed *APOE* genotyping and cognitive testing. Linear mixed models were used to analyze relationships between hemodynamic response to breathing manipulations, *APOE4* carrier status, aging, and cognitive performance.

**Results:** Breathing manipulations were well-tolerated by all participants. Breath holding led to increased etCO<sub>2</sub> and CBF, and decreased CVRI in all subjects. Deep breathing led to decreased etCO<sub>2</sub> and CBF, and increased CVRI. Diminished hemodynamic response to both breathing manipulations was observed in older relative to younger participants, and in *APOE4* carriers relative to non-carriers. Among older adults, attenuated response was also associated with poorer global cognition and memory performance. CVRI effects were detected in more brain regions than those of CBF.

**Conclusions:** Non-invasive instigation of mild hypercapnia and hypocapnia during MRI enabled detection of autoregulatory deficits in community-dwelling older adults. Hemodynamic response was attenuated in older adults and *APOE4* carriers, with diminished response associated with poorer cognition. Reduced acute autoregulatory capacity, due to preclinical cerebrovascular dysfunction, could hamper the proficiency with which changes in blood pressure and CO<sub>2</sub> are met, compromising CBF and neuronal function. Our paradigm may therefore offer an effective measure of hemodynamic changes associated with the earliest stages of cognitive decline and dementia.

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**Keywords:** neuroimaging; structural, dementia - Alzheimer's disease, hypertension

### **A. P. CWIEK, S. M. RAJTMAJER, F. G. HILLARY. Too Good to be True: Machine Learning and the Problem of Overfitting in Network Neuroscience.**

**Objective:** Despite only recently coming to the foreground of neuroimaging research, machine learning algorithms have proven to be powerful tools for uncovering diagnostically relevant patterns hidden in plain sight. Misapplication of these tools, however, can result in classification criteria corresponding too closely to specific data, a phenomenon called overfitting, with profound implications for reproducibility. We examine the current body of neuroimaging research utilizing machine learning to investigate the prevalence of overfitting, reassert the importance of external validation (hereafter referred to as a lockbox), identify common methodological pitfalls, introduce a new classification stability metric, and finally outline good practices for future research.

**Participants and Methods:** We searched primary research articles that used machine learning and network neuroscience to predict clinical diagnostic category. From 471 unique peer-

reviewed publications, 98 papers utilizing machine learning and functional MRI and were retained for analysis. In addition to the presence of a lockbox, the retained articles were coded for various factors including, but not limited to, reported accuracy metrics, imaging node definition, sample size, feature types input to the classifier, cross-validation technique, and algorithm selection. The discrepancy between internal and external classification accuracy, referred to here as score instability, were calculated for the 14 papers containing both internal and lockbox accuracy scores, and potential correlates to inflated scores were analyzed against the coded metrics listed above.

**Results:** Support vector machines were by far the most prevalent machine learning algorithm selected, appearing as at least one of the utilized classifiers in 78.57% of papers. The three next most reoccurring techniques used were linear discriminant analysis (9.18%), regression classification (9.18%), and K-Nearest Neighbor (8.16%). 26.53% of the studies ran multiple machine learning algorithms. Most studies utilized some form of cross-validation, including LOOCV (52.04%), K-fold (18.37%), and various other or unnamed strategies (24.48%). Of note, the remaining 5.10% of studies did not report any cross-validation use. Internal validation produced an average classification accuracy of 85.92% (+/- 8.96%). When classification was performed on lockbox data, the average classification accuracy dropped to 75.40% (+/- 8.80%). Analyzing the papers that included lockbox data, higher internal accuracy was correlated with a greater degree of score instability ( $r^2=0.429$ ,  $p=0.011$ ). Finally, and most critically, only 19.39% of examined papers employed a lockbox, the gold standard diagnostic for overfitting detection.

**Conclusions:** The high discrepancy of internal and lockbox classification accuracy, coupled with the correlation between higher internal classification accuracy and a greater disparity between the two scores, underlines a key issue facing machine learning analysis in fMRI research. Overfitting is both a symptom of poor machine learning practice and a consequence of the current overreliance on accuracy as the primary measure of an algorithm's performance. As an alternative, the authors provide a list of key "good practices" to avoid overfitting, suggest a set of standard reporting metrics to better predict generalizability, and introduce a new metric for assessing classifier scoring stability in a testing dataset. Further research will be necessary to validate these findings as more researchers begin to utilize a lockbox for an estimate of generalizability.

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**Keywords:** neuroimaging: functional, brain disorder, transdisciplinary research

### Paper Session 10: Dementia: Risk & Prediction

9:00 AM - 10:00 AM

**J. YUAN, Q. TAO, T. F. ANG, J. MASSARO, C. LIU, S. DEVINE, S. AUERBACH, J. MEZ, R. AU.** **Midlife and Late-Life Framingham Stroke Risk Profile and Incident Dementia and Subtypes.**

**Objective:** The Framingham Stroke Risk Profile (FSRP) is an aggregate measure of vascular risk and that has been found to be inversely related to cognition. We aim to investigate the associations of midlife and late-life FSRP with incident dementia and subtypes.

**Participants and Methods:** Three age cohorts were selected from participants of the Framingham Heart Study (FHS) based on the different stages of aging as baseline, ranging from

mid- to later life: age cohort 1 55-59 years (y), n=5490; age cohort 2 65-69 y, n=5015; and age cohort 3 75-79 y, n=2693. Baseline FSRP was calculated for each age cohort. The age cohorts 1-3 were longitudinally followed up to 35, 30, and 25 years for incident dementia and subtypes, respectively. The outcome competing events were constructed in competing risk models, Model 1 with dementia and death as competing, Model 2 with AD (including AD without stroke, AD with stroke, and mixed AD and Vascular dementia) and death as competing, and Model 3 with four competing events: (1) AD without stroke; (2) dementia with vascular component that combined AD with stroke, vascular dementia, mixed AD and vascular dementia; (3) other dementia subtypes (e.g. Frontotemporal dementia etc.); and (4) death. The associations between FSRP and competing events were first examined by using the cause-specific hazard (CSH) model, which describes the cause-specific hazard for an outcome event in subjects currently free of any competing event(s) and aimed to explore biological relationships. Associations were then examined using the Fine & Gray hazard (FGH) model, which describes the risk for each event in the presence of competing event(s) aimed at risk prediction. All models were adjusted for age at baseline, sex, education, and generation. Lastly, the associations of each FSRP component with incident AD, and AD without stroke were examined.

**Results:** For the three age cohorts, the median (IQR) follow-up time were 21.4 (15.0, 28.6) y, 15.6 (9.2, 21.3) y, and 10.5 (5.7, 15.4) y, respectively. In CSH models, FSRP showed nonsignificant effect on the cause-specific hazard of incident dementia in all three age cohorts, of AD or AD without stroke in age cohort 1 & 2. Whereas, higher FSRP decreased the cause-specific hazard of AD (HR 0.77, 95% CI: 0.64-0.93), and AD without stroke (HR 0.70, 95% CI: 0.57-0.86) in age cohort 3. However, higher FSRP significantly increased the cause-specific hazard of dementia with vascular component (HR ranges 1.73-2.09) and death (HR ranges 1.79-2.08) in all age cohorts. In FGH models, with presence of the competing risk of death, higher FSRP was significantly associated with decreased risk of incident dementia (HR ranges 0.66-0.70), AD (HR ranges 0.57-0.59), and AD without stroke (HR ranges 0.51-0.53) for all age cohorts. Among FSRP components, anti-hypertensive therapy was significantly associated with decreased risk of AD.

**Conclusions:** Higher FSRP was associated with increased risk of the dementia subtypes with vascular component, but not with AD without stroke subtype. With the presence of competing risk of death and use anti-hypertensive therapy, higher FSRP predict lower incidence of dementia and AD in late life.

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**Keywords:** dementia - Alzheimer's disease, cognitive, vascular cognitive impairment

**M. ALLY, H. ZETTERBERG, K. BLENNOW, M. SUGARMAN, B. E. FRANK, Y. TRIPODIS, A. MCKEE, T. STEIN, B. MARTIN, J. PALMISANO, E. STEINBERG, I. SIMKIN, K. TURK, A. BUDSON, M. O'CONNOR, R. AU, W. QIU, L. GOLDSTEIN, R. KILLIANY, N. KOWALL, R. STERN, J. MEZ, M. ALOSCO. Utility of Plasma P-tau181 for the Detection of Alzheimer's Disease Dementia.**

**Objective:** Blood-based biomarkers are increasingly being viewed as a cost-effective and non-invasive approach for the clinical detection and monitoring of Alzheimer's disease (AD). Advancements in immunoassay technology now make it possible to detect proteins in the blood

that are specific to neurodegenerative diseases, including phosphorylated tau (p-tau). Yet, the ability of plasma p-tau to accurately detect AD dementia remains unclear. Here, we examined the association between plasma p-tau181, cognitive diagnosis, and neuropsychological test performance in participants from the Boston University (BU) Alzheimer's Disease Center (ADC) Longitudinal Clinical Core Registry.

**Participants and Methods:** The sample included 485 participants from the BU ADC, including individuals with normal cognition (n=211), mild cognitive impairment (MCI) due to AD (n=161), and AD dementia (n=113). The sample included all participants who had a baseline blood draw and complete data. Participants completed a comprehensive battery of neuropsychological tests to assess global cognition, attention, executive function, episodic memory, and language abilities. Diagnoses were adjudicated during multidisciplinary diagnostic consensus conferences. Plasma samples were analyzed for p-tau181 using the Simoa platform. Analysis of covariance (ANCOVA) compared plasma p-tau181 levels between normal cognition, MCI, and AD dementia participants, controlling for age, race, sex, education and APOE e4 status. Area under the curve (AUC) statistic from receiver operating characteristic (ROC) using predicted probabilities from binary logistic regression examined the ability of plasma p-tau with and without demographic and APOE covariates to discriminate between the diagnostic groups. Partial correlations tested the association between plasma p-tau181 and neuropsychological test performance, accounting for the above covariates.

**Results:** The mean (SD) age of the sample was 74.28 (7.62), 270 (55.7%) were female and 187 (38.6%) were e4 carriers. ANCOVA models showed that baseline plasma p-tau was higher in participants with AD dementia compared to participants with MCI (mean diff. = 4.59,  $p = 0.001$ ) and normal cognition (mean diff. = 5.93,  $p < 0.001$ ). However, there was no statistically significant difference between participants with MCI and normal cognition. ROC analyses with demographic and APOE covariates showed the diagnostic discrimination accuracy of plasma p-tau for AD dementia vs normal cognition (AUC=0.83), and for AD dementia vs MCI (AUC=0.75). These AUCs improved upon models of only the demographic and APOE covariates (AUC = 0.80 and 0.71, respectively). Partial correlations showed that higher plasma p-tau levels were associated with worse performance on 9/10 neuropsychological tests ( $ps < 0.01$ ).

**Conclusion:** Higher plasma p-tau levels differentiated AD dementia from MCI and normal cognition and were also associated with worse performance on nearly all neuropsychological tests administered. These results provide support for plasma p-tau181 as a blood-based biomarker for the detection of AD dementia. However, our results conflict with past reports that show plasma p-tau181 as a useful marker for preclinical AD.

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**Keywords:** dementia - Alzheimer's disease, mild cognitive impairment

**S. L. ANDERSEN, Y. LIU, C. X. GUAN, S. AUERBACH, D. LIBON, S. DEVINE, R. AU.**  
**Errors Related to Executive Impairment Made on Memory and Language Tests Predict Incident Dementia.**

**Objective:** Dementia is often associated with impaired executive function sometimes best characterized by analyzing errors that are not used to calculate traditional test scores. While errors made on executive function tests have been related to increased incidence of dementia, executive function-related errors made on language and episodic memory tests have not been studied.

**Participants and Methods:** The Framingham Heart Study Generation 2 cohort (n= 4,319) was administered a neuropsychological test protocol that included scoring error responses. After excluding individuals 10% of individuals were identified as independent variables: Wechsler Memory Scale (WMS) Paired Associates (PA) intrusions of semantically-related words, unrelated words, wrong-pairings, and repetitions of intrusions across trials; WMS Logical Memory [LM] related and unrelated intrusions; WMS Visual Reproductions (VR) additions of extraneous details referred to as confabulations, additions of details from another design referred to as contaminations, and perseverations; verbal fluency (i.e., phonemic and semantic fluency combined) intrusions of words with the wrong first letter or from a different category and perseverations, and Boston Naming Test perseverations. Covariates included age, sex, education, cardiovascular risk and ApoE4 (number of alleles). Stepwise logistic regression was conducted using backward elimination with a significance of 0.1 to retain variables that were significantly related to risk for dementia. A second model included adjustment for traditional test scores.

**Results:** A total number of 156 participants were diagnosed with dementia after an average of  $5.1 \pm 2.8$  years of follow-up. The odds of incident dementia increased with each PA semantic intrusion (adjusted Odds Ratio [aOR] 1.41, 95%CI 1.26-1.59), PA repeated intrusion (aOR 1.30, 95%CI 1.06-1.60), and fluency perseveration (aOR 1.10, 95%CI 1.02-1.19). The likelihood of incident dementia also increased if there were one or more LM unrelated intrusions (aOR 1.88, 95%CI 1.16-3.03) or VR confabulations (aOR 1.68, 95%CI 1.05-2.69); and, was doubled if there were VR contaminations (aOR 2.01, 95%CI 1.29-3.12). Older age and e4 allele were also associated with higher odds of incident dementia. When combining all of the above significant error predictors, age, and e4 alleles, only PA semantic intrusions, LM unrelated intrusions, and VR contaminations remained independent predictors of incident dementia with very good accuracy (area under the ROC curve= 0.9008). The addition of quantitative test scores indicated LM unrelated intrusions are associated with 60% higher odds of incident dementia even after controlling for LM total score and PA semantic intrusions are better predictors of incident dementia than PA total score which did not meet model inclusion criteria.

**Conclusions:** Executive function-related errors made on non-executive function tests are predictive of incident dementia. Some errors may be better predictors than traditional total test scores. These findings underscore the need to examine the process and errors made on traditional neuropsychological tests to identify potentially more robust preclinical predictors of incident dementia.

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**Keywords:** executive functions, neuropsychological assessment

**E. PASTERNAK, D. MARRA, Q. LI, A. H. MILLER, Y. WU, J. BIAN, M. JAFFEE, R. M. BAUER, D. MARAGANORE. Mild TBI and Clinical Dementia Risk in the OneFlorida Research Consortium Cohort.**

**Objective:** Although an association between moderate-severe traumatic brain injury (ms-TBI) and risk of late life dementia has become increasingly recognized, the relationship between mild TBI (mTBI) and incident dementia is controversial. Because mTBI is by far more frequent, characterizing this relationship is of utmost value in identifying clinical dementia vulnerability, with important public health and practice implications given the high incidence of mild TBI in older adults. The current study aimed to elucidate the association between mild TBI (mTBI), dementia diagnosis, and proximity of injury to dementia diagnosis. This study also addresses

recall bias and confounding limitations of prior studies by using discreet electronic medical record (EMR) data and matched controls.

**Participants and Methods:** In this retrospective study, EMR data of adults aged 50+ with Alzheimer's disease and related dementias (ADRD) ( $n = 6369$ ;  $M_{age} = 74.9$ ) from the OneFlorida Research Consortium were matched to that of controls ( $n = 30,066$ ;  $M_{age} = 75.3$ ) at a ratio of 1:5. Logistic regression models were conducted to compare the risk of developing ADRD in patients with ( $n = 170$ ) and without ( $n = 29880$ ) a history of mTBI after controlling for demographic, medical, and behavioral health risk factors.

**Results:** After controlling for demographic factors and health comorbidities, history of mTBI was associated with a higher odds ( $OR = 1.63$ ,  $p = .0011$ ) of developing ADRD. When examining the interaction of time, mTBI was a significant predictor only if sustained 0-3 years before ADRD diagnosis ( $OR = 1.88$ ,  $p = .0013$ ). mTBI trended towards significance as a predictor when mTBI was sustained 3-5 years prior to ADRD diagnosis ( $OR = 1.89$ ,  $p = .047$ ) but failed to reach significance when sustained 5+ years before ADRD diagnosis ( $OR = .948$ ,  $p = .880$ ).

**Conclusions:** The current findings suggest that mTBI in older adults is associated with increased risk of clinical dementia status, but only if sustained within three years of dementia diagnosis. Since mTBI shows increasing prevalence in the older adult population, these findings suggest the need for placing older mTBI survivors on close medical surveillance, and for offering them postinjury care to prevent cognitive decline in the short-term aftermath of their injury. Longitudinal prospective studies are needed to better understand whether mTBI in older adults exacerbates a pre-existing pattern of subtle decline, initiates a pathophysiological process leading to dementia, or both. The potential interaction of mTBI and comorbid risk factors for dementia development also bears further investigation.

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**Keywords:** aging disorders, dementia - other cortical, traumatic brain injury

**E. AMARANTE, H. F. ANDREWS, A. CHESEBRO, D. L. SANCHEZ, J. M. BEATO, N. SCHUPF, R. A. LANTIGUA, J. J. MANLY, R. P. MAYEUX, A. M. BRICKMAN. Are residents of Naturally Occurring Retirement Communities (NORCs) at decreased risk for development of dementia?**

**Objective:** Naturally Occurring Retirement Communities (NORCs) in the state of New York are defined as a building, housing complex, or neighborhood that was not originally built for older adults but now contains a large proportion of residents aged 60 and older. NORCs were first designated by New York City as a response to combat the challenges associated with "aging in place" (i.e. being able to remain independent within your community) by providing on-site social and health services, recreational activities, and strengthening community engagement. Previous studies showed that residents of NORCs have benefited socially and medically as well as feeling more inclusive within their neighborhoods, but it is unknown whether NORC residency affects dementia risk. Leveraging data from a community-based cohort of older adults, we tested the hypothesis that NORC residents have lower prevalence and incidence of cognitive impairment and dementia compared with older adults who do not live in NORCs.

**Participants and Methods:** Participants came from the Washington Heights Inwood Columbia Aging Project (WHICAP), a community-based, longitudinal study of cognitive aging and dementia to randomly sample adults >65-years-old residing in Upper Manhattan, New York.

Participants received a medical/neurological examination, standardized interviews, and a neuropsychological battery every 18-24 months. Data from each visit are reviewed by an expert panel that adjudicates a cognitive diagnosis (unimpaired, mild cognitive impairment, or dementia). This analysis included data from n=5034 WHICAP participants (68% women; 26% non-Hispanic white, 29% African American/Black, 43% Hispanic/Latinx, 2% other), who were evaluated an average of 4 longitudinal visits (range 1-14). By cross-referencing addresses of WHICAP participants with addresses designated by the city as NORCs, we identified 135 WHICAP participants residing in a NORC. We compared the prevalence and incidence of MCI or dementia diagnosis between NORC and non-NORC residents, adjusting the models for demographic features and number of evaluations.

**Results:** NORC residents were much less likely to have received a diagnosis of dementia (16% versus 30%,  $\chi^2=12.89$ ,  $p<0.001$ ) and MCI (34% versus 44%  $\chi^2=6.23$ ,  $p<0.001$ ) than non-NORC residents over the course of the study. In adjusted models that examined incident diagnosis, NORC residents were less likely to develop MCI (OR=0.48, 95%CI:0.29-0.78,  $p=0.003$ ) than non-NORC residents, but the two groups had a similar likelihood of developing dementia (OR=0.65, 95%CI:0.36-.1.18,  $p=.16$ )

**Conclusions:** These results suggest that residents of NORCs are less likely to develop cognitive impairment, particularly MCI, than non-NORC residents, suggesting a benefit to “aging in place.” These findings could be mediated by a combination of the psychosocial benefits of being a part of a community and structured services provided by the city, but could also be influenced by confounding factors including differences in opportunities to live in a NORC and change in residency with onset of cognitive impairment.

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**Keywords:** mild cognitive impairment

**A. S. KAWLES, M. KOCHHEISER, R. KESZYCKI, M. RILEY, C. SPENCER, J. LILEK, I. AYALA, R. SHEPARD, K. AJROUD, A. FELDMAN, Q. MAO, M. FLANAGAN, S. WEINTRAUB, M. . MESULAM, E. H. BIGIO, C. GEULA, T. GEFEN. Clinicoanatomic Distribution of the 3R Tauopathy of Pick’s Disease in behavioral variant Frontotemporal Dementia (bvFTD).**

**Objective:** Behavioral variant frontotemporal dementia (bvFTD) is an early-onset clinical dementia syndrome characterized by progressive worsening of behavior and personality at initial stages, with peak areas of focal atrophy typically isolated to bilateral frontotemporal brain regions. Various underlying pathologies can be present, including the 3R tauopathy of Pick’s disease (“PiD”). In this study, we investigated relationships between anatomy, clinical syndrome, and distributions of Pick bodies in well-defined cases of bvFTD using a rigorous stereologic counting method across multiple cortical and subcortical anatomic regions.

**Participants and Methods:** Six right-handed cases with antemortem diagnoses of bvFTD and autopsy-confirmed PiD as the sole pathologic diagnosis were identified from the Northwestern University Alzheimer’s Disease Center brain bank. Longitudinal and uniform neuropsychological data were used to generate domain-specific composite scores to evaluate for patterns of decline in global cognition, memory, executive functioning, language, visuospatial abilities, and behavior/compartment. Specimens were stained immunohistochemically with AT-8 to visualize Pick bodies characteristic of PiD. Unbiased stereological analysis (MicroBrightField,

MBF Bioscience) was performed on 4 regions bilaterally [middle frontal gyrus (MFG), inferior parietal lobule (IPL), superior temporal gyrus (STG), and the dentate gyrus (DG) and CA1 regions of the hippocampal complex], and 4 regions unilaterally [caudate, occipital cortex, amygdala, and anterior cingulate cortex (ACC)]. One-way nonparametric ANOVAs were used to compare regional distributions of Pick bodies.

**Results:** Relative to all cognitive and behavioral domains, the executive functioning composite score showed the fastest rate of decline on average. Stereological findings showed highest densities of Pick bodies in amygdala (~38,000 per mm<sup>3</sup>), caudate (~59,000 per mm<sup>3</sup>), and DG and CA1 regions (~72,000 and ~43,000 per mm<sup>3</sup>, respectively). The DG specifically showed significantly higher densities ( $p < 0.05$ ) compared to all neocortical regions (MFG, STG, IPL; mean = ~24,000 per mm<sup>3</sup>) by an order of approximately 3-fold. In the cortex, density of Pick bodies was greatest in ACC, followed by MFG, STG, and IPL. ANOVAs comparing left versus right hemispheric distribution of pathology in bilateral MFG, STG, and IPL showed no evidence of asymmetry at the group level. As expected, the occipital cortex showed extremely sparse to no pathology.

**Conclusions:** Cortical findings of greatest densities of Pick bodies in the ACC and bilateral MFG—regions implicated in executive functioning and behavior/compartment—suggest that regional distributions of pathology are concordant with the salience of the clinical phenotype characteristic of bvFTD. The magnitude of pathology in the hippocampal complex coupled with a dearth of amnesic symptoms early in disease course raises questions about the selective vulnerability of this unique region to neurodegenerative diseases, including PiD. Future investigations will increase sample size, assess relationships between cognition/behavior and anatomic distribution of pathology, and explore the contribution of neuronal, glial, and synaptic integrity to FTL D-tau.

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**Keywords:** dementia - other cortical

### **Program Chair Welcome & Plenary C: Early Detection of Autism Spectrum Disorder 9:55 AM - 10:55 AM**

**Presenter: Diana L. Robins**

#### **D. ROBINS. Early Detection of Autism Spectrum Disorder.**

Autism spectrum disorder (ASD) is a neurodevelopmental disorder that affects 1 in 54 children. Symptoms manifest during the first years of life, yet most children are not diagnosed until they are 3-5 years old. Subsequently, initiation of ASD-specific early intervention is delayed, which impacts outcomes across the lifespan. Although many labs have explored potential biomarkers in infants and toddlers, behavioral detection and diagnosis remain the current standard. This presentation will review the common warning signs of ASD in toddlers, using video examples to illustrate key behaviors that differentiate toddlers with ASD from those with other developmental delays and typical development, such as joint attention and pretend play. I will describe strategies used to detect ASD risk in toddlers; conflicting guidelines for primary care providers, often the only experts to see very young children; and how utility of screening tools is evaluated,

with emphasis on sensitivity, specificity, and positive predictive value. Using examples from the literature on the Modified Checklist for Autism in Toddlers, Revised, with Follow-Up (M-CHAT-R/F), I will discuss challenges and opportunities in early detection of ASD.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) List common warning signs for ASD in toddlers 2) Describe strategies for detection of ASD before age 2, including conflicting guidelines for primary care providers 3) Discuss utility of screening tools, including sensitivity and specificity, and review evidence for universal ASD-specific screening.

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**Panel Discussion hosted by the INS Student Liaison Committee 01: Neuroimaging and Biomarkers: Our Scope of Practice as Neuropsychologists**

**Presenters: Gaël Chételat, Elisha Josev**

**11:00 AM - 11:55 AM**

**G. CHÉTELAT. Use of neuroimaging in neurodegenerative diseases: Clinical and Research Perspectives.**

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**E. JOSEV. The Use of Neuroimaging in Paediatric Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS).**

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**Paper Session 11: Epilepsy**

**11:00 AM - 12:00 PM**

**K. ARROTTA, A. REYES, E. KAESTNER, W. B. BARR, B. HERMANN, C. R. MCDONALD, R. M. BUSCH. Identifying Cognitive Phenotypes in Frontal Lobe Epilepsy: Moving Towards Precision Neuropsychology.**

**Objective:** There is considerable heterogeneity in the patterns of cognitive impairment observed across and within epilepsy syndromes. To better understand this heterogeneity, researchers have characterized cognitive and behavioural phenotypes across different epilepsy syndromes. Stable/reproducible phenotypes have been identified, particularly among patients with temporal lobe epilepsy (TLE), which has been the most investigated syndrome to date. Furthermore, neuroimaging studies have identified unique neural correlates that are associated with each phenotype. In this study, for the first time, we aimed to identify cognitive phenotypes in frontal lobe epilepsy (FLE) and to compare the clinical and demographic characteristics across phenotypes.

**Participants and Methods:** One hundred and six patients with FLE who underwent a comprehensive neuropsychological evaluation at a level 4 epilepsy center were included. Patients completed three measures within each of the following cognitive domains: language, executive function, processing speed, and verbal and visual learning. Neuropsychological scores were corrected for age, education, sex, and race. Impairment was defined as one standard deviation

below the normative mean. Patients were determined to be impaired in a given domain if two or more of the three cognitive tests fell within the impairment range. Based on the number of impaired cognitive domains and the pattern of impairment, three phenotypes emerged. The *Generalized Phenotype* was defined as having impairment in at least three of the four cognitive domains, the *Domain-Specific Phenotype* was defined as having impairment in one or two cognitive domains, and the *Intact Cognitive Phenotype* included patients with no impairment in any of the cognitive domains. Clinical, cognitive, and demographics variables were compared across the phenotypes.

**Results:** Approximately 35% met criteria for the *Generalized Phenotype*, 45% met criteria for the *Domain-Specific Phenotype*, and 20% met criteria for the *Intact Cognitive Phenotype*. The *Generalized Phenotype* was characterized by pervasive impairment across all tests and the *Domain-Specific Phenotype* demonstrated a predominantly language impaired profile (69% of patients), with secondary impairments in executive function (27%) and processing speed (25%). There were no differences across the phenotypes on epilepsy-related variables (i.e., age of onset, duration, number of antiseizure medications, side of epilepsy onset and surgery). There was a trend towards the *Generalized Phenotype* having fewer years of education relative to the *Intact Cognitive Phenotype* [ $F(2, 103) = 3.03, p = .053$ ; pairwise  $p = .047$ ]. There were no other significant differences in demographic characteristics.

**Conclusions:** This study found three distinct cognitive phenotypes in FLE that were independent of clinical and demographic variables. Interestingly, despite FLE being commonly associated with fronto-subcortical cognitive deficits, we found that language was the most prominent domain-specific impairment in our sample. These findings enhance our understanding of how cognitive function is differentially impacted in FLE and provides additional support for the development and use of cognitive taxonomies in epilepsy. Furthermore, two of the phenotypes in our study (Intact & Generalized) are similarly found across all studies of TLE, suggesting shared phenotypes between FLE and TLE. Unique to FLE are the domain-specific impairments in executive functioning and processing speed, while patients with TLE demonstrate greater impairment in memory.

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**Keywords:** epilepsy / seizure disorders, cognitive functioning

**Y. A. MODIANO, T. WEBBER, B. CERBONE, Z. HANEEF, N. PASTOREK. Predictive Utility of MMPI-2-RF in Differentiating Psychogenic Non-Epileptic Events and Epilepsy in a Largely Male Veteran Sample.**

**Objective:** While psychogenic non-epileptic events (PNEE) and epilepsy (ES) often present similarly, they are etiologically distinct, and correct diagnosis is essential for ensuring appropriate treatment and improving outcomes. The MMPI-2-RF may assist in differential diagnosis, but prior investigations have been limited by disproportionately female sample, inconsistent accounting for profile invalidity, and limited intra-scale variability from dichotomizing variables. The current investigation addressed these gaps by investigating the diagnostic utility of the MMPI-2-RF in differentiating PNEE and ES in a predominantly male sample of Veterans while conservatively accounting for profile invalidity and using a statistical approach that allows for consideration of continuous independent variables to better appreciate intra-scale variance.

**Participants and Methods:** Per the MMPI-2-RF interpretive manual, participants with scores falling in the definitely or likely invalid ranges on validity scales were eliminated. Of the remaining participants, 191 Veterans (73.8% male) completed the MMPI-2-RF and were diagnosed with PNEE (60.2%) or ES (39.8%) by a board-certified neurologist following continuous video EEG. Independent samples t-tests assessed differences in MMPI-2-RF variables by diagnostic groups. Hierarchical stepwise logistical regressions conducted separately by sex (to address known sex differences) assessed predictive utility of MMPI-2-RF indices.

**Results:** Among males, those with PNEE endorsed significantly higher scores on F-r, FBS-r, RBS, RC1, RC7, HPC, and NUC (medium to large effect sizes). The regression block that contained validity, restructured clinical, and substantive scales had a hit rate of 71.63%, which was an improvement from the baseline model hit rate of 56.74% in males. Higher endorsement on RC1 ( $B = .28, p < .001$ ) and lower reporting on GIC ( $B = -.51, p = .01$ ) significantly predicted PNEE diagnosis for males. Among females, there were no significant group differences in MMPI-2-RF indices, but a small effect of higher scores on Fp-r, FBS-r, and NUC was observed for the PNEE group, and small-medium effects of higher RC6 and RC4 scores in the ES group were observed. The regression block with validity, restructured clinical, and substantive scales had a hit rate of 82.00%, which was an improvement from the base rate of 70.00% of PNEE in females. Greater endorsement of RC4 ( $B = -.36, p = .01$ ) significantly predicted diagnostic status within the female ES group.

**Conclusions:** MMPI-2-RF improved diagnostic accuracy of PNEE versus ES for males by 14.89% beyond base rates, while it improved diagnostic accuracy in females by 12%. For males, higher reporting on RC1 increased likelihood for PNEE, consistent with prior research indicating greater endorsement of somatic (as opposed to affective) experiences among males. Greater endorsement of GIC predicting ES membership among males may be related to epilepsy-specific semiology or auras, or males with PNEE may report fewer GI symptoms when compared with other somatic experiences (e.g., neurologic). The novel finding among females of higher endorsement of RC4 predicting ES status may be explained by differences in sample characteristics between prior studies investigating civilian women. Taken together, this supports the utility of the MMPI-2-RF in helping differentiate PNEE from ES in a sample of predominantly male Veterans.

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**Keywords:** seizures (psychogenic), epilepsy / seizure disorders, psychometric constructs

**R. M. BUSCH, O. HOGUE, M. MILLER, L. FERGUSON, M. MCANDREWS, M. J. HAMBERGER, M. KIM, C. R. MCDONALD, A. REYES, D. L. DRANE, B. HERMANN, W. BINGAMAN, I. M. NAJM, M. W. KATTAN, L. JEHI. Nomograms to Predict Memory Outcomes After Temporal Lobe Resection in Adults with Epilepsy.**

**Objective:** To develop and externally validate models to predict the probability of postoperative verbal memory decline in adults following temporal lobe resection (TLR) for epilepsy using easily-accessible preoperative clinical predictors.

**Methods:** Multivariable models were developed to predict delayed verbal memory outcome on three commonly used measures: Rey Auditory Verbal Learning Test (RAVLT) and Logical Memory (LM) and Verbal Paired Associates (VPA) subtests from Wechsler Memory Scale—Third Edition. Using Harrell's step-down procedure for variable selection, models were

developed in 359 adults who underwent TLR at Cleveland Clinic and validated in 290 adults at one of five epilepsy surgery centers in the United States or Canada.

**Results:** Twenty-nine percent of the development cohort and 26% of the validation cohort demonstrated significant decline on at least one verbal memory measure. Initial models had good to excellent predictive accuracy (calibration (c) statistic range=0.77-0.80) in identifying patients with memory decline; however, models slightly underestimated decline in the validation cohort. Model coefficients were updated using data from both cohorts to improve stability. The model for RAVLT included surgery side, baseline memory score, and hippocampal resection. The models for LM and VPA included surgery side, baseline score, and education. Updated model performance was good to excellent (RAVLT  $c=0.81$ , LM  $c=0.76$ , VPA  $c=0.78$ ). Model calibration was very good, indicating no systematic over- or under-estimation of risk.

**Conclusions:** Nomograms are provided in two easy-to-use formats to assist clinicians in estimating the probability of verbal memory decline in adults considering TLR for treatment of epilepsy.

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**Keywords:** epilepsy / seizure disorders - surgical treatment, memory disorders

### **T. MCMILLAN, C. MASON, M. SEIDENBERG, J. JONES, B. HERMANN. Processing Speed and Cognitive Health in Temporal Lobe Epilepsy.**

**Objective:** Temporal lobe epilepsy (TLE) was classically associated with impaired anterograde memory function, but it is now appreciated that impairments can be more widespread and impact general intellectual function, language, visuospatial skills, and executive function. Notably, slowed cognitive and psychomotor processing speed is also a well-known complication of TLE and other epilepsies; however, this domain remains significantly understudied. To characterize the impact of slowed processing speed on cognition in TLE, its role as a mediator in the relationship between intelligence and performance across multiple neuropsychological domains was examined.

**Participants and Methods:** 100 adult TLE patients ( $M_{age} = 36.8$  years) and 89 healthy controls ( $M_{age} = 33.6$  years) completed a neuropsychological battery with 15 cognitive measures. First, latent variables were identified based on theoretical domains and confirmed using latent variable modeling. Next, confirmatory factor analysis was used to identify a common cognitive structure for the various cognitive domains, which included verbal intelligence, immediate memory, delayed memory, executive dysfunction, working memory, and processing speed. Lastly, structural equation modeling was used to examine whether processing speed mediated the relationship between verbal intelligence and other cognitive domains in both the TLE patients and controls.

**Results:** As expected, verbal intelligence was significantly associated with other cognitive domains in both epilepsy and control groups. A total of three structural models, each with different pathways that were free to vary, were compared. Results indicated that the partially constrained model fit the data best data [ $\chi^2(214) = 260.00, p = .02$ ; CFI = .98; TLI = .97; RMSEA=.04 (CI: .02-.05); AIC: 512.00]. For controls, structural equation modeling revealed that verbal intelligence was directly related with other cognitive domains in controls and processing speed did not mediate these relationships. In other words, there was a direct and unmediated (by processing speed) relationship between verbal intelligence and other domains of cognitive function. However, for the TLE group, processing speed mediated the relationship

between verbal intelligence and cognitive performance across all other domains. As processing speed slowed, cognitive performance in other domains was compromised.

**Conclusions:** Slowed processing speed plays a central role in the cognitive efficiency of people with TLE, affecting performance across all examined cognitive domains. Processing speed may be a target for intervention as treatment may serve to improve function in other domains of cognitive function.

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**Keywords:** epilepsy / seizure disorders, intelligence, cognitive

## Poster Session 5: Parkinson's Disease and Other Dementias

11:00 AM - 12:00 PM

### M. E. MCLAREN, T. L. ROBINSON, S. PENNA. **Teleneuropsychology in Parkinson's Disease: A Case Study.**

**Objective:** The recent COVID-19 pandemic has highlighted the need for development of teleneuropsychological assessment methods for patients. While studies have examined validity and feasibility of neuropsychological assessments in differing populations, very few have explored the potential usefulness of teleneuropsychology in patients with Parkinson's disease. Here we report a case study of a Parkinson's disease patient who received both teleneuropsychology and in-person testing. The patient was a 64-year-old, right-handed, Caucasian man with a doctoral degree. He was born and raised in South Africa and reported his primary language, at home and work, as Afrikaans, though he did learn English in school and reported English fluency. He was diagnosed with Parkinson's disease within one year of his evaluation, with motor symptoms including resting right sided tremors and mild gait abnormalities. Cognitive complaints included difficulties with word finding in both English and Afrikaans, concentration difficulties, and memory problems. While the patient denied difficulties with instrumental activities of daily living, his cognitive problems did result in him retiring early from his job.

**Participants and Methods:** Initial telehealth assessment occurred utilizing a Zoom platform while the patient was in his home. He attended an in-person testing session three weeks later for follow-up testing when the neuropsychology clinic reopened. Both telehealth and in person measures included assessment of attention, visuospatial, naming, learning and memory, and executive functioning. Telehealth testing additionally included assessment of cognitive fluency and mood, while in-person testing included measures of psychomotion. Where possible alternative tests within the same domain were used for the in-person follow-up testing to reduce the risk of practice effects (e.g., Rey Osterrieth Complex Figure administered via telehealth and Taylor Complex Figure administered in person).

**Results:** Both the telehealth and in person assessment revealed intact spatial perception, variable processing speed abilities, severely impaired visuoconstruction, mild to moderate deficits in learning, and moderate to severe deficits in memory. The telehealth platform additionally found intact basic attention and working memory which was not re-assessed in person. In-person testing found intact sequential movements and a mild impairment in deductive reasoning. Limitations in interpretation was present for language tests given the patient's English as a Second Language (ESL) status.

**Conclusions:** Results suggest while there are some limitations for teleneuropsychology regarding psychomotor assessment, teleneuropsychology may be useful for assessing cognition in Parkinson's disease patients. The consistency of performance and general interpretation of testing between the telehealth and in-person platforms of assessment indicate further research into the applicability of teleneuropsychology in movement disorders is warranted. This case also suggests further research into the applicability of teleneuropsychology in ESL patients who have fluency in English is warranted.

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**Keywords:** neuropsychological assessment, movement disorders

**L. KENNEY, F. V. LOPEZ, C. PRICE, C. JACOBSON, D. BOWERS. Not All Memory Domains are Created Equal: How the Operationalization of Memory Domains Influences Classification of Parkinson's Disease-Mild Cognitive Impairment.**

**Objective:** Over the last decade, prevalence rates of Parkinson's Disease-Mild Cognitive Impairment (PD-MCI) have varied and often given rise to inconsistent patterns of MCI subtypes. This discrepancy directly relates to variation in impairment criteria, sample differences, and measures/indices used to define cognitive domains. For instance, when operationalizing Memory(/Learning) domains, not only do studies differ on which memory measures are used but also on specific indices (i.e., delayed recall, immediate recall, retention, or recognition) (Goldman et al., 2013; Janvin et al., 2006). This variability in memory metrics has resulted in various prevalence rates of "amnesic impairments" in PD-MCI. In the present study, we examined the impact of different operationalizations of "Memory" on amnesic PD-MCI prevalence rates by individually examining indices on measures of list learning and story memory.

**Participants and Methods:** Participants included a convenience sample of 494 non-demented individuals with idiopathic PD who underwent a comprehensive neuropsychological assessment at the UF Fixel Institute's movement disorders program. Participants (mean age= 64.7±9.04 yrs) were predominantly male (72%) and Caucasian (94%), well-educated (mean= 15.0±2.79 yrs), in mid-stage of disease severity (Hoehn-Yahr), and scored  $\geq 125$  on a cognitive screener (Dementia Rating Scale-2). We operationalized the "Memory" domain using delayed recall (DR) and retention scores from the Hopkin's Verbal Learning Test (HVLT-R) and WMS-III Logical Memory Stories (LM); we examined indices' normative z-scores individually and also created DR and retention HVLT/LM composites (by averaging z-scores). This resulted in 6 distinct memory metrics: LM-DR, LM-Retention, HVLT-DR, HVLT-Retention, Composite-DR, Composite-Retention. Using each memory metric separately, participants were classified as having PD-MCI in the context of performance across other cognitive domains from the neuropsychological exam (Executive Function[EF], Language, Visuospatial, Attention/Working Memory). For all domains, impaired performance was defined as 1.5 SD below published normative means. We compared the prevalence of PD-MCI subtypes as a function of the 6 memory metrics. Using McNemar's tests, we examined differences in marginal frequencies of 'memory' impairment and PD-MCI rates by the 6 memory metrics.

**Results:** The prevalence of PD-MCI ranged from a low of 22% (LM-Retention) to 43% (HVLT-DR). Of those with MCI, a much larger proportion had amnesic impairment when using HVLT-DR (80%) or HVLT-Retention (67%) compared to LM-DR (27%) or LM-Retention (18%). When using HVLT-R indices, the single amnesic subtype had the highest prevalence within

PD-MCI participants (DR:54%, Retention:45%), but when using LM indices or composites, the single non-amnestic subtype (primarily due to EF or Language deficits) had the highest prevalence (ranging from 38-62%). Overall, a significantly larger proportion of participants were impaired on DR than retention indices (regardless of task), and on HVLT but not LM (for both indices) ( $p$ 's<0.01).

**Conclusions:** Our findings affirm that measures/indices used to operationalize memory influence not only prevalence of PD-MCI and but also the pattern of subtypes. Whether using DR or retention, averaging list learning and story memory indices together produces a prevalence of amnestic impairment that seemingly converges two extremes. These findings have implications for conceptualizing PD-MCI and call into question the nature of the 'memory' disturbance in individuals with fronto-subcortical disorders.

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**Keywords:** Parkinson's disease, mild cognitive impairment, test validity

**T. MCMANN, M. NAKHLA, N. WHITELEY, A. TON-LOY, I. LITVAN, S. LESSIG, J. V. FILOTEO, D. M. SCHIEHSER. Antidepressants Exacerbate Cognitive Dysfunction in Parkinson's Disease.**

**Objective:** Antidepressant medications are commonly prescribed in Parkinson's Disease (PD) to treat the high prevalence of depression in this population. Further, cognitive decline represents one of the most common non-motor symptoms in PD, contributing to poor quality of life. Despite the high prevalence of both factors, few studies have evaluated the potential impact of antidepressants on cognition in PD, and to date, findings have been inconsistent. Therefore, the purpose of this study was to clarify the effects of antidepressant use on cognition in PD.

**Participants and Methods:** As part of a parent study on cognition in PD, a retrospective analysis was conducted on 29 non-demented (MDRS >124) PD patients, who demonstrated adequate effort (CVLT FC  $\geq 14$ ), that were taking antidepressants (PD+AntiD) and 29 demographically-matched PD patients who were not taking antidepressants (PD-AntiD). Antidepressants included five classes: selective serotonin reuptake inhibitors, aminoketones, tricyclics, benzodiazepines, and serotonin antagonist reuptake inhibitors. Neuropsychological tests were combined to assess the cognitive domains of memory (learning and delayed recall), attention, visuospatial, language, and executive function. Depression was measured with the Geriatric Depression Scale (GDS). A one-way (PD+AntiD vs. PD-AntiD) analysis of covariance compared the effects of antidepressant use on cognition, controlling for depression and disease duration.

**Results:** On average, both groups were non-depressed and did not significantly differ on GDS (mean < 9;  $p=0.7$ ). Compared to PD-AntiD, the PD+AntiD group performed significantly worse on measures of visuospatial functioning ( $p = 0.05$ ) and memory ( $p = 0.04$ ); the latter appeared to be driven by worse performance in delayed recall ( $p = 0.01$ ), not learning ( $p = 0.10$ ). Groups did not differ on any other cognitive domain.

**Conclusion:** Results indicate that antidepressant use in non-demented PD exacerbates visuospatial and memory dysfunction, particularly delayed recall. These findings underscore the clinical relevance of determining the costs and benefits of treating PD patients with antidepressants and the potential for negative cognitive effects. Future research is warranted with larger sample sizes of varying antidepressant classes and dosages to determine which class and/or dosage may have the greatest impact on cognition in PD.

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**Keywords:** cognitive functioning, depression

**F. V. LOPEZ, L. KENNEY, E. TRIFILIO, A. M. RATAJSKA, C. S. ALTARAS, C. JACOBSON, D. BOWERS. Stacking Up Against Tradition: Computerized Tests of Executive Function on Global Cognitive Status in Parkinson's disease.**

**Objective:** Historically, the clinical assessment of executive functions (EF) involved paper and pencil tasks of set-shifting, planning, working memory, and inhibition. More recently, experimental measures of EF (e.g., flanker task, n-back, etc.) have been incorporated into a computerized battery known as the NIH-Examiner. The goal of the current study was two-fold: 1) to learn how performance on novel EF tasks from the NIH-Examiner contributed to scores on a global cognitive screener in individuals with Parkinson Disease (PD); and 2) to determine the extent to which this contribution converged with that of traditional neuropsychological measures.

**Participants and Methods:** We conducted two independent studies. In one, 64 non-demented individuals with idiopathic PD completed the NIH-Examiner along with a global cognitive screener, the Dementia Rating Scale (DRS-2). Regression analyses were performed with DRS-2 total scores as the dependent variable and NIH-Examiner factor scores as independent variables (i.e., Working Memory, Cognitive Control, and Fluency). As a group, the PD sample was in their mid-60's (mean age = 65.4±7.19), predominately male, well-educated (mean =15.4±2.42), in the mid-stage of disease severity (mean UPDRS Motor 'ON'=23.6±8.97), and scored > 130 on the DRS-2. Second, with a similar though larger PD sample (n=370), traditional neuropsychological measures (i.e., EF, recent memory, language, attention/working memory, and visuospatial skills) were regressed on DRS-2 total scores. Follow-up analyses examined the additional contribution of mood (i.e., depression, anxiety) and motivation/apathy above and beyond neuropsychological variables on the DRS-2.

**Results:** *Study 1:* The overall NIH-Examiner Executive Composite accounted for a significant amount of the variance in DRS-2 performance ( $p=.002$ ,  $R^2=.202$ ). Follow-up regression analyses using factor scores revealed this relationship was solely due to the Fluency factor ( $\beta=.391$ ,  $p=.002$ ), and more specifically semantic fluency ( $\beta=.386$ ,  $p=.004$ ). *Study 2:* In the larger sample, composite scores across EF ( $\beta=.211$ ,  $p=.001$ ), visuospatial ( $\beta=.168$ ,  $p=.001$ ), recent memory ( $\beta=.139$ ,  $p=.008$ ), and language tasks ( $\beta=.137$ ,  $p=.001$ ) accounted for a significant amount of variance in DRS-2 performance ( $p<.001$ ,  $R^2=.255$ ). The addition of apathy (AS;  $\beta=-.144$ ,  $p=.014$ ), but not depression (BDI-II) nor anxiety (STAI), was significantly related to DRS-2 performance, over and above cognitive scores alone ( $\Delta F p=.014$ ,  $\Delta R^2=.013$ ).

**Conclusions:** While the omnibus Executive Composite from the NIH-Examiner was significantly associated with DRS-2 total scores, Fluency scores, specifically semantic fluency, primarily drove this relationship. Given that supermarket fluency is one of the subtests of the DRS-2, this finding likely reflects task and measurement convergence (i.e., paper-pencil fluency tasks) between NIH-Examiner and DRS-2. In contrast, traditional neuropsychological measures, particularly fronto-executive tasks, accounted for 25% of the variance associated with DRS-2 performance. Apathy, but not depression or anxiety, accounted for additional, albeit slight (i.e., 1.3%), variance associated with the DRS-2. Together, DRS-2 performance was better characterized by traditional as compared to computerized measures of EF from the NIH-

Examiner. Additional investigation is needed to determine the clinical utility of NIH-Examiner on other aspects of behavior in PD.

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**Keywords:** Parkinson's disease, executive functions, computerized neuropsychological testing

**C. S. ALTARAS, E. TRIFILIO, F. V. LOPEZ, B. M. SCOTT, D. BOWERS. Examining the NIH EXAMINER Unstructured Task in Parkinson's Disease.**

**Objective:** The NIH EXAMINER is a computerized neuropsychological battery that was developed to analyze executive abilities in neurological disorders, including Parkinson's Disease (PD). The Unstructured Task is an EXAMINER test of planning. It requires examinees to strategically complete a series of simple puzzles within an allotted time (6 minutes). Each puzzle has a designated point value, irrespective of the time required to complete it. As such, examinees need to plan ahead and choose puzzles with high-cost value (i.e., high value items that require less time) and avoid those with low-cost value (i.e., low value items that require more time) to earn as many points as possible. The current study builds on a previous study that examined whether PD patients differed from controls across the three composites of the EXAMINER—fluency, working memory, and cognitive control (Bott et al., 2014) Since the unstructured task is not included in these composites, little is known about its utility in detecting cognitive dysfunction in PD. In the current study, we examined whether performance on the unstructured task differed across three PD groups—cognitively normal, mild cognitive impairment, and elevated cognitive impairment.

**Participants and Methods:** Seventy-seven patients with PD (age = 65.36 [7.62]; disease duration = 9.37 [5.26]; UPDRS on= 23.08 [9.11]) were recruited from University of Florida Fixel Institute. Each participant completed the EXAMINER and other neuropsychological tasks, including Trail Making Test (TMT) and Dementia Rating Scale- 2<sup>nd</sup> edition. (DRS-2). Participants were divided into three groups using the DRS-2—cognitively normal (DRS $\geq$ 139; n= 27), mild cognitive impairment (DRS=134-138; n= 34), and elevated cognitive impairment (DRS  $\leq$  133; n= 16). Analysis of covariance was used to analyze the differences between the cognitive groups on the unstructured task: (1) total points (UTT<sub>Total</sub>); (2) weighted composite (percentage of high value items\*log<sub>10</sub>(UTT<sub>Total</sub>+1); and (3) UTT<sub>Total</sub> when controlling for processing speed (TMT A); age and education were entered as covariates. A Kruskal-Wallis test was also conducted to examine group differences in the number of high and low value items completed.

**Results:** The elevated cognitive impairment group had significantly fewer total points compared to the cognitively normal and mild cognitive impairment groups; the cognitively normal and mild cognitive impairment groups did not significantly differ. When controlling for processing speed, there was no longer a statistical difference between groups on total points. There were no statistical differences between the cognitive groups on the weighted composite score, number of high value items complete, or number of low value items completed.

**Conclusions:** The unstructured task does not appear to be a robust measure in differentiating cognitive status in PD. Although participants with elevated cognitive impairment earned fewer total points, the results suggest that this is secondary to slowness. This is further supported by the lack of differences between the cognitive groups on other measures of the unstructured task. Future studies with a larger sample size and healthy control comparison group will be helpful in further evaluating the use of the unstructured task as an executive measure in PD.

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**Keywords:** Parkinson's disease, planning, assessment

**T. R. GREIF, A. MAHER, A. ASKARI, P. PATIL, C. PERSAD. Anterior Subthalamic Nucleus Lead Location Predicts Greater Phonemic Fluency Decline following Deep Brain Stimulation for Parkinson's Disease.**

**Objective.** Verbal fluency (VF) decline is a well-documented cognitive effect of subthalamic nucleus deep brain stimulation (STN-DBS) for Parkinson's disease (PD), and the decline has been frequently associated with left-sided surgical – rather than stimulation – factors. However, the specific neuroanatomical correlates of this surgical effect remain unclear. While recent studies have examined the impact of lead location among functional STN subdivisions on VF outcomes, methods and results have been mixed. A few reports have identified that ventral STN contacts may worsen VF, while others have suggested medial or posterior contacts. The present study sought to clarify previous findings in a comparably large sample using individually-determined active contact locations divided among X, Y, and Z axes relative to the STN midpoint.

**Participants and Methods.** Participants included 59 individuals diagnosed with idiopathic PD who underwent neuropsychological evaluation pre- and approximately 1-year-post bilateral STN-DBS. STN midpoint was calculated by averaging anterior and posterior poles in each individual's MRI, and coordinates were defined in anterior, lateral, and dorsal directions. Three linear regressions (one per axis) were conducted to identify significant predictors of phonemic fluency change. Each regression involved two steps, with the first block including baseline age, education, handedness, sex, and baseline disease duration, and the second block including the left-sided lead location variables by axis.

**Results.** Neither the X-axis (medial/lateral) nor the Z-axis (ventral/dorsal) models were statistically significant ( $p$ 's > 0.05). However, the final regression model including Y-axis (anterior/posterior) was significant ( $R^2=0.168$ ,  $F(1,47)=5.626$ ,  $p=0.022$ ), such that anterior lead locations within the STN predicted significantly greater decline in phonemic fluency (Unst. B =  $-11.241 \pm 4.739$ ). Demographic and disease variables were not significant predictors of phonemic fluency change in any model.

**Conclusions.** Results suggest that DBS activation of the anterior subdivision of the STN may make a particular contribution to VF decline. This relationship may be mediated by a disruption of frontal projections, which have been associated with phonemic fluency decline and other executive dysfunction. Implications for surgical targeting support the convention of favoring the posterior (“motor”) subdivision of the STN.

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**Keywords:** Parkinson's disease, deep brain stimulation, fluency

**D. KRUMP, S. ROGERS. Clarifying the Impact of Anxiety on Processing Speed in PD: The Role of Modality and Accuracy.**

Contemporary research indicates a negative association between anxiety and cognitive performance in patients who suffer from Parkinson's disease (PD). While patients who report higher levels of anxiety score lower in overall reaction time, there is lack of clarity about whether or not anxiety has an equally deleterious impact on visual versus verbal processing

speed, as well as cognitive accuracy. The present study aims to clarify how anxiety may differentially impact modality of processing speed (verbal versus visual information) and cognitive accuracy among adults with PD.

A total of 141 patients (31% women,  $M$  age = 74.19,  $M$  education = 15.42) diagnosed with PD participated in neuropsychological assessment. State anxiety was evaluated via the BAI, and processing speed measures included WAIS-IV Coding, DKEFS Color Naming and Word Reading, and Trailmaking A.

Those with clinically significant levels of anxiety (mild - severe) had slower speeds on the set of processing speed measures than those without clinical anxiety, Wilks  $\lambda = .88, p < .02$ . When divided into modalities, those with clinical levels of anxiety had worse processing speed on the set of visual measures, Wilks  $\lambda = .90, p < .01$ , but not the set of language measures. At the level of individual subtests, those with any significant level of anxiety had slower speed on WAIS-IV Coding, Trails A, & DKEFS Color Naming, than those with no significant levels of anxiety, all  $ps < .02$ , even when age was controlled via hierarchical regression analyses,  $ps < .03$ . MANOVAs showed no overt differences in errors committed between degrees of anxiety. However, when uncorrected and corrected errors were separated, those with clinically significant anxiety committed more uncorrected errors, Wilks  $\lambda = .95, p < .05$ , but not corrected errors, than those without clinical anxiety.

Clinical anxiety appears to have a differential impact on verbal versus visual processing speed, as well as type of error commission, in patients with PD. Those with clinical levels of anxiety showed worse processing speed on visual measures (e.g., graphomotor and visual scanning speed), but not language measures, suggesting the possibility of anxiety's predilection to adversely impact the right hemisphere. While there was no overt impact of anxiety on overall errors committed, those with significant levels of anxiety committed more uncorrected errors than those without clinical anxiety. This may be related to abnormal control monitoring and error detection. These findings aid in differentiating the precise impact of anxiety on cognition in PD, as well as guiding customization of both cognitive and pharmacological interventions for patients suffering from anxiety.

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**Keywords:** anxiety, information processing speed, Parkinson's disease

**R. LEA, C. ADLER, T. BEACH, C. BELDEN, N. ZHANG, H. SHILL, E. DRIVER-DUNCKLEY, S. MEHTA, J. BENGE. Convergent and Ecological Validity of the Uniform Data Set-3.0 Neuropsychological Battery in a Parkinson's Disease Sample.**

**Objective:** Converging lines of evidence suggests that multiple and overlapping pathological processes frequently underpin the cognitive manifestations of neurodegenerative disorders. Given this overlap, it is important to utilize shared instruments and measures when attempting to conduct research on the cognitive manifestations of these diseases. To this end, the Uniform Data Set 3.0 (UDS 3) neuropsychological battery is well developed for research with Alzheimer's disease and related dementias. However, the battery has to date not been validated in persons with Parkinson's disease, which is the second most common neurodegenerative disorder. The current research examined the convergent validity and the ecological validity of the UDS 3 in participants in the Arizona Study of Aging and Neurodegenerative Disorders (AZSAND).

**Participants and Methods:** Data from 72 individuals diagnosed with Parkinson's disease characterized as having normal cognitive functioning ( $n=45$ ), mild cognitive impairment ( $n=16$ ),

and Parkinson's disease dementia (n=11) were analyzed. Pearson's correlations were used to evaluate the relationship between scores on the UDS 3 and other cognitive measures (Rey Auditory Verbal Learning Test, Stroop test, Clock drawing test), a caregiver rating of activities of daily living (Functional Assessment Questionnaire), and a clinician rating of dementia severity (Clinical Dementia Rating total score).

**Results:** Convergent validity was demonstrated when comparing the UDS 3 to gold standard neuropsychological tests of memory and executive functioning. Correlation values were statistically significant and within the expected direction within domains (i.e. UDS 3 Craft story and Benson figure recall measures correlated .45-.58 with demographically corrected scores from the Rey). Ecological validity was also demonstrated when comparing UDS performance to caregiver ratings of daily living difficulties, with correlations statistically significant and in the expected direction particularly for figure recall ( $r=-.44, p<.01$ ) and the Trail making test ( $r=-.44, p<.01$ ).

**Conclusions:** Findings provide initial support for the convergent and ecological validity of the UDS 3 neuropsychological battery in individuals with Parkinson's disease. Future studies should examine the relationship of UDS 3 scores with Parkinson's disease biomarkers and continue to explore its diagnostic utility in individuals with Parkinson's disease.

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**Keywords:** Parkinson's disease, assessment

### **N. WHITELEY, A. PETKUS, E. ALMKLOV, T. MCMANN, S. LESSIG, I. LITVAN, J. V. FILOTEO, D. M. SCHIEHSER. Is Fatigue Dissociable from Apathy in Parkinson's Disease?**

**Objective:** Fatigue and apathy are prominent and debilitating non-motor symptoms in Parkinson's disease (PD). Both are considered amotivational conditions with common neurobiological origins. While some research suggests that fatigue and apathy are potentially distinguishable in PD, others have found significant associations and overlap between the two. Determining if the two constructs are distinct may help healthcare professionals as they consider appropriate screening and treatment options for each. The current study sought to examine the factor structure of apathy and fatigue in persons with PD.

**Participants and Methods:** A total of 127 persons with PD without dementia completed the Fatigue Severity Scale (FSS), a unidimensional 9-item measure of fatigue severity and the 14-item Starkstein Apathy Scale (AS). Prior research suggests that AS measures two constructs: motivation-interest-energy (cognitive-behavioral symptoms) and indifference (emotional symptoms). A series of structural equation models (SEM) were constructed to examine the factor structure of the FSS and AS. The first model assessed items from the FSS and the AS as one single latent variable. The second model consisted of a 2-factor model (fatigue and apathy as separate latent factors). The third model consisted of three factors, fatigue and the two apathy subscales (1) motivation-interest-energy and 2) indifference), as latent factors. We hypothesized that the first model (one-factor model consisting of both apathy and fatigue) would be a poorer fitting model compared to models estimating separate apathy and fatigue factors. We also hypothesized that the third model (including the two apathy factors) would improve the model fit, confirming that apathy consists of two unique constructs rather than one.

**Results:** A total of 50 (39.4%) persons with PD reported clinically significant symptoms of apathy, while the entire sample of 127 (100%) participants endorsed clinically significant fatigue

on the FSS. The first CFA model did not demonstrate acceptable fit, while the second and third models did (RMSEA <.05). The three factor model which included fatigue and the two apathy factors (motivation-interest-energy and indifference) exhibited acceptable fit and was significantly better than the respective two factor and one factor models ( $p < .01$ ). We also ran an exploratory model in which we constrained the covariance between fatigue and both apathy scales. With this model, fatigue demonstrated a tendency ( $p = .068$ ) to be more related to motivation-interest-energy ( $r = .46$ ) than indifference ( $r = .32$ ).

**Conclusions:** Our findings demonstrate that fatigue and apathy, as measured by the AS and FSS, are dissociable constructs within PD. Of our three models, the 3-factor model (FSS total and two AS dimensions) provided the best fit. This confirms previous work that apathy is not a singular construct but is rather comprised of cognitive-behavioral and emotional symptoms. Finally, our results indicate that fatigue, as measured by the unidimensional FSS, has a tendency to be more similar to the cognitive-behavior symptoms of apathy than the emotional symptoms. These findings highlight the need for clinicians and researchers to separately conceptualize and assess for fatigue and apathy in PD patients, as doing so may better inform treatment and care-related decisions.

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**Keywords:** Parkinson's disease, fatigue, apathy

### **E. F. HOWARD, M. GROSSMAN, D. J. IRWIN, K. A. COUSINS. Frontal Lobe-Mediated Executive Dysfunction Relates to Complex Numbers Impairment in Progressive Supranuclear Palsy.**

**Objective:** Number abilities are needed in many daily activities but are easily compromised due in part to their multifactorial structure, including a basic spatial component thought to contribute to magnitude and an executive component that may play a role in the combinatorial aspect of numerical calculations. Progressive supranuclear palsy (PSP), corticobasal syndrome (CBS), and Lewy body spectrum disorders (LBSD) are parkinsonian movement disorders that are accompanied by cognitive deficits. While research has shown impaired number ability in CBS and relatively preserved number ability in LBSD, differences in numbers performance across parkinsonian phenotypes are not well understood. Regional brain atrophy may contribute in part to differences, as basic numerosity and judgment of perceptually templated dot configurations have been linked to parietal lobe activity, while more complex number abilities (e.g. arithmetic calculations and judgments of randomly-arrayed dots) may demand more cognitive resources and thus rely on an additional executive component mediated by the frontal lobe. Here, we aimed to assess if executive functioning, compared with parietal lobe mediated spatial-magnitude processing, may help explain complex number deficits in parkinsonian movement disorders.

**Participants and Methods:** We selected 55 patients (CBS=11; PSP=15; LBSD=29) based on available neuropsychological and numbers data. Patients with evidence of Alzheimer's disease (AD) co-pathology, as determined by autopsy or CSF biomarkers ( $A\beta_{42} < 192$ ) when available, were excluded due to known interactions of AD pathology with cognitive impairment in these phenotypes. Numbers performance was assessed using a comprehensive battery including Dots-to-Numbers and Numbers-to-Dots matching tasks and Addition/Subtraction tasks. Each task was divided into 'Basic' (templated dot arrays; single-digit arithmetic) and 'Complex' (randomly-distributed dot arrays; double-digit arithmetic) subsections; individual task scores were combined to derive a total 'Basic' and a total 'Complex' score. Since data were not normally distributed,

Kruskal-Wallis  $H$  and Mann-Whitney  $U$  tests performed between-group comparisons on numbers performance, and executive (Letter Fluency=LF) and spatial (Judgment of Line Orientation=JOLO) measures across clinical phenotypes. Spearman correlations related numbers performance to LF and JOLO.

**Results:** Numbers performance showed Complex score differences across phenotypes ( $H(2)=5.93, p=0.05$ ), although we found similar Basic scores ( $p>0.1$ ). Specifically, PSP (mean=24.9) had a worse Complex score than LBSD (mean=27.1,  $W=123, p=0.01$ ), while CBS (mean=26.3) did not differ from PSP or LBSD (both  $p>0.1$ ). Results also showed LF differed across phenotypes ( $H(2)=22.10, p<0.0001$ ), with PSP ( $n=13$ ; mean=20.1,  $W=19, p<0.00001$ ) and CBS ( $n=11$ ; mean=29.6,  $W=80, p=0.02$ ) both performing worse than both LBSD ( $n=28$ ; mean=42.8). In contrast, all phenotypes performed similarly on JOLO ( $p>0.1$ ). Across the entire cohort, Complex score was correlated with LF ( $\rho=0.34, p=0.01$ ) but not JOLO ( $p>0.1$ ). Basic score did not correlate with either LF or JOLO (both  $p>0.1$ ).

**Conclusions:** Among patients with atypical parkinsonian movement disorders, these findings suggest that PSP patients may have significant difficulty on complex number processing, and this deficit may be related in part to executive impairment. Further, these data emphasize the importance of an executive component, rather than solely a spatial component, in complex number abilities, thus highlighting the multidimensional nature of numerical processing.

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**Keywords:** executive functions, movement disorders, cognitive processing

### **B. M. SCOTT, R. S. EISINGER, T. AUSTIN, A. GUNDUZ, D. BOWERS. Cognitive effort-based decision-making in Parkinson patients with motivational disorders.**

**Objective:** Apathy and impulse control disorders (ICDs) are motivational disturbances associated with aberrant reward processing and frequently observed in patients with Parkinson disease (PD). We recently developed a cognitive variation of the Effort Expenditure for Rewards Task (EEfRT) as an objective behavioral measure for dissociating components of reward processing in PD patients while avoiding motor dysfunction as a potential confound. The EEfRT is a multi-trial game in which participants can expend varying degrees of effort to obtain rewards of varying probability. In the present study, we used our modification of the EEfRT to examine (1) the relationship between effort expenditure and self-report measures of psychopathology and (2) the relative clinical utility of these indices for identifying motivational disorders in PD patients.

**Participants and Methods:** 80 non-demented patients (ages 45-83) with mild to moderate idiopathic PD completed the experimental task and motivation questionnaires (AS, QUIP-RS, TEPS and UPPS-P). Patients were psychometrically classified based on motivational status as follows: 15% apathy, 24% ICD, 13% both and 48% neither.

**Results:** A repeated measures ANOVA revealed a significant main effect ( $p < 0.001$ ) and interaction ( $p = 0.004$ ) of probability and reward magnitude for the frequency of hard task selections, with patients expending greater effort for larger rewards on high probability trials. After modeling a series of generalized estimating equations, we found that greater negative urgency and premeditation, along with lower anticipatory anhedonia and positive urgency, significantly predicted increased likelihood of selecting the hard task. Consummatory anhedonia, sensation seeking, and a lack of perseveration were unrelated to effort expenditure. In hierarchical logistic regression analyses, (1) impulsogenic traits (lack of perseverance,

positive and negative urgency) and the frequency of hard task selections in the low probability condition significantly predicted apathy status with 88.2% accuracy ( $-2LL = 31.5$ ,  $p = 0.002$ ,  $R^2 = 0.448$ ), while (2) age, negative urgency and the frequency of hard task selections under chance and high probability conditions significantly predicted ICD status with 82.4% accuracy ( $-2LL = 42.0$ ,  $p = 0.04$ ,  $R^2 = 0.343$ ). In both analyses, the addition of behavioral indices from the experimental task significantly improved prediction accuracy over and above age, levodopa equivalent daily dose and self-report measures (Apathy:  $p = 0.003$ ; ICD:  $p = 0.03$ ).

**Conclusions:** Results suggest that anticipatory anhedonia and impulsogenic traits are important predictors of cognitive effort-based decision-making and that our cognitive variation of the EEfRT may be a useful tool for identifying and quantifying motivational disturbances in patients with Parkinson disease. Findings from this study also build upon our prior work demonstrating the common co-occurrence of apathy and ICDs in PD patients by showing that both of these motivational disorders are associated with increased negative urgency while a lack of perseverance and reduced negative urgency appear to play a role in apathy but not ICDs. Altogether, results of the current study may improve our understanding of constituent motivational processes in Parkinson disease and facilitate the development of clinical trials aimed at treating these motivational disorders and other neuropsychiatric conditions with similar motivational disturbances.

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**Keywords:** Parkinson's disease, motivation, decision-making

### **A. VANDEBUNTE, S. ROGERS. Punctuality as a Predictor of Poor Attention and Processing Speed in Parkinson's Disease.**

**Objective:** Not only do individuals with Parkinson's disease (PD) suffer from worsened motor/movement functions, but they also experience changes in various aspects of cognitive functioning. Among these changes are slowed thinking and increased attentional difficulties. Some ecological behaviors, like whether an individual can attend scheduled appointments on time, are heavily reliant on both of these cognitive functions (processing speed and attention) and may therefore serve as indicators of worsened skills in these functions. This study aimed to explore whether patient punctuality can serve as a predictor of attention and processing speed in PD.

**Participants and Method:** A total of 141 (44 women;  $M$  age = 74;  $M$  education = 15 years) patients with PD completed a comprehensive battery of neuropsychological tests. The attention and processing speed measures administered included WAIS-IV Digit Span and Coding, DKEFS Color Naming and Word Reading, and Trailmaking A.

**Results:** Independent samples  $t$ -test analyses revealed that those who arrived late to their testing appointments performed significantly worse on Trails A,  $t(130) = 3.32$ ,  $p < .01$ , and DKEFS Word Reading,  $t(127) = 2.31$ ,  $p < .03$ , with trends toward worse Digit Span ( $p = .07$ ) and DKEFS Color Naming ( $p = .06$ ), relative to those who arrived on time. When accompaniment by others was controlled via ANCOVA procedures, WAIS-IV Digit Span,  $F(1, 133) = 3.98$ ,  $p < .05$ , Trailmaking A,  $F(1, 129) = 11.01$ ,  $p < .01$ , DKEFS Word Reading  $F(1, 124) = 4.42$ ,  $p < .04$ , and DKEFS Color Naming  $F(1, 126) = 6.12$ ,  $p < .02$ , were all weaker among those who were late.  $T$ -test analyses showed no age- or education-related differences in punctuality, and chi-square analyses revealed no differences in punctuality by gender.

**Conclusions:** These findings suggest that patient punctuality is a predictor of the attentional and processing speed abilities of patients with Parkinson's disease. When controlling for accompaniment by others, individuals who arrived late to their testing appointments exhibited worse simple attention, visual scanning speed, and language processing speed. This suggests that punctuality may be an ecological indicator of worsened attention and processing speed among those with PD, just as weaker abilities in these areas likely contribute to worse punctuality. These findings illuminate a critical relationship between cognition and behavior in PD and may also be useful when clinicians are unable to complete comprehensive neuropsychological testing. Correspondence: *Anna Vandebunte, Palo Alto University, Holland, Michigan, 49423, United States. Email: avandebunte@paloalto.edu*

**Keywords:** aging disorders, Parkinson's disease, cognitive functioning

### **A. VANDEBUNTE, S. ROGERS, R. C. REYNOLDS. Do Sleep Problems Worsen the Cognitive Symptoms of Parkinson's Disease?**

**Objective:** Sleep problems and overt sleep disorders are frequently comorbid with Parkinson's disease (PD). Previous research suggests a link between worsened motor/movement symptoms and sleep disturbances, but little research has examined if cognition varies for those with PD who also experience sleep complications. The present study seeks to determine the impact of sleep problems, including REM sleep behavior disorder, on the cognitive functioning of those with PD.

**Participants and Method:** A total of 141 patients (44 women,  $M$  age = 74.19) diagnosed with PD participated in neuropsychological assessment. They completed a questionnaire and clinical interview assessing sleep disorders, as well as subtests of the WAIS-IV, WMS-IV, DKEFS, COWAT FAS and Animals, BNT, Trailmaking A and B, ROCF, HVLT-R, and BVMT-R.

**Results:** Sleep problems were endorsed by 41% of participants. Those with sleep problems performed significantly worse on WAIS-IV Digit Span, WAIS-IV Arithmetic, and ROCF 3' & 30', all  $t_s > 2.15$ ,  $p_s < .04$ , than those without sleep problems. There was also a trend for significantly worse scores on Trails B, HVLT-R Trials 1-5, and BVMT-R Trials 1-3 for those who endorsed sleep complications. When particular types of sleep disorders were examined, those who had REM sleep behavior disorder (RBD) symptomatology demonstrated weaker scores on ROCF Copy and 30', all  $t_s > 1.95$ ,  $p_s < .05$ , than those without this symptomatology.

**Conclusions:** These findings suggest that sleep problems may adversely influence the cognitive abilities of those with PD. Patients who endorsed problems with sleep demonstrated significantly worse working memory, simple attention, and nonverbal learning and memory for complex information, with a trend for weaker divided attention and both verbal and nonverbal learning, compared to those without sleep complications. REM sleep behavior disorder (RBD) in particular seems to negatively impact the visual construction and delayed visual memory of those with PD. These findings suggest that sleep complications not only exacerbate, but also expand, some of the cognitive deficits typically seen in PD. They also intimate the importance of examining subtypes of PD and alleviating cognitive burden through sleep treatment.

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**Keywords:** Parkinson's disease, sleep, cognitive functioning

**M. N. VANNINI, K. A. HOLIDAY, N. WHITELEY, V. FILOTEO, D. M. SCHIEHSER. Sensitivity to Punishment and Reward in Non-Demented Individuals with Parkinson's Disease.**

**Objective:** Sensitivity to reward (SR) and punishment (SP) are important personality characteristics that could play a role in response to behavioral interventions for mood and motor symptoms. As behavioral interventions are often implemented in Parkinson's Disease (PD), understanding SP and SR in PD could improve treatment efficacy. Recent literature has shown that patients with PD often report higher SP when compared with healthy older adults (HA); however, PD patients do not differ from HA in SR. While higher SP has been found in individuals with anxiety, apathy, and depression, prior studies have failed to control for these symptoms when assessing SP or SR in PD. Given that depression, anxiety, and apathy are common in PD, this study sought to determine potential effects of PD status on SP and SR while controlling for mood symptoms. We hypothesized that after controlling for mood, PD patients would report higher SP than HA, and that SR will be the same for both groups.

**Participants and Methods:** Participants included 102 non-demented individuals with PD and 65 HA, who did not significantly differ on age, race, sex, or education level. All participants completed the two subscales (SR and SP) of the Sensitivity to Punishment and Reward Questionnaire (SPSRQ), the Starkstein Apathy Scale, the Self Evaluation Questionnaire (STAI-TRAIT) and the Hamilton Depression Rating Scale (HAM-D). Six one-way analyses of covariance (ANCOVAs) were conducted to evaluate group differences on SP and SR, while controlling for depression, trait anxiety, apathy (independently) and demographics (age, sex, education level).

**Results:** Controlling for depression ( $p < .001$ ) alone, results revealed a significant group difference in SP such that individuals with PD reported higher SP scores than did HA ( $p = 0.01$ ), while groups did not significantly differ in SR ( $p = 0.50$ ). Similarly, when controlling for apathy ( $p = .08$ ) alone, results showed a significant group difference in SP, in which PD patients reported higher SP than did HA ( $p = 0.03$ ), with no significant difference in SR ( $p = 0.62$ ). However, controlling for anxiety ( $p < .001$ ) revealed no significant group differences in either SP ( $p = 0.53$ ) or SR ( $p = 0.15$ ).

**Conclusions:** Consistent with previous literature, individuals with PD reported higher SP (e.g., verbalizing disappointment) and comparable levels of SR (e.g., praising positive actions) compared to HA, even after accounting for depression and apathy symptoms. However, when anxiety was taken into account, the group differences were no longer significant. These findings demonstrate that increased trait anxiety, not PD status, accounts for higher SP. This is consistent with Gray's personality theory that considers SP a dimension of the Behavioral Inhibition System, which is implicated in anxiety (Gray, 1970). These results suggest that it is critical to consider anxiety in PD, particularly when assessing personality characteristics. While SP appears to be more relevant than SR in PD, consideration and remediation of trait anxiety is indicated to be paramount.

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**Keywords:** personality, Parkinson's disease

**R. I. KAPLAN, J. WALL, C. PLUIM, A. CRONIN-GOLOMB. Discordance Between Reports of Symptoms in Persons with Parkinson's Disease and Informants in an Online Survey Sample.**

**Objective:** Parkinson's disease (PD) is a neurodegenerative disorder that affects multiple subcortical and cortical brain areas and neurotransmitter systems, resulting in a variety of motor symptoms (e.g., tremor, rigidity, slow movement, problems with gait and posture) and non-motor symptoms (e.g., anxiety, depression, apathy, compromised cognition, perceptions of stigma). Informants such as care partners are important sources of information in the assessment of symptoms in persons with PD (PwPD) especially with more severe disease. It is not known, however, as to whether informants and PwPD agree on the presence or severity of symptoms, raising questions about the reliability of report. Using the Boston University Online Survey Study of Parkinson's Disease (BOSS-PD), we examined the concordance between ratings of motor and non-motor symptoms by PwPD and their informants.

**Participants and Methods:** Sixty PwPD-informant pairs completed self- and proxy-versions of the Parkinson's Disease Questionnaire-39 (PDQ, standard measure of quality of life), Quality of Life in Neurological Disorders (NeuroQoL), Parkinson's Anxiety Scale (PAS), Non-Motor Symptom Questionnaire (NMSQ), Unified Parkinson's Disease Rating Scale (Part I: non-motor experiences of daily living, UPDRS<sub>nm</sub>; Part II: motor experiences of daily living, UPDRS<sub>m</sub>), Beck Depression Inventory-II, Starkstein Apathy Scale (AS), Beck Anxiety Inventory, Stigma Scale for Chronic Illness, Stigmatization Scale, and Consumer Experiences of Stigma Questionnaire (CESQ). Paired samples t-tests were performed to examine differences between PwPD and informants on total scores and subscale scores when applicable. Difference scores were calculated by subtracting informant scores from PwPD scores. Multiple regression analyses were then performed to determine which demographic and/or PD clinical variables predicted discordance. PwPD-reported UPDRS<sub>m</sub> was used as an index of disease severity in the regression analyses.

**Results:** PwPD, relative to their informants' reports, endorsed more stigma perception (PDQ-Stigma subscale,  $p < .001$ ), bodily discomfort (PDQ-Bodily Discomfort subscale,  $p < .05$ ), avoidance related to anxiety (PAS-Avoidance subscale,  $p < .05$ ), motor symptoms (UPDRS<sub>m</sub>,  $p < .05$ ), and non-motor symptoms (NMSQ-Total,  $p < .01$ ; and UPDRS<sub>nm</sub>,  $p < .05$ ). Informants, relative to PwPD, reported more apathy (AS,  $p < .05$ ) and discrimination related to stigma (CESQ-Discrimination;  $p < .01$ ). The multiple regression analyses showed that PwPD-reported UPDRS<sub>m</sub> was a significant predictor of discordance for PDQ-Stigma ( $p < .01$ ) and PAS-Avoidance ( $p < .05$ ), in that more motor symptoms predicted more discordance on these measures. The number of years the PwPD and informant knew each other was also a significant predictor of discordance on PAS-Avoidance ( $p < .05$ ), where longer PwPD-Informant relationship predicted more discordance.

**Conclusions:** There were many measures on which PwPD and informants were concordant, indicating the reliability of report in general. Most of the areas of discordance (PDQ-Stigma, PDQ-Bodily Discomfort, NMSQ-Total, PAS-Avoidance, AS, and UPDRS<sub>nm</sub>) represented internalized symptoms. It may be difficult for informants to report symptoms that are experienced internally by PwPD. It may also be that PwPD are more forthcoming over an anonymous online survey than in person, which could account for some of the PwPD-informant differences in reporting internalized symptoms. Disease severity and length of PwPD-informant relationship were meaningful predictors of discordance of internalized symptoms. The results suggest the importance of enhancing care partner awareness of hidden as well as obvious symptoms of PD.

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**Keywords:** Parkinson's disease, everyday functioning, self-report

**S. B. KINGER, A. MCLARIN, J. MORAN, J. T. FOX-FULLER, M. GORDILLO, K. LONG, A. CRONIN-GOLOMB. We Hope You're Listening: A Qualitative Study Identifying Types of Advice Given by Individuals with Parkinson's Disease.**

**Objective:** Persons with Parkinson's disease (PwPD) experience multiple motor and non-motor symptoms arising from neuropathology affecting subcortical and cortical brain areas. The diagnosis is life-changing and is associated with challenges in managing current symptoms and anxiety regarding the unpredictable future course of the disease. The impact of having PD has largely been measured using quantitative methods, and has focused on measuring and categorizing symptoms. Qualitative approaches that give voice to individuals and value their perspectives and recommendations based on their lived experience with PD have been underrepresented in the literature. The purpose of the present qualitative study was to identify the types of advice offered by PwPD to newly diagnosed individuals, their care partners, and medical professionals.

**Participants and Methods:** 347 PwPD (180 women, 165 men, 2 unreported) were recruited through Fox Trial Finder and other sources for the Boston University Online Survey Study of Parkinson's Disease (BOSS-PD), a study of daily function and quality of life in PwPD. Of the total sample, 275 (146 women, 128 men, 1 unreported) responded to three free-response questions regarding advice to those newly diagnosed with PD, their care partners, and medical professionals. Thematic analysis was used to analyze responses to the probe questions, and data were organized using NVivo 12 software. Interrater reliability was continuously assessed among the five coders and served as a guide for evaluating the strength of the coding structure.

**Results:** Interrater reliability for all the coded responses was 94.5%. The different types of advice offered by PwPD fell under seven broad categories: (i) physical/health-related advice (e.g., engaging in, encouraging and prescribing exercise), (ii) medical advice (e.g., finding a good movement disorders specialist, seeking treatment from multidisciplinary teams), (iii) education-related advice (e.g., learning about PD by reading, websites, and support groups; providing information about PD in layman's terms), (iv) advocacy-related advice (e.g., raising awareness about PD, being proactive in treatment choices), (v) research-related advice (e.g., joining a clinical trial, engaging in research), (vi) general planning advice (e.g., planning finances for the future, being mindful about treatment costs), and (vii) psychosocial advice (e.g., engaging in hobbies, respecting the autonomy of PwPD, acknowledging PwPD and being empathetic). The most frequent types of advice given by PwPD included education-related advice and psychosocial advice, with a particular focus on how medical professionals often fail to acknowledge the variety of challenges faced by PwPD and to support them with empathy and education.

**Conclusions:** The types of advice given by PwPD highlight current gaps in meeting their various needs, and provide recommendations to improve care based on their lived experiences. In particular, the need to obtain more information about PD, and in non-expert terms, seems pronounced, along with the need for better communication so that PwPD feel acknowledged and heard by care partners, family and friends, and their healthcare team. These findings indicate areas for improvement in personal relationships and healthcare settings. Listening to and acting on the advice provided by PwPD may significantly improve their quality of care and quality of life.

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**Keywords:** Parkinson's disease, quality of life, movement disorders

**L. G. POOLE, S. B. KINGER, A. CRONIN-GOLOMB, S. NEARGARDER. Exercise Engagement in Relation to Motor Symptoms and Quality of Life in Parkinson's Disease.**

**Objective:** Persons with Parkinson's disease (PwPD), a disorder affecting multiple subcortical and cortical brain areas, commonly experience motor symptoms and compromised quality of life (QoL). Whereas exercise engagement is known to attenuate motor symptoms and improve QoL in PD, whether these factors predict exercise behavior is unknown. We investigated relations between self-reported exercise, motor symptoms, and QoL, hypothesizing that experiencing better QoL, less severe and less unpleasant motor symptoms, and less frequent motor-related limitations would predict exercise engagement.

**Participants and Methods:** We administered the Boston University Online Survey Study (BOSS-PD) to 347 individuals (180 women, 165 men, 2 unreported) recruited through PD-interest websites. Measures included the Parkinson's Disease Questionnaire (PDQ-39), Quality of Life in Neurological Disorders scales (NeuroQoL), Stigma Scale for Chronic Illnesses (SSCI), Unified Parkinson's Disease Rating Scale Part II: Motor Experiences of Daily Living (UPDRS<sub>m</sub>), and questions about motor symptom unpleasantness (BOSS-PD<sub>motor</sub>), how often one experienced motor-related symptoms that limited activities of daily living (BOSS-PD<sub>ADL</sub>), and exercise behavior. Respondents were grouped by exercise endorsement (yes/no). These subgroups were matched by age and education level (n=274, 146 women, 128 men). Two-tailed independent t-tests assessed differences between exercisers (202) and non-exercisers (72). Point-biserial correlations were used to examine the associations between exercise engagement, and QoL and motor symptoms separately. Binary logistic regressions assessed the predictive nature of the significant correlates on exercise engagement.

**Results:** Compared to PwPD who did not exercise, those who exercised experienced significantly better QoL (PDQ-39, SSCI, and NeuroQoL), less severe (UPDRS<sub>m</sub>) and less unpleasant (BOSS-PD<sub>motor</sub>) motor symptoms, and less frequent motor-related limitations (BOSS-PD<sub>ADL</sub>) (all p's<.001). Exercise engagement correlated with better scores (all r's=-.17 to -.30, all p's<.006). PDQ-39, NeuroQoL, and SSCI scores were entered into a logistic regression to assess the predictive nature of QoL factors and were found to account for 14% of variance in exercise endorsement. PDQ-39 total score was the only significant predictor of exercise endorsement in this block (Exp[B]=.976, p=.018). A post-hoc analysis was conducted to determine whether one or more PDQ-39 subscale scores were significant predictors of exercise endorsement. The mobility subscale was the only significant predictor (Exp[B]=.958, p=.048). In a separate block, UPDRS<sub>m</sub>, BOSS-PD<sub>motor</sub>, and BOSS-PD<sub>ADL</sub> were entered into a logistic regression to assess the predictive nature of motor limitations and were found to account for 9% of variance in exercise endorsement. No individual scores were significant predictors.

**Conclusions:** Compared to non-exercisers, PwPD who endorsed exercising experienced better QoL, less severe and less unpleasant motor symptoms, and less frequent motor-related activity of daily living limitations. Logistic regressions indicated that less frequent QoL issues, especially related to mobility, and better motor function predicted exercise engagement. Because experiencing QoL and motor issues affects exercise engagement in PD, it may be important for healthcare professionals to identify and address sources of motor and QoL issues, specifically

those related to mobility, in PwPD before prescribing exercise in order to enhance adherence, which in turn would reduce motor symptoms and improve QoL.

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**Keywords:** Parkinson's disease, movement disorders, quality of life

**S. B. KINGER, L. G. POOLE, S. NEARGARDER, A. CRONIN-GOLOMB. The Relation Between Exercise and Non-Motor Symptoms in Parkinson's Disease.**

**Objective:** In addition to motor symptoms, persons with Parkinson's disease (PwPD) commonly experience non-motor symptoms (NMS) arising from pathology in subcortical and cortical brain areas. Physical exercise is known to attenuate motor symptoms in PwPD, but its relation to NMS is less well understood. We investigated relations between self-reported exercise and NMS such as depression, anxiety, and fatigue in PwPD, hypothesizing that exercisers would experience fewer and less severe NMS. We also examined determinants of exercise behavior, with a particular interest in which NMS predicted exercise engagement.

**Participants and Methods:** Participants with PD (347; 180 women, 165 men, 2 unreported) responded to the Boston University Online Survey Study (BOSS-PD). This sample was grouped by exercise engagement (yes/no), with exercisers (202) and non-exercisers (72) matched for age and education (146 women, 128 men). The measures administered were the Non-Motor Symptoms Questionnaire (NMSQ), the Beck Depression Inventory-II, the Parkinson's Anxiety Scale, the Unified Parkinson's Disease Rating Scale Part I section on Non-Motor Experiences of Daily Living (UPDRS<sub>nm</sub>), the Quality of Life in Neurological Disorders (Neuro-QoL) fatigue subscale, and questions about exercise habits. Two-tailed independent sample t-tests compared NMS scores between exercisers and non-exercisers. Point-biserial correlations were used to examine the associations between exercise engagement and NMS. Variables that significantly correlated with exercise engagement were then entered into a binary logistic regression in order to identify which non-motor symptoms predicted exercise engagement.

**Results:** PwPD who exercised had fewer and less frequent symptoms on the NMSQ, less severe symptoms on the UPDRS<sub>nm</sub>, and lower depression, anxiety and fatigue scores (all  $p's \leq .002$ ). All assessment scores significantly and negatively correlated with exercise engagement (all  $r's = -.18$  to  $-.30$ , all  $p's \leq .002$ ). NMS assessment scores were entered into the regression model and were found to account for 15.7% of variance in exercise engagement. Fatigue alone was a significant predictor of exercise engagement ( $p = .03$ ).

**Conclusions:** NMS were fewer and less frequent, and depression, anxiety, and fatigue less severe, in PwPD who exercised relative to non-exercisers. In the regression analysis, fatigue was the only non-motor symptom predictor of exercise engagement. This can have important implications for medical professionals, as fatigue as a symptom would need to be identified and addressed if PwPD are expected to engage in exercise as part of their treatment plan to reduce both motor and non-motor symptoms.

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**Keywords:** Parkinson's disease, fatigue, depression

**J. WALL, L. N. RAMDAS, S. B. KINGER, A. CRONIN-GOLOMB. Caregiver Perspectives on the Experience of Parkinson's Disease: A Qualitative Analysis.**

**Objective:** Parkinson's Disease (PD) is a disorder characterized by neurodegeneration of subcortical and cortical brain areas, which leads to a variety of motor and non-motor symptoms. These impairments can severely limit individuals' ability to care for themselves, prompting increasing reliance on care partner assistance. Whereas previous studies have focused on the quality of life of persons with PD (PwPD), the present project examined the experience of care partners, using responses from the Boston University Online Survey Study of Parkinson's Disease (BOSS-PD). Specifically, we queried care partners as to challenges faced and advice they would give to PwPD and those who interact with them.

**Participants and Methods:** There were 60 PwPD-informant pairs who completed BOSS-PD. Of the 60 informants (care partners), 45 responded to the five free-response questions, including challenges faced by them and by the PwPD, and advice to PwPD, care partners, and healthcare professionals. We conducted inductive qualitative analysis of the responses using NVivo-12 software. Multiple coders examined each response for significant themes and patterns. Interrater reliability was assessed, and coders met regularly to resolve coding discrepancies.

**Results:** Across all responses, interrater reliability was 93.2%. The analysis revealed several common themes, endorsed by at least one-quarter of the sample. (1) Initial reaction to diagnosis (challenges): PwPD and their care partners experienced difficulties accepting a diagnosis of PD as well as high levels of anxiety about the uncertain progression of PD and its impact on daily life. (2) Current challenges: managing motor symptoms (e.g., tremor, rigidity, and postural instability), treatment-related challenges (e.g., timing of medications), and impact on interpersonal relationships (e.g., uncertainty by the care partner about whether to treat PwPD the same as before). (3) Frequent types of advice given included health-related lifestyle advice (e.g., staying active and following a healthy diet), medical advice (e.g., find a movement disorder specialist), education advice (e.g., read as much as possible about PD), and psychosocial advice (e.g., expressing the need for more empathy from medical professionals).

**Conclusions:** The themes identified in this study shed light on the most significant challenges faced by care partners of PwPD, helpful coping strategies, and advice on lifestyle, treatment methods, and education, as well as areas for psychosocial improvement, especially regarding the need for healthcare professionals to listen and to see the whole person in front of them. Respondents emphasized the challenges posed by the symptoms of PD and the importance of exercise in controlling symptoms. Considerable attention was placed on future-oriented anxiety and interpersonal challenges and advice. Together, these findings indicate avenues for further research and for clinical application to provide support for PwPD and their care partners over what may for many be a long course of disease, and to help improve their quality of life.

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**Keywords:** Parkinson's disease, quality of life, caregiver burden

**K. K. MOLLENKOPF, L. J. BENNETT-LELEUX, A. M. SANDLIN, C. M. REED, L. M. WILLIAMS, M. A. VASQUEZ, A. N. HAYGOOD, M. D. BARNETT. Physical Activity and Motor Performance Among Older Adults with Neurocognitive Disorder.**

**Objective:** Physical activity, as measured by daily step count data, has an inverse relationship with various health outcomes, such as type 2 diabetes mellitus, cardiovascular incident risk, and all-cause mortality in older adults<sup>2</sup>. In addition, physical activity has been shown to be a protective factor against cognitive decline and is associated with greater motor ability in older adults<sup>1,3</sup>. The purpose of this preliminary study was to investigate the relationship between

physical activity and motor ability among older adults with neurocognitive disorders. We hypothesized that greater physical activity would be associated with higher motor ability.

**Participants and Methods:** Physical activity was operationalized as average daily step count data over a two-week period using Fitbit devices while motor performance was measured by the time to complete the Grooved Pegboard task in seconds (calculated as an average between dominant and nondominant hand performance)<sup>4</sup>. Participants were older adults seeking neuropsychological evaluation at an institutional clinic, operated by a southern university, who were diagnosed with major or mild neurocognitive disorders.

**Results:** Physical activity explained 59.1% of variance in motor ability. Greater physical activity was associated with higher motor performance ( $\beta = -.77, p = .043$ ).

**Conclusions:** Physical activity is associated with higher levels of fine motor skills among older adults with neurocognitive impairment. Physical activity may aid in preserving motor functioning among older adults with neurocognitive impairment.

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**Keywords:** aging disorders, motor function, motor speed

## R. OKOLICHANY, H. AARON, K. JOHNSON, K. SHEIKH, S. SKAGGS, D. DYER, H. BOOKER, K. OWEN, J. MATHIS, P. PADALA, S. MOONEY. Global Cognition and IADL Correlates of Apathy in Probable Alzheimer Dementia.

**Objective.** Prior research has demonstrated that apathy and cognitive deficits are associated with diminished ability to perform instrumental activities of daily living (IADLs) – at least in comparatively small samples of normal older adults, mild cognitive impairment, and heterogeneous dementia. Apathy is defined as diminished motivation and engagement in goal-directed activity and is a common neuropsychiatric symptom in Dementia of Alzheimer’s type (DAT). The purpose of the present study was to replicate and extend prior research examining relationships between apathy, cognitive impairment, and IADLs in a large nationally-representative homogenous probable DAT patient sample.

**Participants and Methods.** 2,744 primary English-speaking patients with apathy and probable DAT from who had been assessed with the Neuropsychiatric Inventory Questionnaire (NIQ), Mini-Mental Status Exam (MMSE), and Functional Activities Questionnaire (FAQ) were identified from the National Alzheimer’s Coordinating Center Uniform Dataset.

**Results.** Subject mean(*SD*) age and education were 74.5(9.9) and 14.6(3.2) years, respectively. Fifty-two percent female. Eighty-four percent Caucasian and 14% African American. NIQ

Apathy Severity was rated as 53% “Mild”, 35% “Moderate”, and 12% as “Severe.” Mean(*SD*) MMSE Total score was 19.2(6.8).

Reported frequency of subjects who remained independent (INDP), required assistance (RA), or judged dependent (DPND) in their ability to complete IADLs per collateral informant report were as follows: Paying bills (INDP = 18%; RA = 17%; DPND = 56%), completing taxes (INDP = 12%; RA = 15%; DPND = 61%), shopping alone (INDP = 34%; RA = 27%; DPND = 38%), playing games of skill or work on hobbies (INDP = 47%; RA = 20%; DPND = 27%), using stove (INDP = 62%; RA = 13%; DPND = 24%), preparing meals (INDP = 34%; RA = 18%; DPND = 38%), keeping track of current events (INDP = 43%; RA = 27%; DPND = 29%), paying attention and understanding information (INDP = 59%; RA = 24%; DPND = 17%), remembering appointments (INDP = 21%; RA = 35%; DPND = 44%), and traveling (INDP = 25%; RA = 20%; DPND = 55%).

NIQ Apathy Severity was negatively correlated with MMSE Total Scores ( $\rho = -.163, p < .001$ ) and modestly positively associated with all FAQ IADLs [i.e.,  $\rho$ 's were: .191 (Bills), .163 (Taxes), .204 (Shopping), .216 (Games), .210 (Stove), .216 (Meal prep), .195 (Events), .213 (Pay attention), .194 (Remembering appointments), .152 (Travel); all  $p$ 's  $< .001$ ]. Relative to NIQ Apathy Severity, MMSE Total Score was more strongly associated with FAQ IADLs status [i.e.,  $\rho$ 's were: -.482 (Bills), -.420 (Taxes), -.535 (Shopping), -.516 (Games), -.532 (Stove), -.520 (Meal prep), -.519 (Events), -.437 (Pay attention), -.512 (Remembering appointments), -.470 (Travel); all  $p$ 's  $< .001$ ].

**Conclusions.** Consistent with prior research, results demonstrate statistically significant relationships between apathy, global cognition, and IADL status in a large nationally-representative probable DAT sample. Global cognitive impairment was more strongly associated with IADL status than severity of apathy in our sample. Further development of intervention and rehabilitation efforts targeting apathy as an adjunct to cognitive enhancement may promote improved IADL status in DAT patients.

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**Keywords:** dementia - Alzheimer's disease, ecological validity, apathy

## **T. RIGBY, A. WATTS. Does Objectively Measured Physical Activity Level Predict Cognitive Function in Community Dwelling Older Adults With and Without Mild Alzheimer's Disease.**

**Objective:** A large volume of literature surmises that engagement in physical activity results in better brain health, prevention of cognitive decline, and reduced incidence of dementia. The current study investigated the relationship between objectively measured physical activity and cognitive performance in older adults with and without early Alzheimer's Dementia (AD), and considers the best measurement approaches for studying physical activity in this population.

**Participants and Methods:** This cross-sectional secondary analysis included individuals with mild AD ( $n = 39$ ) and well characterized cognitively normal older adults ( $n = 53$ ) from the University of Kansas Alzheimer's Disease Center Registry. Participants completed in-person cognitive testing in three domains (verbal memory, attention, executive function). Physical activity was measured for 7 days using Actigraph GT3X+ accelerometer worn on the dominant hip in a free-living environment. Multiple regression analysis identified the intensity and total amount of physical activity most strongly associated with better cognitive performance on the three cognitive factors.

**Results:** Total daily activity was significantly and non-linearly associated with verbal memory ( $b = -.22$ ;  $p = .001$ ) attention ( $b = -.22$ ;  $p = .02$ ), and executive function ( $b = -.16$ ;  $p = .04$ ); the non-linear relationship implies a positive association with cognition for those that had lower to moderate levels of activity and a negative association for those with higher levels of activity. Light physical activity, defined by traditional activity cut-points, did not significantly predict cognitive performance in adjusted models. Higher levels of moderate to vigorous physical activity was significantly associated with higher performance on executive function ( $b = .22$ ;  $p = .02$ ), but not verbal memory or attention. The association between moderate to vigorous physical activity and verbal memory performance significantly differed as a function of AD status ( $b = .43$ ;  $p = .03$ ). People with mild AD who engaged in more moderate to vigorous physical activity had significantly better verbal memory performance. This effect was not found in models of attention or executive function.

**Conclusions:** Total daily activity significantly predicted verbal memory, attention, and executive function in a non-linear fashion, suggesting a point of diminishing returns where more physical activity did not necessarily benefit cognition. These findings imply that physical activity interventions may see the greatest cognitive gains when focused on moving largely sedentary individuals into engaging in more daily activity, as opposed to focusing on achieving a particular physical activity intensity level. There appeared to be some benefit, to verbal memory in particular, for a portion of individuals with mild AD that engaged in more moderate to vigorous physical activity. However, some individuals with mild AD did not appear to benefit from greater levels of intensity or total physical activity. This represents a shift away from the focus on exercise intensity level to a total daily activity perspective which may be valuable in older adult populations.

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**Keywords:** mild cognitive impairment, aging (normal), cognitive functioning

### **A. ELLURU, L. D. MEDINA. Seeing Color: Examining Cognitive Profiles in Autopsy-Confirmed Alzheimer's Disease (AD) Across Ethno-Racially Diverse Groups.**

**Objective:** Current demographic projections in the United States indicate a dramatic shift towards a more diverse population. However, many diverse groups are underrepresented in Alzheimer disease and related dementia (ADRD) research despite disproportionate risk. There is a critical need to examine the relationships between culturally-related demographic and health factors with neuropsychological tests used to diagnose the clinical syndrome of ADRD. We sought to investigate profiles of cognitive deficits in autopsy-confirmed Alzheimer's disease (AD) across ethno-racially diverse groups in the National Alzheimer's Coordinating Center (NACC) cohort.

**Participants and Methods:** Baseline cognitive data from 26 Black/African American, 21 Hispanic/Latino (H/L), and 4 Asian American/Pacific Islander (AAPI) individuals with dementia and autopsy-confirmed AD were first standardized to ethno-racially matched, cognitively normal NACC samples. All participants were tested in English and most endorsed English as a primary language. Cognitive composites reflecting episodic memory, attention, executive function, and language abilities were created. Data were compared to a case-control matched sample of non-Hispanic White (NHW;  $n=85$ ) individuals with autopsy-confirmed AD controlling for age, education, and sex.

**Results:** Groups did not differ from NHW on age (at baseline or death), disease severity, or vascular pathology. Repeated measures ANCOVA with Bonferroni correction ( $p \leq 0.05/4$  domains = 0.125) revealed diverse patterns of cognitive performance. Compared to NHW, the Black/African American group performed better on all domains; the H/L group performed better on memory, attention, and executive function; and the AAPI performed better on language.

**Conclusions:** Results suggest disparate cognitive profiles in pathologically-confirmed AD among diverse groups. These differences may be associated with variable measurement error in these neuropsychological tests. Additionally, factors contributing to ADRD in ethno-racially diverse groups may differ than those in NHW individuals. While interpretation of the results is limited to small sample size, they are consistent with and build on previous findings. Further research is needed on factors influencing these discrepancies.

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**Keywords:** neuropsychological assessment, ethnicity, dementia - Alzheimer's disease

**H. AARON, R. OKOLICHANY, K. SHEIKH, K. JOHNSON, D. DYER, S. SKAGGS, K. OWEN, H. BOOKER, J. MATHIS, P. PADALA, S. MOONEY. Frequency of IADL Impairment in Probable Alzheimer's Dementia Patients Unable to Complete Trails B.**

**Objective.** The Trail Making Tests are commonly used objective performance based cognitive procedures employed during neuropsychological evaluations. Trail Making Test B (TMTB) is sensitive to brain dysfunction and has previously shown to predict driving fitness – an important Instrumental Activity of Daily Living (IADL). The purpose of the present study was to examine the base rates of impaired IADLs in a large, nationally representative homogenous probable Dementia of Alzheimer's Type (DAT) patient sample who attempted TMTB but discontinued after 300 seconds consistent with standardized administration guidelines.

**Participants and Methods.** 1,686 primary English-speaking patients with probable DAT who had been assessed with TMTB and for whom the collateral informant completed Functional Activities Questionnaire (FAQ) were identified from the National Alzheimer's Coordinating Center Uniform Dataset.

**Results.** Subject mean(*SD*) age and education were 74.3 (9.6) and 14.3 (3.3) years, respectively. Fifty-seven percent female. Eighty-two percent Caucasian and 16% African American. Mean(*SD*) MMSE Total score and Trails A seconds to complete were 20.8(4.4) and 82.3"(39.3"), respectively. All participants attempted Trails B and were discontinued after 300".

Reported frequency of subjects who required assistance (RA) or had been judged dependent (DPND) in their ability to complete IADLs per collateral informant report were as follows: Paying bills (RA = 21%; DPND = 48%), completing taxes (RA = 17%; DPND = 52%), shopping alone (RA = 29%; DPND = 26%), playing games of skill or working on hobbies (RA = 19%; DPND = 16%), using stove (RA = 11%; DPND = 13%), preparing meals (RA = 21%; DPND = 25%), keeping track of current events (RA = 27%; DPND = 18%), paying attention and understanding information (RA = 21%; DPND = 9%), remembering appointments (RA = 39%; DPND = 32%), and traveling (RA = 19%; DPND = 47%).

**Conclusions.** Consistent with prior research, results demonstrate that poor performance on TMTB in probable DAT patients was associated with high base rate of collateral informant-confirmed patient difficulties with traveling out of the neighborhood, driving, and arranging transportation (i.e., occurring in 66% of this sample). These results also highlight that when

probable DAT patients were unable to complete TMTB in less than 300 seconds, they also commonly demonstrated difficulties writing checks and paying bills on time (i.e., 69% of cases reported herein), assembling tax related paperwork (i.e., 69% of cases), shopping alone (i.e., 55% of cases), preparing balanced meal (i.e., 46% of cases), and remembering appointments and important dates/times including medication use (i.e., 71% of cases). These results support the ecological validity of TMTB by highlighting the potential functional implications when a patient is unable to complete TMTB in less than 300" and may serve to facilitate in the identification of potential targets for intervention and disposition planning.

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**Keywords:** ecological validity, activities of daily living, dementia - Alzheimer's disease

**S. HOLMQVIST, S. NGUYEN, I. H. COTA, K. R. THOMAS, E. EDMONDS, K. J. BANGEN. Intraindividual Cognitive Variability is a Marker of Early Neurodegeneration in Older Adults.**

**Objective:** Intraindividual cognitive variability (IIV) is the variability in performance across multiple measures within a single testing session. Higher IIV has been found to be associated with increased risk of cognitive decline and development of Alzheimer's disease (AD). We have previously shown that higher IIV predicts faster rates of hippocampal and entorhinal atrophy and functional decline. We sought to examine the association between IIV and neuroimaging biomarkers, including (1) cortical thickness in the medial temporal and frontal lobes and (2) white matter hypointensity volume in nondemented older adults.

**Participants and Methods:** Eighty-one nondemented older adults (mean age = 74.1 years) underwent magnetic resonance imaging (MRI) of the brain and neuropsychological assessment. Cortical thickness and volumes were quantified using FreeSurfer Version 6 in *a priori* regions of interest susceptible to AD pathology including the entorhinal cortex, hippocampus, inferior temporal cortex, inferior parietal cortex, rostral middle frontal gyrus, and medial orbitofrontal cortex. We also examined total volume of white matter hypointensities, a marker thought to reflect small vessel cerebrovascular changes. Before calculating the IIV index, individual raw scores for the following 8 measures were converted into demographically-corrected z-scores: Delis-Kaplan Executive Function Systems (D-KEFS) Verbal Fluency, Multilingual Naming Test (MiNT), construction subtest of the Dementia Rating Scale-2 (DRS-2), California Verbal Learning Test, Second Edition (CVLT-II), the Logical Memory subtest of Wechsler Memory Scale-Revised (WMS-R), and Trail Making Test (TMT), Parts A and B. The TMT z-scores were multiplied by -1 so higher z-scores reflected better performance for all scores. The intraindividual standard deviation across the 8 z-scores was computed to create the IIV index. For each participant, the mean of the 8 z-scores was also computed. Vascular risk burden was quantified using the Framingham Stroke Risk Profile (FSRP).

**Results:** Linear regression models showed that, after adjusting for age, sex, and education, greater IIV was significantly associated with lower bilateral entorhinal thickness ( $\beta = -.357$ ,  $p = .002$ ) and greater white matter hypointensities volume at trend level ( $\beta = .232$ ,  $p = .095$ ). When additionally adjusting for vascular risk burden and mean cognitive performance, the association between higher IIV and lower entorhinal thickness remained ( $\beta = -.299$ ,  $p = .012$ ) whereas the trend level association with white matter hypointensities was attenuated ( $\beta = .147$ ,  $p = .288$ ). Follow-up analyses showed that lower mean cognitive performance was significantly associated with

reduced hippocampal volume ( $\beta=333.15$ ,  $p=.013$ ), but not entorhinal thickness ( $\beta=.101$ ,  $p=.097$ ) or white matter hypointensity volume ( $\beta=-.107$ ,  $p=.144$ ).

**Conclusions:** The results suggest that IIV may be an early sensitive marker of entorhinal degeneration above and beyond demographics, mean cognitive performance, and vascular risk burden. In contrast, lower mean cognitive performance was significantly associated with reduced hippocampal volume but not entorhinal thickness. Given that entorhinal cortex is affected before the hippocampus in Braak's staging of neurofibrillary tangle progression in AD, IIV may be a more sensitive marker of very early AD changes relative to mean cognitive performance. Future studies should examine how IIV may predict future brain changes including neuronal and cerebrovascular changes in larger samples.

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**Keywords:** cognitive functioning, neuroimaging: structural, dementia - Alzheimer's disease

**M. BECKER, J. Z. CALDWELL, A. RITTER, V. R. MISHRA, J. CUMMINGS, J. B. MILLER. Early and Late List Learning in Parkinson's and Alzheimer's Diseases.**

**Objective:** List learning tasks provide critical information that differentiates patterns of cognitive functioning in individuals with dementia-related mild neurocognitive deficits. Previous work from Putcha et al. (2019) indicated that decreased cortical thickness in the dorsal attention network was associated with poor early list learning, and reduced hippocampal volume was associated with worse late list learning in those with Alzheimer's disease (AD) compared to controls. This study examined early and late list learning patterns in persons with mild neurocognitive disorder due to Parkinson's disease (PD) in comparison to AD. Such findings would aid in meaningful interpretation of list learning in PD and provide evidence of cognitive impairment distinct from AD degeneration. Those with PD were expected to have poor early learning relative to AD, with better late learning, delayed recall, and retention.

**Participants and Methods:** Participants included 69 people with mild neurocognitive disorder due to Alzheimer's disease (MCI-AD; age = 73.4, education = 16.0, % male = 62.3, % White = 94.2), 25 with mild neurocognitive disorder due to Parkinson's disease (MCI-PD; age = 70.2, education = 15.1, % male = 72.0, % White = 79.2), and 53 healthy controls (CNC; age = 70.1, education = 16.4, % male = 45.3, % White = 90.6) from the Nevada Center for Neurodegeneration and Translational Neuroscience (CNTN) baseline dataset. Rey Auditory Verbal Learning Test (RAVLT) scores were examined with trials one and two collapsed to represent early learning, and trials four and five collapsed for late learning. Differences in performance between groups were examined across early and late learning trials, delayed recall, and retention following ANCOVA with Tukey comparisons using R.

**Results:** Preliminary results from ANCOVA with age as a covariate indicated that MCI-PD and MCI-AD groups performed significantly worse than the CNC group on early learning, late learning, delayed recall (MCI-PD  $p < .001$ ,  $r = .29-.31$ ; MCI-AD  $p < .001$ ,  $r = .41-.51$ ) respectively, and retention (MCI-PD  $p < .05$ ,  $r = .23$ ; MCI-AD  $p < .001$ ,  $r = .44$ ). However, non-significant MCI-PD and MCI-AD post hoc comparisons were likely due to weak power from a small sample size for the MCI-PD group. Subsequent ANOVA's adjusted for the CNC group trended in expected directions between MCI-PD and MCI-AD groups for late learning ( $p = .08$ ) and retention ( $p = .08$ ).

**Conclusions:** Findings lend preliminary support for the distinction between memory failures in PD and AD and are encouraging for future research. These initial comparisons between MCI-PD

and MCI-AD suggest that MCI-PD performance on early learning may be similar to AD, whereas the AD group may have worse performance on late learning and retention, which may ultimately reflect underlying differences in neurodegeneration. Understanding these differences may shed additional light on patterns of anatomical dysfunction driving specific memory processes.

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**Keywords:** dementia - Alzheimer's disease, Parkinson's disease, learning

### **M. C. ACEVEDO-MOLINA, S. GRIEGO, M. GRILLI. Exploring Autobiographical Memory in Bilingual Hispanics.**

**Objective:** Hispanics in the United States (US) are expected to experience the greatest increase in Alzheimer's disease (AD) diagnoses in the next four decades. Unfortunately, accumulating evidence suggests that currently available cognitive tests may be less accurate at detecting cognitive decline in Hispanics. As such, there is a critical need for better cognitive tests for age- and AD related cognitive decline in Hispanics. Episodic autobiographical memory (EAM), which is our memory for personally relevant events, has the potential to be a sensitive measure of both normal and AD-risk related cognitive aging. More importantly, EAM has the potential to be a culturally appropriate measure given that individuals are asked to describe personal events, which inherently come from their own cultural framework and background knowledge. However, studies that examine autobiographical memory in Hispanics in the US are lacking. Broadly, the focus of the present study is to examine EAM in Hispanics with the purpose of contributing to the development of more sensitive and culturally appropriate cognitive tests that can be used among this population. An important feature about the population of Hispanics in the U.S. is they are commonly bilingual. Thus, as a first step we aimed to examine if bilingualism influenced EAM specificity in young bilingual Hispanics.

**Participants and methods:** Twenty cognitively healthy young bilingual Hispanics narrated EAMs in English and Spanish, describing events that happened while speaking one language or the other. Using the scoring protocol of the Autobiographical Interview (Levine et al, 2002), we evaluated the narratives for episodic and non-episodic detail. We also asked young bilinguals which language they were primarily using when the memories were encoded.

**Results:** We found that young bilingual Hispanics retrieve more episodic than non-episodic (semantic/other) detail while describing EAMs in English or Spanish. There was no difference in overall detail for memories retrieved in English versus Spanish. Interestingly, language congruency did not influence EAM specificity either.

**Conclusions:** We replicated an important finding from the literature with non-Hispanic White young adults, namely that EAM tends to be described mostly with episodic details. From a feasibility standpoint, our findings suggest that we can conduct the Autobiographical Interview in bilingual Hispanics in both English and Spanish. Future directions include recruiting older monolingual and bilingual Hispanics to examine the relationship between age and EAM specificity among this population. Given the present findings, there is ample opportunity to observe age-related decline in EAM episodic specificity.

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**Keywords:** bilingualism, aging (normal), memory: normal

**C. ALEXANDER, J. SUHR. APOE, But Not Traumatic Brain Injury, Predicts Risk for Alzheimer's Disease.**

**Objective:** Previous studies have shown mixed results when assessing the potential effects of TBI history on development of Alzheimer's disease (AD) later in life. While some studies have shown that TBI history appears to increase risk for AD, others have shown no association. This relationship may depend on the severity of TBI history and could be confounded by current effects of TBI. The current analysis utilized only participants with normal cognition at baseline, accounted for other likely moderators such as previous health history, and examined the potential interaction between TBI history and APOE status.

**Participants and Methods:** Participant data were drawn from the National Alzheimer's Coordinating Centers' Uniform Dataset. Participants were included if they had normal cognition at baseline, were 50 or older at baseline, had at least 3 years of follow-up data, and either had normal cognition at all visits or were eventually diagnosed with AD. Information utilized included race, age, years of education, diagnosis at each visit, TBI history, cardiovascular risk factors, and APOE status.

The final sample (N = 4512) was 67.7% female, 83.0% White, and 31.6% APOE e4 carriers. 91.0% of the sample had no history of TBI; 6.4% had a history of TBI with brief LOC; and 2.6% had a history of TBI with extended LOC. Mean baseline age was 71.3; years of education, 15.8; and years of follow-up data, 6.2. Cardiovascular risk factors that differed between normal cognition and eventual AD groups (TIA, stroke, and hypertension) were collapsed into a single variable (health history) for further analyses.

A Cox proportional hazards regression analysis was performed, with survival time operationalized as age at diagnosis for individuals in the AD diagnostic group and age at last visit for individuals in the normal cognition group. TBI severity was entered as a first step; APOE status, race, health history composite score, years of education, and years of follow-up were entered as a second step; and the interaction between TBI severity and APOE status was added as a final step. The Holm (1979) correction was used to control Type I error due to the large sample size.

**Results:** TBI history did not affect risk for AD at any step. Presence of the APOE e4 allele increased risk (HR = 2.58; 95% CI = 2.14 – 3.10;  $p < .001$ ), but the interaction of APOE with TBI was not significant. Race, health history, and education did not affect risk for AD, but each additional year of follow-up was associated with increased risk for AD diagnosis (HR = 1.07; 95% CI = 1.03 – 1.11;  $p < .001$ ).

**Conclusions:** After eliminating direct effects of TBI on cognition, TBI history does not appear to affect risk for AD. Consistent with current literature, presence of the APOE e4 allele increased risk for AD. Interestingly, other covariates such as race and cardiovascular health history did not affect risk of developing AD.

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**Keywords:** traumatic brain injury, aging disorders, apolipoprotein E

**I. PELCHER, C. PUZO, Y. TRIPODIS, H. APARICIO, E. STEINBERG, A. PHELPS, B. MARTIN, J. PALMISANO, E. VASSEY, C. LINDBERGH, A. MCKEE, T. STEIN, R. KILLIANY, R. AU, N. KOWALL, R. STERN, J. MEZ, M. ALOSCO. Revised Framingham Stroke Risk Profile: Association with Cognitive Status and MRI-Derived Volumetric Measures.**

**Objective:** The Framingham Stroke Risk Profile (FSRP) was created in 1991 to estimate 10-year risk of stroke and has been adopted to study the association between cerebrovascular disease (CBVD) and brain aging. It was revised in 2017 (rFSRP) to reflect contemporary trends in vascular risk factors and stroke risk. This study examined the association between the rFSRP and cognitive and brain aging outcomes among participants from the National Alzheimer's Coordinating Center (NACC) Uniform Data Set (UDS).

**Participants and Methods:** Cross-sectional rFSRP was computed at baseline for 19,309 participants (mean age=72.84, SD=8.48) from the NACC-UDS [9,697 (50.2%) normal cognition, 4,705 (24.4%) MCI, 4,907 (25.4%) dementia]. The sample was restricted to participants who had complete data across all primary independent and dependent outcomes. Multivariable linear, logistic, or ordinal regressions examined the association between the rFSRP and diagnostic status, neuropsychological test performance, CDR® Sum of Boxes, as well as total brain volume (TBV), hippocampal volume (HCV) and log-transformed white matter hyperintensities (WMH) for an MRI subset (n=1,196). Models controlled for age, sex, education, racial identity, *APOE*  $\epsilon 4$  status, and estimated intracranial volume for MRI models. Neuropsychological test performance was analyzed for measures of psychomotor speed, working memory, executive function, episodic memory, and language.

**Results:** The mean rFSRP probability was 10.42% (min.=0.50%, max.=95.71%). Higher rFSRP scores corresponded to greater CDR Sum of Boxes ( $\beta=0.02$ ,  $p=0.028$ ) and worse performance on: Trail Making Test A ( $\beta=0.05$ ,  $p<0.001$ ) and B ( $\beta=0.057$ ,  $p<0.001$ ), and Digit Symbol ( $\beta= -0.058$ ,  $p<0.001$ ). Higher rFSRP scores were associated with increased odds for a greater volume of log-transformed WMH (OR=1.02 per quartile,  $p=0.015$ ). No associations were observed for diagnosis, episodic memory or language test scores, HCV, or TBV. The statistically significant effects of the rFSRP for neuropsychological test scores, as well as MRI volumetrics, remained after controlling for AD as the primary etiology ( $ps<0.05$  for all).

**Conclusions:** The results provide support for the rFSRP as a useful and pragmatic metric for studying the association between vascular risk factors (VRF) and cognitive and brain aging. This study provides continued support for VRF as potentially modifiable targets for intervention and prevention of cognitive decline.

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**Keywords:** cardiovascular disease, cerebrovascular disease, stroke

### **C. FERGUSON. Understanding the Relationships Between Neurocognitive Variables Across the Early Alzheimer's Disease Spectrum: An Application of Network Psychometrics.**

**Objective:** Descriptions of the typical pattern of impairment in Alzheimer's disease onset refer to relationships *between* neurocognitive variables as well as deficits *in* certain variables. For example, episodic memory impairment is predominant while difficulties in other neurocognitive domains are subsidiary. Despite the importance of considering the relationships between variables in neuropsychological formulation, these relationships have not been explicitly statistically modelled across the early Alzheimer's disease spectrum. Psychometric network analysis estimates relationships between variables once relationships between all other variables in the model have been accounted for, giving rise to a network model of the relationships amongst variables in which the variables can be assumed to influence each other. This study

aimed to create psychometric network models of the relationships between neurocognitive variables at three points along the early Alzheimer's disease spectrum.

**Participants and Methods:** The Gaussian graphical model with extended Bayesian information criterion graphical lasso model selection and regularisation was used to model the relationships amongst a range of neuropsychological test results in cognitively normal ( $n = 229$ ), amnesic mild cognitive impaired ( $n = 395$ ), and early Alzheimer's disease ( $n = 191$ ) groups of older adults. Each network model was analysed visually. The global structure (i.e. the specific patterns of links between variables) and the overall strength (i.e. the sum of the partial correlations between variables) of the network models were quantitatively compared across groups. The strength centrality of the variables (i.e. the sum of the partial correlations connected to a variable) in each network model was also explored.

**Results:** The global strength of the network models did not appear to differ significantly across groups. The overall structure of the network models for cognitively normal and early Alzheimer's disease ( $p = .028$ ) were marginally different, while the network models for cognitively normal and amnesic mild cognitive impairment ( $p = 0.047$ ) and amnesic mild cognitive impairment and early Alzheimer's disease ( $p = .423$ ) groups were not surprisingly different. Regarding the patterns within each network model, two putative clusters emerged in the models for the clinical groups. These were a cluster of memory and language related variables and a cluster of executive, attention and processing speed related variables. This pattern was not observed in the model for the cognitively normal group where variables were relatively isolated from each other. Regarding strength centrality, a measure of processing speed and a measure of delayed episodic memory were the two most central nodes all network models.

**Conclusion:** The findings suggest that a degree of reorganisation amongst neurocognitive variables takes place across the early Alzheimer's disease spectrum. In other words, after conditioning on all available variables, scores on certain tests appear to relate more strongly with each other at different stages of health and disease. Subsequently, while deficits may be particularly noticeable on episodic memory tasks, the relationships amongst neurocognitive functions may also change early in the course of the disease. Psychometric and theoretical network models may help to model these dynamics and to quantify verbal descriptions of the typical neuropsychological profiles across the Alzheimer's disease spectrum.

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**Keywords:** dementia - Alzheimer's disease, neurocognition, psychometrics

### **J. SCHOLL, S. WIERSIG, Z. B. WOOD, S. SALONGA, L. BENNETT. Relationship Between APOE4 Status, Combat Exposure, and Dementia.**

**Objective:** The presence of one or two epsilon of APOE4 alleles is associated with dementia. Additionally, it has been shown that work-related stress is associated with higher risks of dementia. As a result, it is expected that combat exposure will be correlated with dementia with APOE4 status controlled for.

**Participants and Methods:** APOE4 genotype results, Combat Exposure Scale scores, and Clinical Dementia Rating Scale Global Score was considered from 171 Vietnam veterans who participated in collaborative Alzheimer's Disease Neuroimaging Initiative and Department of Defense Study. A correlation was run to assess the association between combat exposure and dementia. A partial correlation was run to control for APOE4 status. Combat exposure was

categorized into five groups, light (0-8), light-moderate (9-16), moderate (17-24), moderate-heavy (25-32), heavy (33-41).

**Results:** Combat exposure was not correlated with dementia  $r(171) = .054, p = .485$ . Additionally, there was no correlation when APOE4 status was controlled for  $r(171) = .052, p = .504$ .

**Conclusions:** This study's results support a previous study indicating that combat experiences for WWII veterans were not associated with dementia. Additionally, the Clinical Dementia Rating Scale in this study has a restricted range. None of the participants on the scale rated above an MCI. Further research with a less restricted range is necessary to validate these results.

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**Keywords:** apolipoprotein E, dementia - Alzheimer's disease, mild cognitive impairment

### **K. R. CHAPMAN, G. TREMONT, M. SPITZNAGEL. Development of an Assessment Measure for Sexual Disinhibition in Dementia.**

**Objective:** Sexual disinhibition in dementia is reported at variable rates (between 1.8% to 25% of dementia samples) and behaviors associated with sexual disinhibition are poorly characterized. This paucity in available data may be due to a lack of standardized assessment methods. A recent systematic review proposed four behavioral domains associated with sexual disinhibition: hypersexual/obsessive behaviors, inappropriate/lewd behaviors, inappropriate interactions with others, and inappropriate comments. The present study aimed to create a new caregiver-report measure by statistically evaluating the underlying behavioral domains of sexual disinhibition.

**Participants and Methods:** 622 informal caregivers recruited from social media dementia caregiver groups were randomly divided into Initial Validation (n=311) and Cross-Validation (n=311) groups. All caregivers completed a 36-item sexual disinhibition item pool that captured symptom presence, frequency, severity, and caregiver impact. Caregivers also completed measures of convergent (Aggressive Behaviors Scale, ABS; Cohen Mansfield Agitation Inventory-Short; CMAI) and discriminant (Pain Self-Efficacy Questionnaire-Significant Other, PSEQ-SO; Epworth Sleepiness Scale, ESS) validity. Exploratory factor analysis in the initial validation group followed by examination of scree plot and factor loadings led to the creation of provisional scales, which were then examined psychometrically and confirmatory-factor analyzed in the cross-validation group to assess model fit ( $\chi^2$ , CFI, RMSEA, SRMR).

**Results:** Initial validation revealed evidence for a five behavioral domain structure: Inability to Inhibit, Oversharing, Inappropriate Comments, Inappropriate Exposure, and Overly Flirtatious. Provisional scales based on these domains demonstrated sufficient to strong psychometric properties (Cronbach's  $\alpha=0.82-0.91$ ; convergent validity  $r=0.13-0.29$ ; discriminant validity  $r=-0.23-0.12$ ). Confirmatory factor analysis to examine the stability of results indicated strong support for three of the five factors (Oversharing, Inappropriate Comments, and Inappropriate Exposure) with more mixed results for the other two factors (Inability to Inhibit, Overly Flirtatious). Due to replication of psychometric results (Cronbach's  $\alpha=0.82-0.94$ ; convergent validity  $r=0.10-0.33$ ; discriminant validity  $r=-0.04-0.09$ ), the five behavioral domain structure was retained as the basis for measure development.

**Conclusions:** The current study is the first to statistically evaluate the underlying factor structure of sexual disinhibition, culminating in the creation of a new caregiver-report measure. While further work is needed to substantiate psychometric qualities, the new measure can be used to

better understand the problem of sexual disinhibition in dementia and aid in the creation of supportive interventions.

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**Keywords:** disinhibition, assessment

**L. EDWARDS, L. IACCARINO, Y. COBIGO, J. PHAM, H. ROSEN, D. SOLEIMANI-MEIGOONI, A. STROM, A. WOLF, G. D. RABINOVICI, R. LA JOIE. Relative Contributions of White Matter Hyperintensities and PET Biomarkers of Amyloid and Tau Pathologies to Cognitive Deficits in Symptomatic Patients with Alzheimer's Disease.**

**Objective:** White matter hyperintensities (WMH) are frequently observed on fluid attenuated inversion recovery (FLAIR) imaging in patients with Alzheimer's disease (AD). We examined the relationship between WMH volume and positron emission tomography (PET) biomarkers of AD pathology as well as their relative contributions to cognitive deficits in patients diagnosed with MCI and AD.

**Participants and Methods:** 3-Tesla structural MRI, 18F-flortaucipir (tau)-PET and 11C-PIB (amyloid)-PET were acquired on 119 amyloid-PET positive patients diagnosed with mild cognitive impairment or AD dementia. Standardized uptake value ratio (SUVR) flortaucipir- and PIB-PET images were created using tracer-specific reference regions and warped to template space for analysis. A subsample of 69 patients underwent FLAIR imaging and was used for the main analyses (FLAIR sample), while the other 50 patients were used to run voxelwise PET-to-cognition analyses (PET-only sample) to identify regions where PET binding was associated with cognitive composite scores (episodic memory, executive, language, semantic, and visuospatial cognition). WMH were segmented using FLAIR and T1-weighted images based on a two-step supervised algorithm including a trained linear regression classification and a Hidden Markov Random Field algorithm. Global WMH volume was normalized by intracranial volume and natural log-transformed. For each cognitive composite score, a linear regression model was run in the FLAIR sample to assess the independent contributions of global WMH volume and flortaucipir- and PIB-SUVR extracted from cognitive domain-specific regions (as identified in the PET-only sample), controlling for age, sex, and years of education.

**Results:** The PET-only and FLAIR samples had similar demographics (age:  $65.5 \pm 9$  vs.  $65.6 \pm 10$  years; sex: 50% vs. 54% female,  $ps \geq .70$ ) and clinical characteristics (MMSE:  $22.2 \pm 5.8$  vs.  $21.7 \pm 5.6$ ,  $p = .61$ ; all cognitive composite score  $ps \geq 0.12$ ). In the PET-only sample, cognitive scores were associated with flortaucipir-SUVR in a region-specific pattern: bilateral medial temporal cortices for episodic memory, left anterior temporal lobe for semantic memory, occipital areas for visuospatial function, fronto-parietal areas for executive function, and left temporo-frontal areas for language. In contrast, PIB-SUVR only showed weak association to executive function in a scattered pattern. In the FLAIR sample, global WMH volume was inversely correlated to global cortical PIB-SUVR ( $r = -.25$ ,  $p = .04$ ) but not global cortical flortaucipir-SUVR ( $r = -.18$ ,  $p = .15$ ). Older age was associated with lower global cortical flortaucipir-SUVR ( $r = -.70$ ,  $p < .001$ ), and higher global WMH volume ( $r = .46$ ,  $p < .001$ ) but not global cortical PIB-SUVR ( $r = -.08$ ,  $p = .50$ ). Linear regression models showed that for all cognitive domains, both higher global WMH volume and domain-specific regional flortaucipir-SUVR predicted worse performance: episodic memory (standardized  $\beta_{FTP} = -.355$ ,  $p = .005$ ;  $\beta_{WMH} = -.345$ ,  $p = .01$ ), semantic memory ( $\beta_{FTP} = -.306$ ,  $p = .007$ ;  $\beta_{WMH} = -.504$ ,  $p < .001$ ), visuospatial function ( $\beta_{FTP} = -.527$ ,  $p < .001$ ;  $\beta_{WMH} = -.252$ ,  $p = .03$ ), executive function ( $\beta_{FTP} = -.576$ ,  $p < .001$ ;

$\beta_{WMH} = -.281, p = .02$ ), and language ( $\beta_{FTP} = -.769, p < .001$ ;  $\beta_{WMH} = -.220, p = .04$ ). PIB-SUVR did not contribute to deficits in any cognitive domain.

**Conclusions:** Regional tau-PET and global WMH volume are independently associated with several cognitive domains in amyloid-positive patients diagnosed with MCI and clinically defined AD dementia. The clinically relevant effects of white matter lesions suggest that modifiable factors of cerebrovascular health may be valuable therapeutic targets for mitigating cognitive impairment, even in biomarker-positive patients on the AD continuum.

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**Keywords:** dementia - Alzheimer's disease, cerebrovascular disease

**K. S. PATRICK, J. T. MARTIN, K. R. CHAPMAN, M. SPITZNAGEL. Pain in persons with dementia: The contribution of neuropsychiatric symptoms and pain self-efficacy to caregiver burden.**

**Objective:** Studies have shown a link between burden in caregivers of persons with dementia and neuropsychiatric symptoms in the care recipient. If pain is present in the care recipient, it could exacerbate burden, but may not exert significant influence in the context of sufficient pain self-efficacy, or the care recipient's ability to manage pain symptoms. It was hypothesized that, in a sample of dementia care recipients with pain, caregiver burden would be related to severity of the care recipient's neuropsychiatric symptoms, but that low pain self-efficacy in the dementia care recipient would contribute to burden above and beyond neuropsychiatric symptoms.

**Participants and Methods:** A sample of 189 caregiver/care recipient dyads in which the care recipient experiences pain was recruited online through social media. Caregivers completed measures including the Zarit Burden Interview-12 (ZBI-12), Cohen Mansfield Agitation Index-Short (CMAI-S), the Pain Self-Efficacy Questionnaire-Significant Other (PSEQ-SO), and self-reported demographic and disease variables. Hierarchical multiple regression analysis examined the contribution of pain self-efficacy to caregiver burden beyond neuropsychiatric symptoms, while controlling for duration of disease.

**Results:** The CMAI-S predicted caregiver burden ( $\Delta R^2 = .168, \Delta F(1, 184) = 37.58, p < .001$ ), accounting for 16.8% of the variance in ZBI-12 scores. Addition of the PSEQ-SO improved the model ( $\Delta R^2 = .048, \Delta F(1, 183) = 11.25, p = .001$ ), accounting for an additional 4.8% of variance. The final model accounted for 22.6% of the variance in ZBI-12 ( $R^2 = .226, F(3, 183) = 17.81, p < .001$ ). Higher CMAI-S ( $B = .321, SE = .059, \beta = .362, p < .001$ ) and lower PSEQ-SO ( $B = -.158, SE = .047, \beta = -.224, p = .001$ ) were associated with higher ZBI-12.

**Conclusions:** Consistent with hypotheses, results indicated that greater neuropsychiatric symptoms and lower pain self-efficacy were associated with greater caregiver burden, with low pain self-efficacy contributing to caregiver burden beyond the impact of neuropsychiatric symptoms alone. When pain and neuropsychiatric symptoms are present in the dementia patient, addressing low pain self-efficacy might alleviate caregiver burden to a greater extent than focusing on neuropsychiatric symptoms alone. Future research should explore mechanisms through which pain influences neuropsychiatric symptoms and whether or not improvement in pain self-efficacy in dementia care recipients leads to a decrease in neuropsychiatric symptoms and subsequent alleviation of burden in the caregiver.

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**Keywords:** dementia - Alzheimer's disease, caregiver burden, neuropsychiatry

**P. PREMNATH, G. A. MARSHALL, M. J. PROPERZI, P. B. ROSENBERG, J. R. GATCHEL. Trajectory of Neuropsychiatric Symptoms in Relation to Tau Burden in Older Adults with Mild Cognitive Impairment and Alzheimer's disease Dementia.**

**Objective:** Evidence suggests that neuropsychiatric symptoms (NPS) may be among the earliest clinical indicators in individuals at risk for Alzheimer's Disease (AD). Examining relationships between NPS and AD related pathology may be important to identify targets for effective treatment across various stages of disease progression. In the current study, we examined the relationship between regional tau and longitudinal change in NPS in older adults with Mild Cognitive Impairment (MCI) and AD dementia from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database.

**Participants and Methods:** Three hundred and sixteen ADNI participants (235 with MCI; 81 with AD dementia; age: 75.5 ±8.1; 56% females) underwent baseline tau imaging (utilizing flortaucipir (FTP) positron emission tomography (PET)) and clinical assessment with the Neuropsychiatric Inventory (NPI) (every 6-12 months (average follow up= 46.1 months)). Total NPI score was examined in relation to tau PET signal in two FreeSurfer defined regions of interest (ROIs) affected in AD (precuneus) and involved in behavioral control (rostral anterior cingulate cortex (rACC) that also comprise nodes of the frontal-parietal control network). In separate primary linear mixed models, the association between dependent variable NPI (for each study visit) and tau FTP SUVR in precuneus or rACC was examined, in addition to the tau FTP SUVR X time interaction, with covariates: age and sex.

**Results:** Higher precuneus tau was associated with higher NPI over time ( $\beta=0.047$ ;  $t=2.08$ ; 95 % CI (0.002, 0.09);  $p=0.038$ ). Sex was also a significant predictor of higher NPI (females with greater NPI:  $\beta=1.55$ ;  $t=2.14$ ; 95 % CI (-2.97, -0.13);  $p=0.033$ ). Greater rACC tau ( $\beta=3.75$ ;  $t=1.95$ ; 95 % CI (-0.019, 7.51);  $p=0.05$ ), but not its interaction with time ( $\beta=-0.005$ ;  $t=-0.21$ ; 95 % CI (-0.06, 0.05);  $p=0.83$ ), was associated with greater NPI; sex was also a significant predictor in this model (females with greater NPI:  $\beta=1.63$ ;  $t=2.23$ ; 95 % CI (-3.06, -0.17);  $p=0.026$ ). In secondary analyses, cortical amyloid (Florbetapir PET) X time was a significant predictor of greater NPI over time for both precuneus ( $\beta=0.10$ ;  $t=4.00$ ; 95 % CI (0.05, 0.15);  $p<001$ ) and rACC tau ( $\beta=0.11$ ;  $t=4.55$ ; 95 % CI (0.06, 0.16);  $p<001$ ).

**Conclusions:**

Higher rACC tau was associated with greater NPS, while higher precuneus tau may contribute to increasing NPS over time in early-stage AD. This, and the observed effect of cortical amyloid, may be indicative of contribution of early AD pathology to behavioral symptoms as the clinical disease progresses. Future studies should examine different symptoms within the NPI scale to identify specific NPS that contribute to or are exacerbated by disease progression, as well as contributions of cerebrovascular and circuit level dysfunction.

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**Keywords:** positron emission tomography, dementia - Alzheimer's disease, neuropsychiatry

**S. SALONGA, Z. B. WOOD, R. J. MCCLURE, J. SCHOLL, L. BENNETT. Severity of Combat Exposure of Veterans with PTSD and Dementia.**

**Objective:** Previous research has demonstrated a strong positive correlation between Post Traumatic Stress Disorder (PTSD) and the risk of developing dementia. As such, this study analyzed the correlation between various degrees of combat exposure, based on the total score on the self-response Combat Exposure Scale (CES), and severity of dementia, based on the Clinical Dementia Rating (CDR) Scale total score. It was hypothesized that higher levels of combat exposure in veterans with a diagnosis of PTSD would positively correlate with dementia symptom severity.

**Participants and Methods:** Baseline CES total score and CDR total score from combat veterans, ages 60-84, who participated in the Alzheimer's Disease Neuroimaging Initiative (ADNI) study. The participants were provided all three assessments (PTSD, CES, and CDR). A univariate analysis was used to analyze the data to compare combat veterans with PTSD and no PTSD, the severity of combat exposure, and the symptoms of dementia.

**Results:** A total of 242 veterans were assessed for PTSD using the Clinician Administered PTSD Scale (CAPS) – Lifetime; 129 (53%) received a clinical PTSD diagnosis. Of the 242 veterans for whom a CDR was completed, 155 (64%) did not meet the diagnostic criteria of dementia, 84 (35%) were diagnosed with possible dementia, and 3 (1%) met the criteria for mild dementia. 76 (59%) combat veterans with a diagnosis of PTSD did not demonstrate symptoms of dementia, 52 (40%) veterans with PTSD demonstrated symptoms of possible dementia, and one (1%) veteran with PTSD demonstrated mild dementia. Mean combat exposure was 2.79 (range=1-5,  $SD \pm 1.34$ ). Neither PTSD diagnosis ( $F(1, 231) = 3.59, p = .059$ ) nor CES total score with PTSD ( $F(4, 128) = 1.11, p = .354$ ) were significantly correlated with dementia symptom severity.

**Conclusions:** While not reaching statistical significance, the correlations between PTSD diagnosis and dementia symptom severity was trending toward significance, consistent with prior findings. Notably, the current findings were restricted by the limited range of the CDR scale as no participant was rated as having more than mild dementia symptoms. Further analysis of the role stress-related mental health symptoms on the risk of developing dementia in combat veterans is warranted. In addition, future studies would likely benefit from utilization of a more nuanced scale of dementia symptom severity.

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**Keywords:** dementia - Alzheimer's disease, post-traumatic stress disorder

**A. NGUYEN, R. J. MCCLURE, A. MARTINEZ, L. BENNETT. Examination of Potential Cross-Cultural Differences in Individuals who are at a Higher-Risk for Dementia.**

**Objectives:** Frequency and impact of certain risk factors for dementia vary significantly across racial groups; however, the relationship between race-related risk factors for individuals with dementia has not yet been fully examined. The extant literature indicates hypertension is positively correlated with cognitive decline and hypertension disproportionately impacts Black individuals in comparison to their White counterparts. Further, prior research found the presence of an apolipoprotein 4 allele (APOE-4) may lead to faster cognitive decline, in areas such as semantic memory and working memory, in White versus Black individuals. Given that the impact hypertension and the presence of an APOE-4 allele varies across racial groups, it is important to examine the cognitive impact across groups. The current study explored the

relationship between race, dementia diagnosis in individuals with hypertension and at least one APOE-4 allele.

**Participants and Methods:** Data was gathered from the Alzheimer's Disease Neuroimaging Initiative (ADNI). APOE-4 status and diagnosis of both hypertension and dementia at baseline assessment from 435 (35 Black, 400 White) individuals were considered. Participants ranged from 55 to 89 years of age and self-identified as either Black or White. Three separate chi-squared analyses were utilized to examine the relationship between gene status, race, and dementia diagnosis with the overall goal to determine if there was a statistically significant difference between the expected and observed frequencies of Alzheimer's disease based on race in individuals with diagnosed hypertension and presence of at least one APOE-4 allele.

**Results:** Black and White individuals with two APOE-4 alleles who had also been diagnosed hypertension were at a statistically significant increased risk for carrying a diagnosis of dementia ( $p=0.002$ ) as compared to those with one APOE-4 allele who had also been diagnosed hypertension. Notably, in a second chi-square analysis, APOE-4 gene status was not observed to significantly differ between race groups ( $p>0.05$ ). Within the same sample, amongst individuals with diagnosed hypertension and the presence of at least one APOE-4 allele, no significant difference in dementia diagnosis was observed as a function of race ( $p>0.05$ ) in the final analysis.

**Conclusions:** Consistent with the literature, the current study found that individuals with two APOE-4 alleles were at a statistically significant increased risk for a dementia diagnosis, regardless of race. Further, results did not corroborate that cultural identity significantly moderated dementia outcome or gene status. Notably, there was a large discrepancy in sample sizes between Black and White individuals, highlighting the need to engage more individuals who identify as racial minorities in cognitive research to better understand the impact of racial health disparities. The inability to control for other factors that may impact cognitive decline such as hypertensive medication was another limitation. Future research examining the potential cross-cultural presentations of dementia due to the different impact and prevalence rate of known dementia risk factors would be beneficial.

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**Keywords:** dementia - Alzheimer's disease, cross-cultural issues, diversity

**R. J. MCCLURE, A. NGUYEN, S. SALONGA, L. BENNETT. Blood Glucose Levels Predict Verbal Memory in Individuals with Alzheimer's Disease and Type II Diabetes.**

**Objective:** Type II diabetes is a known risk factor for developing Alzheimer's disease. Individuals with type II diabetes score lower on measures of verbal memory. Alzheimer's disease diagnosis is also associated with declines in verbal memory performance. Recent research has indicated higher blood glucose levels may exacerbate executive deficits in older adults with impairment. Research also indicated that in adults under 70 that maintain good glycemic control, type II diabetes only has a small impact on cognitive functions. While the positive relationship between type II diabetes and the risk of Alzheimer's disease diagnosis has been established, the role of blood glucose levels on verbal memory performance in a population with both conditions is not yet fully understood. This study explored the predictive effect of blood glucose levels on verbal memory performance in individuals with Alzheimer's disease and type II diabetes.

**Participants and Methods:** The study cohort consisted of 149 individuals with Alzheimer's disease and type II diabetes drawn from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database who were assessed via pre-FDG blood glucose tests, Wechsler Memory Scale (WMS) Logical Memory test, and Rey Auditory Verbal Learning Test (RAVLT). In order to examine the relationship between blood glucose and verbal memory performance, cohort sample data was analyzed using simple linear regression with blood glucose levels predicting outcome variables of immediate recall and long delay recall of contextual verbal information (stories), and short- and long- delay recall and recognition of non-contextual verbal information (word list).

**Results:** Blood glucose levels significantly predicted verbal memory performance in individuals with Alzheimer's disease and type II diabetes, such that individuals with higher blood glucose levels had lower scores on verbal memory performance measures of contextual verbal information and non-contextual verbal information. Specifically, for each 10 point increase in blood glucose levels, there was a score decrease by 1 point in immediate recall and by 1.2 points in long delay recall of contextual verbal information, and by 1.2 points in short delay recall, by 1.3 points in long delay recall, and by 1.1 points in recognition of non-contextual verbal information (all  $p$ 's < .001).

**Conclusion:** Blood glucose levels were observed to significantly predict verbal memory performance scores in individuals with Alzheimer's disease and type II diabetes, suggesting that higher blood glucose levels may decrease verbal memory performance. Management of blood glucose levels should be considered when assessing and interpreting verbal memory performance in individuals with both Alzheimer's disease and type II diabetes.

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**Keywords:** dementia - Alzheimer's disease, diabetes, cognitive functioning

**K. KADEY, J. L. WOODARD, A. C. MOLL, K. A. NIELSON, C. C. SMITH, S. DURGERIAN, S. M. RAO. Five-Year Change in Body Mass Index Predicts Conversion to Mild Cognitive Impairment or Dementia only in APOE  $\epsilon$ 4 Allele Carriers.**

**Objective:** The aim of this study was to investigate the interactions between the APOE  $\epsilon$ 4 allele and body mass index (BMI; baseline and five-year change) on conversion to mild cognitive impairment (MCI) or dementia in initially cognitively healthy older adults.

**Participants and Methods:** Participants were 1,289 cognitively healthy elders (34.4% male) from the National Alzheimer's Coordinating Center (NACC) study. Baseline BMI ( $\text{bBMI}$ ) was coded as a continuous measure ( $\text{kg/m}^2$ ), and five-year change in BMI ( $\Delta\text{BMI}$ ) was calculated using standardized residualized change scores. Fisher's Exact Tests and two-way factorial ANOVA's were used to evaluate group differences in  $\text{bBMI}$ ,  $\Delta\text{BMI}$ , and other demographics based on APOE  $\epsilon$ 4 carrier status, conversion status, and both carrier and conversion status. Multiple binary logistic regression, adjusting for age, sex, race, education, APOE, and  $\text{bBMI}$  in the first model, related the interaction between APOE and  $\text{bBMI}$  to risk of diagnostic conversion to MCI or dementia. Secondary logistic regression analyses repeated the previously described model, replacing  $\text{bBMI}$  with  $\Delta\text{BMI}$ .

**Results:** After five years, significantly more  $\epsilon$ 4 carriers (30.6%) converted to MCI or dementia than noncarriers (17.6%),  $p < .001$ ,  $\text{OR}=2.06$ . There were no differences between conversion or carrier groups on BMI at baseline, but converters exhibited significantly greater declines in BMI over time than nonconverters,  $p < .006$ ,  $d = 0.20$ . Neither  $\text{bBMI}$  ( $\text{OR}=0.99$ ,  $95\% \text{CI}=0.96-1.02$ ,  $p = .48$ ) nor the  $\text{bBMI}$  by APOE  $\epsilon$ 4 interaction ( $\text{OR}=1.02$ ,  $95\% \text{CI}=0.96-1.08$ ,  $p = .59$ ), predicted

conversion. Although  $\Delta$ BMI also did not significantly predict conversion (OR=0.90, 95% CI=0.78-1.04,  $p = .14$ ), the interaction between  $\Delta$ BMI and carrier status was significant (OR=0.72, 95% CI=0.53-0.98,  $p = .035$ ). For carriers only, each one-unit decline in BMI over five years was associated with a 27% increase in the odds of conversion (OR=0.73, 95% CI=0.57-0.94,  $p = .013$ ).

**Conclusions:** A decline in BMI over five years, but not  $\Delta$ BMI, was strongly associated with conversion to MCI or dementia only for APOE  $\epsilon 4$  carriers. The specificity of these relationships among  $\epsilon 4$  carriers suggest the possibility of concurrent changes in cognition and metabolism in those who convert to MCI or dementia. The precise mechanisms, however, are not fully understood, and likely reflect the combined impacts of dysregulated brain lipid and glucose metabolism, decreased cellular cholesterol transport, increased neuro-inflammation, increased blood-brain barrier permeability, and amyloid-beta aggregation that are associated with the APOE  $\epsilon 4$  allele. Our findings suggest interventions and behaviors aimed at maintaining body mass, or counteracting the metabolic impacts of the APOE  $\epsilon 4$  allele, may be important for long term cognitive health in older adults at genetic risk for AD.

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**Keywords:** dementia - Alzheimer's disease, apolipoprotein E, mild cognitive impairment

**J. N. MOODY, K. E. VALERIO, A. N. HASSELBACH, S. PRIETO, M. W. LOGUE, S. M. HAYES, J. P. HAYES. Body Mass Index and Genetic Risk for Alzheimer's Disease Predict Conversion to Alzheimer's Disease.**

**Objective:** Body mass index (BMI) is a risk factor for Alzheimer's disease (AD) although the relationship is complex. Obesity in midlife is associated with increased risk for AD, whereas in late life, the evidence is mixed. This study examined the influence of individual differences in genetic risk for AD to further clarify the relationship between late-life BMI and conversion to AD.

**Participants and Methods:** Participants included 54 cases categorized as cognitively normal or as having mild cognitive impairment at baseline who converted to AD within 24 months and 54 matched controls from the Alzheimer's Disease Neuroimaging Initiative (ADNI) cohort. BMI was measured at baseline. Genetic risk for AD was assessed via genome-wide polygenic risk scores. Conditional logistic regression models were run to determine if BMI and polygenic risk predicted conversion to AD.

**Results:** An interaction was observed between BMI and genetic risk (OR = 0.88,  $P = 0.045$ ), such that individuals with lower BMI and higher polygenic risk were more likely to convert to AD (OR = 2.73,  $P = 0.004$ ) relative to individuals with higher BMI (OR = 1.22,  $P = 0.510$ ). This interaction remained significant after adjusting for the effects of apolipoprotein E  $\epsilon 4$  and cerebrospinal fluid biomarkers of AD, including amyloid beta, tau, and phosphorylated tau (OR = 0.75,  $P = 0.021$ ). Sex-stratified analyses revealed a significant association in males (OR = 0.82,  $P = 0.031$ ), but not females (OR = 1.07,  $P = 0.658$ ).

**Conclusions:** These results show that higher genetic risk in the context of lower BMI predicts conversion to AD in the next two years, particularly among males. AD-related brain changes associated with lower BMI and high genetic risk for AD may affect the same neural pathways; therefore, these two risk factors in combination may lead to greater neural disruptions and consequently increase the likelihood of clinical manifestation of AD.

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**Keywords:** dementia - Alzheimer's disease, genetics, mild cognitive impairment

**E. JOHNSON, C. ALEXANDER, G. J. LEE, K. ANGERS, D. NDIAYE, J. SUHR. Racial differences in cognitive decline: A longitudinal examination of predictors of neuropsychological performance and development of Alzheimer's disease.**

**Objective:** Some studies have found that Black individuals evidence greater risk for developing Alzheimer's disease (AD) and cognitive decline compared to White individuals. Prior work also suggests that risk factors, including cardiovascular disease and APOE e4, occur at a higher rate in Black individuals, which may partially explain this finding. However, some research suggests that the presence of the APOE e4 allele is less predictive of cognitive decline and eventual AD diagnosis among Black individuals. It remains unclear why Black individuals show greater decline in research studies. This study examined longitudinal differences in the predictive effect of risk factors on cognitive decline between adults.

**Participants & Methods:** Participants included 7459 older adults (mean age at baseline = 71.33, SD = 9.45; 62% female; 83.9% white) from the National Alzheimer's Coordinating Center's Uniform Dataset who presented for evaluations due to memory-related concerns. Measures of verbal fluency, naming, and immediate/delayed story memory were administered across 10 visits. Health risk factors and cognitive diagnoses were assessed at each visit. Participants who identified as White or Black, were 50 or older, and who had no diagnosis of AD or other neurocognitive disorders at baseline were included in the analyses.

**Results:** First, a survival analysis was used to examine predictors of AD development across 10 visits. Second, a series of multilevel models were used to determine predictors of decline in the cognitive domains described above. Race (Black/ White), APOE status (present/absent e4 allele), sex, education, diabetes, and hypertension were included as predictors. Due to the large sample size, only  $p$  values less than .01 were considered significant. The interaction of race and APOE status was not significant in predicting conversion to AD or decline in any cognitive domain and was removed from the final models (all  $p$ 's > .01). The survival analysis indicated that presence of APOE e4, being male, identifying as White, and being older at baseline significantly predicted conversion to AD (all  $p$ 's < .001). Multilevel models revealed that greater declines in fluency were predicted by race, presence of APOE e4, and presence of hypertension; greater declines in naming were predicted by APOE e4, race, education, and sex (all  $p$ 's  $\leq$  .01); declines in immediate memory were predicted by APOE e4, race, and sex (all  $p$ 's  $\leq$  .001); and declines in delayed memory were predicted by APOE e4 and race (all  $p$ 's < .001). Notably, Black participants performed worse at baseline relative to White participants in all cognitive domains, even after controlling for known cognitive risk factors (all  $p$ 's < .01). However, Black participants showed slower decline in cognitive performance across time in all cognitive domains (all  $p$ 's < .01).

**Conclusions:** Analyses did not support previous assertions that APOE e4 differentially affects Black individuals. Cognitive performance among Black individuals consistently reflected lower baseline scores, yet slower decline when controlling for known risk factors. Results raise questions regarding the accuracy of baseline scores in predicting decline for Black individuals.

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**Keywords:** aging disorders, dementia - Alzheimer's disease, apolipoprotein E

**T. PRINCE, J. PAREDES, N. STARK, E. SCHWARTZ. MRI and Neuropsychological Comparisons of Native and Non-Native English Speakers with Alzheimer's Disease.**

**Objective:** Research suggests that bilingual individuals diagnosed with Alzheimer's disease (AD) experience onset of symptoms significantly later than native English speakers (NES), which may result from "cognitive reserve" in bilingual individuals. However, findings have been mixed when comparing structural and neurocognitive differences of individuals with the same age and education. The current project seeks to compare age- and education-matched NES to bilingual non-native English speakers (non-NES), using MRI and neuropsychological testing.

**Participants and Methods:** Fifty-two individuals (33 females), including 26 non-NES ( $M_{age} = 79.27$ ,  $M_{edu} = 13.08$ ) and 26 NES participants ( $M_{age} = 79.46$ ,  $M_{edu} = 13.38$ ), were selected from the National Alzheimer's Coordinating Center database. Inclusion criteria included a diagnosis of AD and neuropsychological testing within three-months of MRI. Exclusion criteria included a diagnosis of any other neurodegenerative condition, stroke history, and traumatic brain injury. Neuropsychological test scores were converted into percentiles using Shirk's normative calculator. Imaging of Dementia & Aging lab performed calculations for MRI data using Linux-based software.

All neuropsychological tests were administered in English. Participants were assigned to one of two groups: Primary language as English (i.e., NES group) and primary language as anything other than English (i.e., non-NES group). The non-NES group's primary language included Spanish, Japanese, Polish, German, Portuguese, Tagalog, Chinese, Dutch, Greek, Hungarian, and Romanian.

**Results:** There were MRI structural differences between groups in: left ( $d = 0.56$ ) entorhinal gray matter volume; left ( $d = 0.67$ ) and right ( $d = 0.83$ ) entorhinal cortical thickness; left ( $d = 0.75$ ) and right ( $d = 0.90$ ) inferior parietal gray matter cortical thickness; left ( $d = 0.81$ ) and right ( $d = 0.77$ ) inferior temporal cortical thickness; left ( $d = 0.81$ ) and right ( $d = 0.92$ ) superior temporal cortical thickness; left ( $d = 0.79$ ) and right ( $d = 0.91$ ) medial temporal cortical thickness; right middle temporal gray matter volume ( $d = 0.63$ ); left ( $d = 0.67$ ) orbitofrontal cortical thickness; right lateral orbitofrontal gray matter volume ( $d = 0.64$ ); right lateral orbitofrontal cortical thickness ( $d = 1.0$ ); and right medial orbitofrontal cortical thickness ( $d = 0.76$ ). There were significant group differences on Digit Span Forward (DSF) ( $d = 1.08$ ) and DSF length ( $d = 1.1$ ). Both groups were impaired, though without significant group differences, on Boston Naming Test, Logical Memory, Trails B, and Animal Fluency.

**Conclusions:** Results indicated that the non-NES group had greater volumes and cortical thickness in temporal regions, select areas of the prefrontal cortex, and inferior parietal lobe cortical thickness. Respectively, these areas are associated with memory, select executive functions, and multimodal functions (e.g., apprehension of multiple written and spoken words, abstract thinking). These structural differences are consistent with prior literature. However, further research is needed to determine the neuropsychological significance of these structural differences, as group differences were only significant on a simple attention test. Both groups were similarly impaired on a measure of memory, executive functioning, category fluency, and confrontation naming.

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**Keywords:** dementia - Alzheimer's disease, bilingualism, neuroimaging: structural

**F. L. LIBUTTI, Z. B. WOOD, L. BENNETT. Depression as a Moderator of Relationship between APOE  $\epsilon$ 4 Allele Presence and Alzheimer's Disease Severity.**

**Objective:** Prior research recognizes that the presence of one or two APOE  $\epsilon$ 4 allele(s) increases the risk of developing dementia, specifically Alzheimer's disease (AD). Additionally, research suggests presence of at least one APOE  $\epsilon$ 4 allele is associated with experiencing late-life depression. There is also evidence that individuals with depression and Alzheimer's disease demonstrate more cognitive and social impairments than nondepressed patients. The current study explored the impact of depressive symptoms (as measured by the Geriatric Depression Scale [GDS]) on the relationship between APOE  $\epsilon$ 4 allele presence and Alzheimer's disease symptom severity using data from the Alzheimer's Disease Neuroimaging Initiative (ADNI).

**Participants and Methods:** The current study utilized baseline APOE  $\epsilon$ 4 allele status, Cognitive Dementia Rating Scale (CDR) total score, and GDS total score data for 1,854 individuals from the Alzheimer's Disease Neuroimaging Initiative (ADNI). It was hypothesized that the relationship between presence of one or more APOE  $\epsilon$ 4 allele and Alzheimer's Disease symptom severity (as measured by the CDR total score) would be moderated by self-reported depression symptom severity (GDS total score). Analyses were conducted in SPSS version 25; moderation analyses were computed via the PROCESS v3.5 macros.

**Results:** Consistent with prior research, the presence of one or more APOE  $\epsilon$ 4 allele(s) was a significant predictor of Alzheimer's disease severity ( $p < 0.001$ ). Similarly, depression severity was a significant predictor of Alzheimer's disease severity ( $p < 0.001$ ). The study also found the interaction between depression symptom severity and presence of one or more APOE  $\epsilon$ 4 alleles was significant ( $p = 0.03$ ) and served to slightly attenuate the relationship between APOE  $\epsilon$ 4 allele presence and AD symptom severity. The effect size of the described analysis was small (0.0022).

**Conclusions:** The current findings further support key relationships between both presence of APOE  $\epsilon$ 4 allele(s) and depression symptom severity, and Alzheimer's disease severity documented in the literature. The negative association observed between self-reported depression symptom severity and AD symptom severity may be a reflection of the well-researched collinearity of anosognosia and AD symptom severity. In light of these results, further research examining the interaction of having at least one APOE  $\epsilon$ 4 allele and depressive symptoms on Alzheimer's disease symptom severity is warranted.

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**Keywords:** depression, anosognosia, dementia - Alzheimer's disease

**Z. B. WOOD, J. SCHOLL, S. SALONGA, L. BENNETT. Effect of Depressive Symptoms and Alzheimer's Disease Severity on Right Hippocampal Volume.**

**Objective:** The link between Alzheimer's disease and hippocampal atrophy is well-established. Additionally, there is evidence that depression is associated with a reduction in hippocampal volume; however, there are instances where this relationship is inconsistent. Sawyer et al. (2012) looked at the relationship between depression and the left and right hippocampal volumes finding only a relationship between depression and a reduction in right hippocampal volume.

**Participants and Methods:** In light of this, the current study sought to examine the impact of Alzheimer's disease symptom severity (as measured by Cognitive Dementia Rating [CDR] Scale total score) on right hippocampal volume when moderated by self-reported depressive symptoms (as measured by the Geriatric Depression Scale [GDS] total score) utilizing data from 98

participants from the Alzheimer's Disease Neuroimaging Initiative (ADNI). Analyses were conducted in SPSS version 25; moderation analyses were computed via the PROCESS v3.5 macros.

**Results:** After controlling for total brain volume, the effect of Alzheimer's disease symptom severity on right hippocampal volume was significant ( $p = 0.02$ ). While not reaching statistical significance, the interaction between depressive symptoms and Alzheimer's disease on right hippocampal volume was observed to be trending toward significance ( $R^2$  change = 0.03;  $p = 0.06$ ).

**Conclusions:** The current findings suggest the combination of Alzheimer's disease and depressive symptoms may have a larger negative impact on right hippocampal volume than either Alzheimer's disease or depressive symptoms independently. Notably, the restricted range of possible CDR Total Scores likely limited the current findings. Given the trend toward significance despite such a limitation, further research exploring the interaction of Alzheimer's disease and depression on right hippocampal volume appears warranted.

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**Keywords:** hippocampus, depression, dementia - Alzheimer's disease

### **W. NG, T. VIRDEN, J. POWELL. Functional Ability of Individuals with Alzheimer's disease, Apolipoprotein E $\epsilon$ 4, and Type 2 Diabetes.**

**Objective:** As the number of individuals aged 65 and older escalate, the prevalence for Alzheimer's disease (AD) and diabetes is projected to increase (Alzheimer's Association, 2020; Centers for Disease Control and Prevention, 2020). Though studies are mixed regarding cognitive outcomes and neuropathology in individuals with type 2 diabetes (DM2) and AD, the specific relationship concerning functional abilities is not well understood. More specifically, to our knowledge, no studies have explored the interactive effect of DM2 and ApoE  $\epsilon$ 4 status in individuals with AD. This study investigates the interaction of DM2 and ApoE  $\epsilon$ 4 status of autopsy confirmed AD individuals to determine whether DM2 and ApoE  $\epsilon$ 4 status promotes more severe functional impairment compared to AD individuals without DM2 and ApoE  $\epsilon$ 4 status.

**Participants and Methods:** Participants included 310 autopsy confirmed individuals with AD ( $M_{\text{age of death}} = 86$ ; 46.5% female) who completed the Functional Activities Questionnaire (FAQ) prior to death. Participants included the following groups: AD $\epsilon$ 4- (44.2%), AD $\epsilon$ 4+ (35.8%), AD/DM $\epsilon$ 4- (9.4%), AD/DM $\epsilon$ 4+ (10.6%). Archival data was obtained from the Banner Sun Health Research Institute Brain and Body Donation Program (BBDP) in Arizona. Functional impairment was analyzed using the analysis of variance (ANOVA).

**Results:** ANOVA yielded a significant main effect ( $F(3, 306) = 4.91$ ,  $p = .002$ ,  $\eta^2 = 0.05$ ). Fischer's LSD post hoc analysis indicated AD individuals with ApoE  $\epsilon$ 4 (AD $\epsilon$ 4+;  $M = 24.86$ ,  $SD = 8.63$ ) scored higher on the FAQ relative to those without ApoE  $\epsilon$ 4 (AD $\epsilon$ 4-;  $M = 20.93$ ,  $SD = 10.69$ ;  $p < .001$ ). Similarly, AD $\epsilon$ 4+ individuals scored higher on the FAQ compared to AD individuals with DM2 and without ApoE  $\epsilon$ 4 (AD/DM $\epsilon$ 4-;  $M = 20.21$ ,  $SD = 11.69$ ;  $p < .05$ ). No significant differences were found between those with and without DM2.

**Conclusions:** Results indicate individuals with AD and the ApoE  $\epsilon$ 4 gene have more functional impairment compared to AD individuals without ApoE  $\epsilon$ 4. Likewise, AD individuals with ApoE  $\epsilon$ 4 demonstrated more functional impairment than AD individuals with DM2 but without ApoE  $\epsilon$ 4. Findings indicate the presence of the ApoE  $\epsilon$ 4 gene may be a better predictor for functional

decline in individuals with AD than DM2. Interestingly, DM2 status did not seem to impact severity of functional ability and future studies may expand this research by examining protective factors (i.e., DM2 medications) that may impact functional abilities in this population.

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**Keywords:** diabetes, apolipoprotein E

**J. STOCKS, K. POPURI, M. BEG, L. WANG. Concordance between Cortical Neurodegeneration and FDG-PET Hypometabolism across Brain Networks Differentially Predicts Memory Decline in “A/T/N” subgroups of Alzheimer’s Disease.**

**Objective:** Converging evidence suggests that Alzheimer’s disease (AD) affects multiple large-scale brain networks. The understanding of relationships between alterations in brain structure and function across brain networks and how they relate to changes in cognition can increase our understanding of the disease process in AD. To this aim, we evaluated individual concordance between cortical thinning (neurodegeneration) and cortical glucose hypometabolism within distributed brain networks at baseline, and whether the concordance measures predicted longitudinal memory change within CSF-defined (i.e., amyloid, total tau, and p-tau) “A/T/N” subgroups of AD.

**Participants & Methods:** Alzheimer’s Disease Neuroimaging Initiative (ADNI) subjects with baseline CSF analysis, structural MRI and FDG-PET data: AD-Continuum (A+(T or N -/+), N = 559), Non-AD Pathologic Change (A-(T or N+), N = 149), Normal (A-T-N-, N = 179). T1-MPRAGE scans underwent FreeSurfer processing to estimate cortical thickness as the distance between white matter and pial matter at each vertex. Normalized <sup>18</sup>FDG-PET images were co-registered to T1-images and uptake values within the cortical gray matter were projected onto its FS corresponding cortical white surface. Neuroimaging data was parcellated according to a cortical network atlas by Ji et al. (2019). For each participant, Pearson correlations were computed between values of cortical thickness and FDG metabolism across all vertices within each network, reflecting concordance in the degree of atrophy and hypometabolism. Memory was assessed using a composite scale for memory (ADNI\_MEM) extracted from the ADNI neuropsychological battery. Model covariates include age, sex, education and APOE-4 genotype status. The rate of change in memory was modeled using a linear mixed effects model with fixed effects of time from baseline and model covariates. Multivariate analysis of variance models assessing the effects of A/T/N status on network concordance while accounting for model covariates were examined. The rate of change in memory for each individual was extracted from the model and associations to network concordance was tested using network-wise multivariate regression models corrected for model covariates.

**Results:** In AD-Continuum compared to Normal subjects, concordance was increased across brain networks excluding primary and secondary visual networks. In AD-Continuum compared to Non-AD pathological change subjects, there was greater concordance of atrophy and hypometabolism in networks known to be impacted in AD (e.g. default mode network, DMN), while Non-AD pathological change subjects showed greater concordance in the posterior multimodal network. The network-wise analyses showed that longitudinal ADNI-MEM decline was predicted by increased baseline concordance in the dorsal attention, language, frontoparietal and default mode networks among amyloid-positive AD-Continuum subjects. Among Non-AD Pathologic Change subjects, ADNI-MEM decline was predicted by increased concordance in the

language and default mode networks. No network relationships with ADNI\_MEM decline were found among Normal subjects.

**Conclusions:** Baseline measures of multimodal concordance are predictive of longitudinal cognitive change, with specific brain networks implicated dependant on A/T/N status. Multimodal neuroimaging analyses can unravel the structure-function relationships that contribute to clinical outcomes and diagnostic uncertainty in AD.

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**Keywords:** dementia - Alzheimer's disease, dementia - other cortical, neuroimaging: functional

**C. PLUIM, D. RENTZ, J. T. FOX-FULLER, J. E. MARTINEZ, C. VILA-CASTELAR, P. A. ADUEN, A. BAENA, R. A. SPERLING, K. PAPP, F. LOPERA, Y. QUIROZ. Digital Clock Drawing and Markers of Brain Pathology in Preclinical Autosomal Dominant Alzheimer's Disease.**

**Objective:** A digitized version of the Clock Drawing Test (DCTClock) is known to capture subtle nuances in cognitive performance with high spatial and temporal precision. Research has shown that DCTClock performance is related to early changes in memory and biomarkers in Alzheimer's disease (AD), and can discriminate cognitively impaired older adults from healthy controls. There is no previous research examining DCTClock performance in individuals with autosomal dominant AD (ADAD), who are virtually guaranteed to develop early-onset dementia in mid-life. Here we used the DCTClock in a Colombian cohort with Presenilin1 (*PSEN1*) E280A ADAD, and assessed how DCTClock performance relates to markers of brain pathology and verbal memory performance.

**Participants and Methods:** A total of 30 individuals with *PSEN1* E280A ADAD were enrolled in our ongoing study (12 non-demented carriers and 18 age, sex, and education-matched non-carriers; age 36 +/- 6 years old). Participants completed the DCTClock command (i.e., spontaneous clock drawing) and copy (i.e., drawing a replication) conditions, the Mini-Mental State Examination (MMSE), and the Consortium to Establish a Registry for AD Word List Learning (delayed recall; CERAD WLL). They also underwent Positron Emission Tomography (PET) scanning to measure cortical amyloid and regional tau burden (i.e., inferior temporal tau and entorhinal tau). For these preliminary analyses, Mann-Whitney tests and Spearman correlations were conducted to examine group differences and relationships among DCTClock performance, AD pathology, and verbal memory. DCTClock analyses included a combined total score (scored from 0 to 100) and four domain-specific scores (both command and copy conditions) of drawing efficiency, simple motor, information processing, and spatial reasoning.

**Results:** There were no differences between groups in DCTClock Total (Carriers= 44.7 (29.2), Non-Carriers= 61.3 (24.2);  $p=.134$ ) or composite scores. Carriers performed significantly worse on MMSE ( $p=.001$ ) and CERAD WLL delayed recall ( $p=.015$ ), and had greater cortical amyloid ( $p<.001$ ) and entorhinal tau burden ( $p=.025$ ), compared to non-carriers. In the whole sample, DCTClock Total scores correlated with education ( $r=.558$ ,  $p=.001$ ) and CERAD WLL delayed recall ( $r=.472$ ,  $p=.008$ ), but not with markers of AD pathology ( $p's>.28$ ). Further, command spatial reasoning scores negatively correlated with mean cortical amyloid ( $r=-.389$   $p=.034$ ) and entorhinal tau ( $r=-.418$ ,  $p=.021$ ). In the carrier-only group, only the positive association between DCTClock Total scores and CERAD WLL was significant ( $r=.719$ ,  $p=.008$ ). All correlations between AD pathology and Copy DCTClock composite scores were nonsignificant ( $p's>.08$ ).

**Conclusions:** Preliminary results suggest that DCTClock Total Score relates to verbal memory performance, and that command spatial reasoning may relate to AD pathology in non-demented individuals with *PSEN1* E280A ADAD. Findings also suggest that the DCTClock may be useful in detecting subtle cognitive changes in those at risk for AD, prior to clinical onset. Due to our small sample size, future research is needed to confirm our preliminary findings and further examine whether the DCTClock can be used to assess individuals in preclinical stages of AD, and distinguish non-demented ADAD carriers from non-carriers.

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**Keywords:** dementia - Alzheimer's disease, neuropsychological assessment

### **A. R. MCWATERS, P. VIK. Anosognosia Prevalence in a Community Sample of Older Adults.**

**Objective:** Many neurodegenerative diseases have anosognosia as an associated symptom, likely due to atrophy and hypoperfusion of frontal and tempo-parietal brain areas that occurs as a consequence of neurodegeneration (Salmon et al., 2006; Vogel et al., 2005; Zamboni et al., 2010).

Anosognosia has been found to predict dementia progression and severity of decline. Individuals with MCI display higher instances of anosognosia compared to non-clinical samples (Lehner et al., 2015; Mak, Chin, Ng, Yeo, & Hameed, 2015), and the presence of anosognosia in MCI predicts severity of decline and progression to Alzheimer's disease (Tabert et al., 2002).

Although there are multiple methods to assess anosognosia, a self-prediction and performance discrepancy method is often used in clinical settings and does not rely on an informant report (Starkstein et al., 2006). More research is needed to determine if anosognosia can be detected based on a discrepancy between patient self-report and performance on a brief cognitive screening measure. Therefore, the purpose of this study was to develop an approach to detect anosognosia based on discrepancy between the FrSBe, (a self-report executive/behavioral measure) and the MoCA (a measure of global cognitive functioning in a community sample of older adults).

**Participants and Methods:** Data was collected from a sample of older adults with English language fluency (N = 90) recruited through community outreach efforts. Participants were given the MoCA, FrSBe, DKEFS: CWIT, and CVLT-2. Participants were placed in four groups based on cognitive performance (MoCA) and subjective complaints (FrSBe). The Anosognosia group included participants scoring low on MoCA and within normal limits on FrSBe (N = 15; 16.1% of the total sample); (b) Insight group included participants scoring low on MoCA and high on FrSBe (N = 11; 11.8% of the total sample); (c) the Worried-Healthy group were participants who scored within normal limits on MoCA and high on FrSBe (N = 18; 19.4% of the total sample); (d) and the Healthy-Aware participants scored within normal limits on both MoCA and FrSBe (N = 49; 52.7% of the total sample).

**Results:** A series of 2x2 ANOVAs were conducted to test the interaction effect of MoCA x FrSBe performance. Although both low MoCA groups exhibited poorer performance on the CVLT-2 and the CWIT than the high MoCA groups, the interaction effect failed to improve the model for CWIT 3 ( $F(1, 88) = 3.148, p = .079$ ), CWIT 4 ( $F(1, 88) = 3.310, p = .072$ ), CVLT-2: Short Delay ( $F(1, 89) = .230, p = .632$ ) and Long Delay ( $F(1, 87) = 1.147, p = .287$ ).

**Conclusions:** The data did not support the original hypotheses; however, the research does highlight the complexity of measuring anosognosia, specifically in a community sample. This

research also highlights the inconsistency between executive functioning self-report and objective executive functioning measures. This provides further evidence that more information is needed to gauge awareness other than patient self-report. Capacity measures may have stronger ecological validity and are less confounded by presenting mood and anxiety symptoms. Further research is needed in this area.

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**Keywords:** anosognosia, aging disorders, cognitive functioning

**I. C. TURNEY, P. LAO, J. AVILA-RIEGER, M. ARCE RENTERÍA, J. M. VONK, D. SEBLOVA, K. IGWE, A. RIVERA, J. BERROA, M. MARTINEZ, A. GIUDICESSI, I. MARTINEZ ABREU, A. CABRERA, M. MONTOYA, N. SCHUPF, R. P. MAYEUX, J. J. MANLY, A. M. BRICKMAN. Is Brain Health in Middle-aged Adults Associated with Their Parents' Cognitive Status?**

**Objective:** There are racial and ethnic disparities in risk and prevalence of Alzheimer's disease (AD), with non-Hispanic Blacks and Latinx having a 2-fold increased risk compared with non-Hispanic whites. In the current study, we examined whether MRI markers of brain health in middle-aged adults are related to their parents' directly-assessed memory and diagnostic status. Transmission of AD risk might be mediated by degenerative factors in non-Hispanic whites, while mediated by vascular factors in non-Hispanic Blacks and Latinx. We hypothesized that in non-Hispanic whites, MRI markers of neurodegeneration, while in non-Hispanic Blacks and Latinx, markers of cerebrovascular disease, would be associated with memory impairment in their parents.

**Participants and Methods:** Participants were a 528 racially/ethnically diverse middle-aged older adults drawn from the Offspring study, who received MRI ( $M_{age} = 54.7 \pm 10.5$  years; non-Hispanic White  $n=32$ , non-Hispanic Black  $n=113$ , Latinx  $n=357$ ; women  $n=325$ ). They are the adult children of participants in the Washington Heights Inwood Columbia Aging Project, a community-based cohort study of aging and dementia representing the ethnic/racial diversity of upper Manhattan. Language preference among Latinx participants may capture relevant aspects of sociocultural experiences within race/ethnicity; thus, we treated Latinx tested in Spanish ( $n=230$ ) and English ( $n=127$ ) as distinct groups. We examined the relationship of MRI markers of neurodegeneration and cerebrovascular disease in Offspring study participants with directly-measured parental memory scores and cognitive impairment diagnostic status (i.e., clinical diagnosis of mild cognitive impairment/AD versus control).

**Results:** Parental memory was more strongly associated with hippocampal volume among non-Hispanic whites than among non-Hispanic Blacks, Latinx tested in English, and Latinx tested in Spanish. Parental cognitive impairment status was more strongly associated with white matter hyperintensity (WMH) volume among non-Hispanic Blacks and Latinx than among non-Hispanic whites. This effect was driven primarily by the observation that non-Hispanic whites whose parents had memory impairment had lower WMH volume than non-Hispanic Blacks and Latinx whose parents had memory impairment. These observed effects were of small magnitude. There was no association between parental cognition or diagnostic status and presence of infarcts or microbleeds across racial/ethnic groups.

**Conclusions:** Results suggest different pathways of transmission of risk from one racial/ethnic generation to the next, showing that parental memory impairment aggregates with markers of

neurodegeneration in non-Hispanic whites and with markers of cerebrovascular diseases in non-Hispanic Black and Latinx offspring.

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**Keywords:** cerebrovascular disease, ethnicity, neuroimaging: structural

**J. CARCAMO, A. J. KOCIOLEK, K. FERNANDEZ , Y. GU, C. W. ZHU, Y. STERN, S. COSENTINO. Neuropsychological Predictors of Severe Dependency in a Multiethnic Community Cohort of Individuals with Alzheimer’s Disease.**

**Objective:** Neuropsychological profile is a key contributor to the diagnosis of Alzheimer’s disease (AD) dementia. As a reflection of the underlying neuropathology, neuropsychological profile may also hold prognostic value for time to specific disease outcomes. The Dependence Scale (DS) is a validated tool that measures the amount of assistance needed by individuals with AD and has demonstrated comparable associations with markers of disease severity across both clinic and community-based cohorts. One component of the DS, the Equivalent Institutional Care (EIC) rating, appears to offer an unbiased assessment of care in multiethnic and community cohorts. Categories of the EIC include limited home care, adult home (supervised setting with frequent assistance in activities of daily living), and health-related facility. The aim of this study was to assess the predictive value of baseline neuropsychological tests for severe dependency in AD as defined by the EIC, in a multiethnic, community cohort.

**Participants and Methods:** One hundred and fifty elders diagnosed with AD at baseline and enrolled in the Predictors 3 cohort were seen for annual study visits with a mean follow up time = 3.30 years (SD=1.75), mean age=85.19 years, 72.7% had 0-8 years of education, 80.7% were females, and the majority were Hispanic (84%), while 11.3% were Black and 4.7% were White. Participants were assessed for level of everyday function using the Clinical Dementia Rating (CDR) scale, presence of extrapyramidal symptoms, and a neuropsychological test battery spanning the following four areas: *Semantic Processing* (15-item Boston Naming Test (BNT) and Category Naming: Animals, Food, Clothing); *Executive Functioning* (Letter Fluency (CFL) and Wechsler Adult Intelligence Scales-Revised (WAIS-R) Similarities subtest); *Memory* (Selective Reminding Test (SRT), a serial list learning task consisting of recall and recognition components); and *Visuospatial* (5-item Rosen Drawing Test). Additionally, participants were assigned an EIC rating as part of the Dependence Scale at each annual visit. Cox proportional hazard models, adjusted for baseline age, gender, ethnicity, education, presence of extrapyramidal signs, and CDR score, were used to determine the predictive value of each neuropsychological test at baseline on relative risk of meeting severe dependency defined by the EIC rating.

**Results:** Cox proportional hazards indicated that Semantic Processing and Memory scores were associated with higher risk of severe dependency (BNT (hazard ratio (HR)=.902, p=.047), Category Naming (HR=.835,p<.001), SRT Total Recall (HR=.966,p=.049), SRT Delayed Recall (HR=.798,p=.026), and SRT Recognition (HR=.877,p=.008). Executive Functioning and Visuospatial scores were not predictive of the EIC severe dependency endpoint.

**Conclusions:** The integrity of semantic processing and memory abilities in the mild stage of dementia appears to predict time to severe dependency in a multiethnic community cohort of elders diagnosed with AD. These results, consistent with the literature demonstrating that both semantic processing and memory can help predict the progression of AD, extend knowledge regarding predictors of disease outcomes to a multiethnic community cohort. Interestingly, these

results diverge from work demonstrating that disproportionate executive dysfunction predicts mortality in a similar cohort, perhaps suggesting that the disease mechanisms which contribute to severe dependency and mortality are not one in the same.

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**Keywords:** cognitive neuroscience, aging disorders, neuropsychological assessment

**N. HEYDARI, M. J. HAMBERGER. The Relation between Subjective and Objective Naming in Healthy Aging, Mild Cognitive Impairment, and Alzheimer's Disease.**

**Objective:** Word-finding or "naming" difficulty increases with age and can become more severe in individuals with Mild Cognitive Impairment (MCI) and Alzheimer's disease (AD). As subjective naming difficulty may improve diagnostic clarity for detection of neurodegenerative diseases, we asked more targeted questions regarding subjective experience to determine whether this level of detail would improve the relation between subjective and objective naming. Specifically, we asked participants to rate their level of difficulty: 1) naming objects in their environment, and 2) in everyday conversations. We hypothesized that 1) most people experience word-finding difficulty in everyday discourse, and 2) subjective naming difficulties in conversations would correlate with auditory naming performance, whereas, subjective naming difficulty for objects would correlate with visual naming performance.

**Participants and Methods:** Participants were 407 healthy adults, 41 PAD, and 16 MCI patients ages 56-100 (mean (SD): Controls: Age: 72.64 (10.6), Education: 15.0 (2.5), FSIQ: 104.7 (16.2); PAD: Age: 75.7 (6.9), Education: 16.5 (2.8), FSIQ: 99.33 (16.1); MCI: Age: 75.1 (8.0), Education: 16.3 (2.8), FSIQ: 108.6 (14.0)). Subjective word-finding difficulty was assessed using two 7-point Likert scales: 1) How often does word-finding difficulty occur when naming objects and 2) How often does word-finding difficulty occur during everyday conversations. Objective naming was assessed with the Older Adult Auditory Naming (ANT) and Visual Naming tests (VNT). ANT and VNT scores were converted to age- and education-stratified z-scores (Number Correct, Response Time (RT), and Tip-of-the-tongues (TOT; items named 2-20 seconds or after 20 seconds following a phonemic cue). One-way ANOVAs compared demographic data, and object and conversation frequency across groups. Pearson correlations analyzed relations between subjective and objective measures.

**Results:** There were no groups differences in FSIQ or Age, however, healthy adults were less educated than MCI and PAD patients,  $p < 0.05$ . While MCI and PAD patients did not differ in subjective ratings of object versus conversation naming difficulty, controls reported more frequent difficulty in conversations ( $M = 2.55$ ,  $SD = 1.26$ ) than when naming objects ( $M = 0.95$ ,  $SD = 1.07$ ,  $p < .001$ ). For MCI patients, higher ratings of subjective difficulty in conversation were associated with slower RT for auditory naming,  $p = 0.049$ . For PAD patients, conversation frequency was associated with auditory naming RT, TOT, and number correct, as well as visual naming RT, all  $p < 0.05$ . Controls showed no significant relations between subjective and objective naming.

**Conclusions:** As hypothesized, healthy older adults rated word-finding as more frequent during conversations than when naming objects; however, correlations between subjective and objective naming were not significant, likely reflecting the truncated range of performance in a healthy sample. By contrast, MCI and AD patients exhibited comparable ratings for word-finding difficulty during conversations and when naming objects, yet, only ratings for conversations correlated with naming performance (i.e., both ANT and VNT). Results suggest that subjective

word-finding difficulty in conversations aligns with both auditory and visual naming performance in patients on a trajectory of decline. Thus, asking this more specific question that is better matched to patient experience might improve detection of early signs of decline, potentially assisting with diagnosis of MCI and AD.

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**Keywords:** naming

**S. SADAGHIYANI, K. DAVIS, J. JOPPICH, B. M. HAMPSTEAD, A. RAHMAN-FILIPAK. Interest and Willingness to Engage in Alzheimer’s Disease Risk Disclosure in a Racially Diverse Sample of Older Adults and their Caregivers.**

**Objective:** Through advances in genetic and imaging research, multiple indicators or biomarkers have been validated to quantify Alzheimer’s Disease (AD) pathology and/or associated risk for Dementia-Alzheimer’s type (DAT) before symptoms arise. However, this information is rarely shared in clinical or research settings. Little is known about whether patients want to know their DAT risk, or how they may plan to use this information in the future. The current study aimed to assess racial differences in participant ( $n=34$ ; 41.2% African-American) and caregiver ( $n=35$ ; 33.3% African-American) willingness to engage in DAT risk disclosure based on four different sources of information: clinical information, structural neuroimaging, apolipoprotein-E (APOE) genetic profile, and/or amyloid and tau burden on positron emission tomography (PET) imaging. We also aimed to identify perceived benefits and barriers to engaging in DAT risk disclosure among these respondents.

**Participants and Methods:** Participants and their current or potential caregivers were recruited from the longitudinal observational cohort of the Michigan Alzheimer’s Disease Research Center (MADRC) or two MADRC-associated studies, through which they were consensus diagnosed as either cognitively healthy or with Mild Cognitive Impairment (MCI). Respondents were asked about their level of interest in learning about their risk for DAT based on standard clinical information, structural neuroimaging, APOE status, or amyloid/tau positivity separately (0 = no interest, 4 = strong interest). They were also asked to provide a “yes/no” response to whether they would choose to engage in disclosure based on each level of information. Semi-structured interviews were also used to determine perceived benefits of and barriers to engaging in risk disclosure for each group.

**Results:** Mann-Whitney U tests revealed no race- or sex-based differences in interest in any of the four risk disclosure categories for participants (clinical information:  $U = 130, p = .232$ ; structural neuroimaging:  $U = 137, p = .830$ ; apolipoprotein-E genetic profile:  $U = 126, p = .337$ ; PET imaging:  $U = 129, p = .491$ ) or caregivers (clinical information:  $U = 136, p = .909$ ; clinical neuroimaging:  $U = 137, p = .979$ ; apolipoprotein-E genetic profile:  $U = 126, p = .570$ ; PET imaging:  $U = 137, p = .979$ ). Furthermore, 100% of participants and a minimum of 88.9% of caregivers reported that they would choose to receive the participant’s DAT risk information for each of the risk indicators. Fisher’s Exact tests demonstrated that no differences in these proportions vary by race, sex, or diagnosis. While listed benefits of DAT risk disclosure were copious and varied, most participants (91.2%) and caregivers (80%) did not endorse any significant barriers to engaging in risk disclosure, even when common risks or concerns were provided.

**Conclusions:** Our results suggest that, regardless of race or whether cognitively healthy or symptomatic, the majority of patients and respective caregivers would want to know all aspects

of their risk for AD/DAT equally. These findings indicate the need to develop both psychoeducation about the benefits and risks of AD biomarker disclosure, as well as empirically-supported, culturally-sensitive disclosure protocols to diverse patients and families.

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**Keywords:** dementia - Alzheimer's disease, aging disorders

**P. A. ADUEN, J. E. MARTINEZ, A. BAENA, Y. BOCANEGRA, J. R. GATCHEL, L. RAMIREZ-GOMEZ, E. GUZMÁN-VÉLEZ, C. VILA-CASTELAR, J. T. FOX-FULLER, C. PLUIM, F. LOPERA, G. M. SLAVICH, Y. QUIROZ.** Association of Lifetime Stress Exposure with Cognition and Brain Pathology in Autosomal Dominant Alzheimer's Disease: Preliminary Findings from the COLBOS Project.

**Objective:** It is well documented that acute and chronic stress exposure are associated with increased risk for a large array of mental and physical health conditions. Stress constructs, including lifetime stress exposure and perceived severity, have been linked to poorer cognitive function and faster decline in healthy older adults and those diagnosed with Alzheimer's disease (AD). To our knowledge, there is limited research examining lifetime stress exposure in Autosomal Dominant Alzheimer's Disease (ADAD) and its relation to cognition and pathologic burden. In this cross-sectional study, we aimed to examine whether greater lifetime and recent stress exposure were associated with worse cognition and elevated amyloid and tau pathology in a sample of cognitively unimpaired members from the largest known ADAD kindred.

**Participants & Methods:** A total of 22 members of the Colombian kindred with the Presenilin1 (PSEN1) E280A mutation (12 non-demented carriers; 10 non-carriers matched for age, sex, and education; *M* age= 37, 68.2% female) were included. Participants completed the Stress and Adversity Inventory (STRAIN) to assess cumulative and recent (past 6 months) stress exposure and severity. Memory and executive functioning, domains known to be sensitive to early changes in AD and stress exposure, were assessed with the Free and Cued Selective Reminding Test (FCSRT) and FAS/Animal fluency tasks. Patients underwent Positron Emission Tomography (PET) to measure cortical amyloid and regional tau burden (i.e., inferotemporal/entorhinal tau). Mann-Whitney U tests and Spearman correlations were used to explore group differences and relations among cumulative/recent stress exposure, cognition, and AD pathology.

**Results:** Groups did not significantly differ across demographic variables of age, sex, or education (all  $p > .05$ ). Compared to non-carriers, carriers had greater cortical amyloid burden ( $p < .001$ ) and lower immediate free recall performance (Trial 3 FCSRT), (Mann Whitney-U=28.00,  $p = .036$ ), but did not significantly differ in regional tau burden or verbal fluency measures (all  $p > .05$ ). With regard to stress exposure, carriers and non-carriers did not significantly differ in lifetime stressor count or severity, nor recent stressor count (all  $p > .05$ ). However, there was a tendency toward carriers reporting more severe recent stressors than non-carriers (Mann-Whitney U=85.50,  $p = .09$ ). When examining the entire sample, AD-related PET biomarkers were not significantly related to stress variables of interest, when controlling for age (all  $p < .05$ ). There was a tendency toward more severe recent stressors and worse immediate recall performance on the FCSRT ( $r = -.36$ ,  $p = .09$ ). In carriers only, greater recent stressor count and lifetime chronic stressor count tended to be related to worse semantic fluency ( $r = -.58$ ,  $p = .05$ ) and delayed recall performance ( $r = -.52$ ,  $p = .08$ ).

**Conclusions:** Preliminary findings of this ongoing study suggest that recent stress exposure and severity may influence immediate learning processes, while lifetime chronic stress exposure may influence memory recall in non-demented PSEN1 E280A mutation carriers. In keeping with prior studies, preliminary data highlight the potential role of stress and its impact on cognition, even among those with a genetic risk to develop dementia. With ongoing data collection, we aim to examine the role of stress in rate of cognitive decline and accumulation of AD-pathology over time.

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**Keywords:** dementia - Alzheimer's disease, cognitive functioning, chronic stress

**H. FATIMA, A. PARKER, B. K. MOKHTARI, A. CARLEW, L. H. LACRITZ, J. SCHAFFERT, M. CULLUM. Functional Ability Questionnaire Ratings Predict Time to Nursing Home Placement in Patients with Alzheimer's Disease.**

**Objective:** Nursing home placement is a common occurrence following a dementia diagnosis, with an admission rate of 20% after one year and 50% in five years. Recent research on predictors of nursing home placement identified deficits in instrumental activities of daily living (IADLs) as a significant risk. Identifying measures that are predictive of later nursing home admission can assist in the development of community support plans to delay costly care facility placements. This study examined the utility of the Functional Abilities Questionnaire (FAQ) as a predictive measure of subsequent nursing home placement in patients with Alzheimer's disease (AD).

**Participants and Methods:** 137 patients ( $M_{age}=77.37$ ,  $SD=9.16$ ) with a diagnosis of Probable or Possible AD and subsequent nursing home placement were obtained from the National Alzheimer's Coordinating Center Dataset. Patients' informants completed the FAQ (max score of 30), assessing patient IADLs over the past month. The total FAQ score ( $Mean=23.04$ ,  $SD=8.07$ ) from the first visit with a clinical AD diagnosis was used. Time in months from initial diagnosis to nursing home placement was computed ( $M_{months}=21.08$ ,  $SD=19.55$ ). Mean MMSE scores and Clinical Dementia Rating-Sum of Boxes were 18.53 ( $SD=15.51$ ) and 9.63 ( $SD=5.02$ ) respectively. Hierarchical multiple regression was used to examine the relationship between AD participants' total FAQ and time to nursing home placement, controlling for sex, race, age and marital status at the time of diagnosis.

**Results:** Sex, race, age and marital status were entered at Step 1, explaining 3.8% of the variance in time to nursing home placement. After entry of FAQ total at Step 2, the total variance explained by the model as a whole was 15.9%,  $F(5,131) = 4.96$ ,  $p < .001$ . FAQ total explained an additional 12.1% of the variance in time to nursing home placement, after controlling for sex, race, age, and marital status,  $R^2 \text{ change} = .12$ ,  $F \text{ change}(1,131) = 18.87$ ,  $p < .001$ . In the final model, only FAQ ratings at the time of AD diagnosis significantly predicted time to nursing home placement (beta value =  $-.354$ ,  $p < .001$ ). Sex, race, age, and marital status were not predictors of time to nursing home placement. For every one-point increment in FAQ score, time to nursing home placement decreased by .86 months.

**Conclusion:** In patients with a clinical diagnosis of AD, informant functional ratings on the FAQ at initial diagnosis were predictive of time to future nursing home placement. These findings support the utility of IADL measures such as the FAQ in patients with dementia to inform future care planning. Additional examination of the nature and severity of functional impairments that are most predictive of nursing home placement would help to further refine the use of IADL

measures in this population. Furthermore, early identification of future patient care needs may help to target community interventions.

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**Keywords:** activities of daily living, assessment, planning

**J. L. JOYCE, S. CHAPMAN, R. E. ABRAHAM, K. CHAN, M. BARKER, S. RIZER, P. SUNDERARAMAN, W. C. KREISL, S. COSENTINO. Mood Symptoms Do Not Change the Sensitivity of Subjective Cognitive Decline to Intrusions.**

**Objective:** Mood disturbances, such as depression or anxiety, have historically been a differential diagnosis for Alzheimer's disease (AD) and related disorders, but growing evidence suggests that psychiatric symptoms among older adults may in fact represent early manifestations of degenerative disease. Likewise, the presence of depression, anxiety, or both has been proposed to confound the utility of Subjective Cognitive Decline (SCD) as a marker of preclinical AD. However, psychiatric symptoms may increase rather than decrease the concern for preclinical AD in individuals with memory complaints. In this study, we examine whether considering mood symptoms affects the utility of SCD as a sensitive early cognitive marker of AD, specifically, intrusions on a list learning test.

**Participants and Methods:** 90 cognitively normal older adults were assessed for SCD, anxiety, depression, and memory. SCD was measured with a 20-item age-anchored questionnaire (i.e., "in comparison to others your age"). Anxiety and depression were assessed with the Beck Anxiety Inventory and the Geriatric Depression Scale. Intrusions were measured with the Loewenstein-Acevedo Scales of Semantic Interference and Learning (LASSI-L). Demographically adjusted (age, sex, education and race), cross-sectional, linear regression models were conducted to examine SCD, anxiety, and depression as individual and combined predictors of intrusions. Models were evaluated using R Square, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC).

**Results:** Whilst individual models examining depression ( $F(5,84) = 4.01, p = .003$ ; R square = .19; AIC = -371.180; BIC -356.181) and anxiety ( $F(5,84) = 4.56, p = .001$ ; R square = .22; AIC = -368.472; BIC -368.472) were significant, neither depression nor anxiety themselves were significant predictors of intrusions ( $p > .05$ ). In contrast, the individual model containing SCD was significant ( $F(5,83) = 5.13, p < .001$ ; R square = .24; AIC = -372.075; BIC = -357.143) and SCD predicted intrusions ( $b = .24, p = .015$ ). The combined model including both SCD and anxiety was significant ( $F(6,81) = 4.29, p = .001$ ; R square = .24; AIC = -365.335; BIC -347.993) but neither SCD nor anxiety independently predicted intrusions ( $p > .05$ ). The combined model including both SCD and depression was also significant ( $F(6,82) = 4.23, p = .001$ ; R square = .24; AIC = -370.116; BIC = -352.695) but only SCD predicted intrusions ( $b = .25, p = .017$ ).

**Conclusions:** In the current study, the model that included SCD only best predicted intrusions on a challenging list-learning test. Mood symptoms such as self-reported anxiety and depression did not add to the sensitivity of SCD to intrusions, nor did the models examining either mood symptom as individual predictors of intrusions achieve a better model fit than SCD alone. Current results therefore suggest that although mood symptoms may at times signal the earliest stages of degenerative disease, they do not appear to strengthen SCD's association with a marker of subtle cognitive dysfunction. However, differentiation between longstanding and new-onset mood complaints may help further disentangle this relationship. Ongoing longitudinal work is

examining the clinical evolution of individuals to determine the extent to which the cross-sectional associations seen between SCD, mood, and intrusions evolve over time.

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**Keywords:** neuropsychological assessment, depression, anxiety

**Z. ZHENG, M. BARKER, R. PATEL, L. S. HONIG, S. RIZER, M. FEITOSA, S. L. ANDERSEN, S. AUERBACH, L. N. RAMDAS, A. I. YASHIN, A. M. KULMINSKI, K. CHRISTENSEN, S. COSENTINO. Associations Between Education and Cognitive Profiles at Time of Alzheimer's Disease Diagnosis.**

**Objective:** Cognitive profiles are used to make inferences about the distribution of underlying neuropathology, and are thus a valuable component of the differential diagnosis process during dementia evaluations. However, it is possible that factors such as educational attainment may contribute to cognitive profile. Indeed, educational attainment plays an important role in the cognitive functioning of older adults and has been shown to differentially impact specific cognitive domains. While the vast majority of individuals diagnosed with dementia due to Alzheimer's Disease (AD) demonstrate episodic memory impairment, patterns of performance in language, executive functioning, and visuospatial domains differ across individuals. We aimed to understand the extent to which education may influence cognitive profiles across these domains at the time of AD diagnosis.

**Participants and Methods:** Participants included 42 older adults enrolled in the multi-site, longitudinal Long Life Family Study, who were diagnosed with probable AD by clinical consensus, based on neuropsychological testing, assessment of everyday functioning, and history provided via informants on a dementia survey. Raw scores on neuropsychological tests were converted to demographically-adjusted z-scores (age, education, and sex) using the National Alzheimer's Coordinating Center normative database. Participants were assigned a cognitive profile score reflecting z-score discrepancies across domains of language, executive function, and episodic memory. The language-memory profile score was calculated by subtracting Animal Fluency from Logical Memory Delay. The executive-memory profile score was calculated by subtracting Trail Making Part B from Logical Memory Delay. The executive-language profile score was calculated by subtracting Trail Making Part B from Animal Fluency. Linear regressions were conducted to examine the association between education, measured in years, and cognitive profile z-scores. The visuospatial domain was examined separately as a dichotomous score using the MMSE Pentagons (intact vs. impaired). An independent samples t-test examined the extent to which education differed between participants with and without visuospatial impairment.

**Results:** Education was a significant predictor of the executive-language profile score ( $p=.032$ ). Specifically, fewer years of education was associated with a greater relative impairment of executive function compared to language. Participants with impaired visuospatial skills had significantly fewer years of education as compared to those without impairment ( $p=.025$ ). After controlling for age, this difference between the two groups trended towards, but did not reach, significance ( $p=.071$ ). Education was not a significant predictor of either language-memory or executive-memory profile scores (both  $p >.05$ ).

**Conclusions:** Education appears to play a role in the cognitive profile of AD at the time of diagnosis. Specifically, fewer years of education may produce a profile in which executive function is more compromised than semantic fluency. Understanding the effects of education not

just on individual tests, but on cognitive profiles themselves, is of great significance in both research and clinical contexts. These findings have relevance for the development of specific diagnostic assessments for individuals with different educational backgrounds, and for the differential diagnosis of dementia subtypes.

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**Keywords:** executive functions, language, visuospatial functions

**M. ARCE RENTERÍA, J. M. VONK, M. MARTINEZ, P. LAO, I. C. TURNEY, J. AVILA-RIEGER, M. MONTOYA, R. P. MAYEUX, A. M. BRICKMAN, J. J. MANLY. Active Bilingualism, Parental Alzheimer's Disease, and Cognitive Performance among Middle-aged Latinx.**

**Objective:** Parental history of Alzheimer's disease (AD) increases dementia risk and is associated with greater cognitive impairment in middle age. Hispanics/Latinx (hereafter Latinx) are at increased risk for AD compared with non-Hispanic whites. It is critical to determine factors that confer protection and resilience towards AD in this at-risk population. Bilingualism may protect against cognitive aging, but bilinguals can differ on various characteristics (e.g., frequency of bilingual language use). Most studies on the effect of bilingualism on dementia risk examine group differences between bilinguals and monolinguals, treating bilinguals as a monolithic group. We investigated if active bilingualism, defined as daily use of two languages, protected against the effect of parental AD status on cognition compared to passive bilingualism (acquisition of a second language but only using one daily) among bilingual middle-aged Latinx adults. We hypothesized that active bilingualism would be associated with better cognition than passive bilingualism, and active bilingualism would promote resilience to AD risk due to parental AD status.

**Participants and Methods:** We assessed cognition using the NIH Toolbox Cognition battery in 185 English-Spanish bilingual middle-aged Latinx adults with ( $n=68$ ) and without ( $n=117$ ) determined parental AD status ( $M_{age}=55\text{yrs}\pm 11$ ; 71% women). The cognitive domains of processing speed, set-shifting, working memory, and inhibition/attention were measured with the NIH Toolbox Cognition battery. Bilingualism was determined by self-reported use of English and Spanish. Active bilinguals reported using both languages daily. We evaluated the effects of bilingualism and parental AD on cognitive domain scores, adjusting for age, sex, years of education, immigration status, and parental education.

**Results:** Latinx passive bilinguals on average had fewer years of education, were more likely to have been tested in Spanish and were more likely to be an immigrant compared to Latinx active bilinguals. Our primary hypothesis was partially supported, in that active bilinguals performed better on tests of processing speed ( $B=-3.79$ , 95%CI[-6.18,-1.41]) compared with passive bilinguals, but no differences were found for other cognitive domains. Parental AD status was not reliably associated with cognitive performance. There was no difference in the relationship of parental AD status with executive function between active and passive bilinguals (all  $p$ 's>.10).

**Conclusions:** While active bilingualism was associated with better processing speed, it was not associated with improved cognitive functioning across other aspects of executive functioning. Although we did not find that active bilingualism protected against the negative effects of parental AD, there was no overall effect of parental AD on cognition in this sample. Longitudinal studies are needed to evaluate the effect of active bilingualism on rate of cognitive decline and its association with biological markers of disease.

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**Keywords:** bilingualism, cognitive reserve, dementia - Alzheimer's disease

**L. D. NELSON, J. R. BARRIO. Longitudinal study of changes in amyloid and tau biomarkers in Alzheimer's disease and Down syndrome.**

**Objective:** To document longitudinal changes in physiological biomarkers of Alzheimer's disease in Down syndrome.

**Participants and Methods:** A cohort of  $n = 15$  adults with intellectual disability and trisomy 21 Down syndrome was derived from our original sample ( $N = 19$ ), previously reported. Two of the cardinal symptoms of AD,  $\beta$ -amyloid and tau, were measured using a radiolabeled compound, called [ $^{18}\text{F}$ ]FDDNP, and results were compared to resting-state glucose metabolic rate ([ $^{18}\text{F}$ ]FDG). Neuropsychological testing was conducted. Two male participants died approximately three months and three years post follow-up and brain autopsies were performed.

**Results:** Results of mixed model statistical design showed *age* as the predominant variable significantly associated with increased global levels of  $\beta$ -amyloid and tau throughout the brain.

A significant interaction of age X time X brain region of interest (ROI) was demonstrated based on [ $^{18}\text{F}$ ]FDG PET, supporting region-specific steady decline in brain function over time. Only socio-behavioral (not cognitive) levels of functioning significantly predicted global [ $^{18}\text{F}$ ]FDG SUVR level change over time. Immunohistochemical assay analysis of A $\beta$ -42 and A $\beta$ -40 and tau levels in their brain tissue showed high degree of specificity in expected directions between results of *in vivo* and post-mortem data.

**Conclusions:** Preliminary support for reliability of this combined physiological, functional, and psychometric method of measuring Alzheimer's disease biomarkers, and tracking *changes* in beta-amyloid and tau levels over time, was indicated. Critical analysis of *psychometric* outcome variables raised new issues regarding validity of subjects' report. Preliminary results based on this sample support a reliable method of early detection of Alzheimer's disease in this population. This conclusion was supported by high degree of specificity in expected directions between results of *in vivo* and post-mortem data. Potential for diagnostic capability of this method in people at risk for Alzheimer's disease was indicated.

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**Keywords:** intellectual disability, neurophysiology, social processes

**A. DENNY, A. J. DACOSTA, M. YOUSIF, A. LOGALBO. Neuropsychological Risk Factors for Progression of Mild Cognitive Impairment to Alzheimer's Disease.**

**Objective:** The present study examines various neuropsychological test data and their association with the stability of mild cognitive impairment (MCI) over time or progression of MCI to dementia of the Alzheimer's type (AD) in a memory disorder clinic sample.

**Participants and Methods:** Twelve years of archival cognitive testing data from 94 Health First Memory Disorder Clinic (HFMD) patients was utilized. Participants were included in this study if they were diagnosed with MCI following initial cognitive testing and then re-evaluated and diagnosed with either stable MCI, dementia of the Alzheimer's type (AD), or mixed dementia (dementia of the Alzheimer's type and vascular dementia). Patients' cognitive testing data was obtained from an existing research database at HFMD and included as predictors in this present study.

**Results:** Participants with a lower "best" score (highest number of words recalled on one individual learning trial) on a 10-item word list were more likely to progress to dementia, with an odds ratio of 2.211 (95% CI, 1.079 to 4.530), Wald,  $\chi^2(1) = 4.697, p = .030$ . Participants who obtained lower scaled scores on semantic fluency were more likely to convert to dementia, with an odds ratio of 1.255 (95% CI, 1.091 to 1.445), Wald,  $\chi^2(1) = 10.047, p = .002$ . Participants who endorsed more items on the Geriatric Depression Scale (GDS) were also more likely to convert to dementia, with an odds ratio of 1.751 (95% CI, 1.134 to 2.705), Wald,  $\chi^2(1) = 6.387, p = .011$ .

**Conclusions:** Subtle deficits in performance on tasks of verbal learning and semantic fluency, as well as elevated levels of depression, appear to be significant risk factors for progression of MCI to AD across evaluations. These results suggest that pattern analysis of neuropsychological testing can assist in detection of patients in the prodromal phase of AD. Future research should attempt to replicate these findings in the context of other dementia subtypes.

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**Keywords:** dementia - Alzheimer's disease, mild cognitive impairment, neuropsychological assessment

**S. J. BANKS, A. A. TSIKNIA, E. E. SUNDERMANN, K. J. BANGEN. Sex Differences in the Relationship Between Cardiovascular Risk, Cerebral Blood Flow and Cognition.**

**Objective:** Women on the Alzheimer's disease (AD) trajectory differ significantly from men in terms of both cognitive decline and the extent of pathology. Studies have shown that women can bear a bigger burden of pathology without jeopardizing cognitive performance when compared to men. Additionally, studies have confirmed the importance of cardiovascular risk in the development and progression of AD. Here, we examine sex differences in the effects of cardiovascular risk, measured by a composite score accounting for inherent cardiovascular sex-differences, on regional cerebral blood flow (CBF), measured by arterial spin labelling MRI (ASL-MRI). Finally, we investigated how CBF differentially impacts cognition in men and women. **Methods:** 46 women and 50 men with mild cognitive impairment or dementia from AD Neuroimaging Initiative were included. We calculated the Framingham Heart Study cardiovascular disease risk algorithm (FHS-CVD). CBF was measured on average  $1.46 \pm 1.44$  years later in temporal regions known to be affected in AD, including the hippocampus (HC) and inferior temporal gyrus (ITG). Using linear regressions we examined the interactive effects of sex and FHS-CVD on CBF while controlling for age, precentral gyrus CBF, amyloid status and time between FHS-CVD assessment and ASL scan. We further investigated the relationship between regional CBF and memory performance (Rey Auditory Verbal Learning Test: AVLT learning) and a combined index of cognition and function (Clinical Dementia Rating Sum of Boxes: CDR-SB). **Results:** While there were no significant main effects of sex or FHS-CVD on CBF, there was a significant interaction between sex and FHS-CVD on subsequent ITG CBF ( $p = 0.004$ ), such that higher FHS-CVD predicted significantly lower CBF in women ( $p = 0.028$ ) but not men. We found no relationship between FHS-CVD and HC CBF in either sex. We observed a significant interaction effect of sex and CBF (ITG  $p = 0.008$ , HC  $p = 0.029$ ) on CDR-SB. Specifically, higher ITG and HC CBF was associated with lower (better) CDR-SB in males ( $p = 0.001$ ,  $p = 0.030$  respectively) but there was no relationship between regional CBF and CDR-SB in females. Lastly, although we found no interaction effect of sex and CBF on RAVLT learning score, when stratifying by sex, men with higher HC and ITG CBF had a higher RAVLT learning score ( $p = 0.015$ ,  $p = 0.038$  respectively). However, no such relationship was observed

in women. Conclusion: These results illustrate an important sex difference in the relationship between vascular risk and CBF in a region involved in AD, in clinically impaired older adults. While women in this group showed reduced ITG CBF when they had higher cardiovascular risk, inferior temporal CBF did not relate to cognition. Men appeared more cognitively vulnerable to the impact of reduced CBF, although CBF was not associated with cardiovascular risk. This provides further evidence that women with AD have cognitive reserve, but extends previous findings to vascular pathology. Although these results are preliminary in nature, they warrant further investigation of the ways in which cardiovascular risk differentially affects cerebrovascular health, and in turn cognition, in men and women.

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**Keywords:** cognitive reserve, dementia - Alzheimer's disease

**S. J. BANKS, Y. ZHAO, D. M. JACOBS, E. E. SUNDERMANN, R. A. BERNIER, S. EDLAND. The Impact of Sex and Amyloid Status on Cognitive Performance in Aging.**

**Objective:** While there is increasing awareness of sex difference in cognitive performance in symptomatic Alzheimer's disease (AD), little is known about sex effects on cognition in preclinical AD (i.e., overall normal cognition but positive  $\beta$ -amyloid testing). We sought to determine (A) if there are group-level differences between men and women who are  $\beta$ -amyloid positive or negative on neuropsychological measures and (B) if cognitive test scores be used to predict  $\beta$ -amyloid status.

**Participants and Methods:** 4146 participants were included from the Anti-Amyloid Treatment in Asymptomatic Alzheimer's Disease (A4) clinical trial and Longitudinal Evaluation of Amyloid Risk and Neurodegeneration (LEARN) cohort datasets. In the  $\beta$ -amyloid positive sample (n=1182), 58.7% were women. In the  $\beta$ -amyloid negative sample (n=2964), 59.4% were women.  $\beta$ -amyloid status was determined by florbetapir PET, dichotomized as SUVR > 1.15 ( $\beta$ -amyloid positive), and SUVR  $\leq$  1.09 ( $\beta$ -amyloid negative). Cognitive assessments included the A4 primary outcome measure (the Alzheimer's Disease Cooperative Study Preclinical Alzheimer Cognitive Composite: PACC), a cognitive battery, and the experimental C3 computerized battery which incorporates aspects of the Cogstate Brief Battery, Face Name Association Test and the Behavioral Pattern Separation Task-Object (BPST).

Multivariate Linear regression models were used to assess the independent and interactive effects of sex and  $\beta$ -amyloid status on scores after covarying for age and years of education. Sensitivity and specificity was assessed by receiver operator characteristic (ROC) curves, using Delong's test to compare the area under curves (AUC).

**Results:** Main effect differences in mean by sex were found for the PACC, free and cued selective reminding, MMSE, Digit Symbol, Logical Memory II, and C3 measures: One Card Learning, all aspects of the Face Name Association Test (all  $p < .05$ ).

$\beta$ -amyloid positive participants scored significantly lower than  $\beta$ -amyloid negative participants on the PACC; Digit Symbol; Cogstate Identification, One Back, One Card Learning; and BPST (all  $p$ -values < .05).

Only Cogstate One Card Learning demonstrated a sex-by-amyloid interaction, with men having an advantage over women if  $\beta$ -amyloid negative, but performing worse than women if  $\beta$ -amyloid positive.

No test was useful for discriminating amyloid positivity in men or in women: After controlling for age and education, adding any other test to the discriminant model did not significantly improve predictive utility of the model (e.g., for the PACC, AUC 0.60 vs 0.59;  $p > 0.05$ ).

**Conclusions:** Several of the tests examined demonstrate statistical differences in cognitively normal populations between  $\beta$ -amyloid positive and  $\beta$ -amyloid negative groups, notably Cogstate measures and BPST. Many tests also differed by sex, especially those with a verbal component. Despite significant associations between  $\beta$ -amyloid status and cognitive test scores, no tests are sensitive or specific enough to determine  $\beta$ -amyloid status in an individual. Our results highlight the importance of considering sex, AD pathology and their interaction when measuring cognitive aging. Furthermore, these results highlight the potential of nontraditional cognitive tests in detecting very subtle preclinical changes, and the need for biomarker confirmation of preclinical AD.

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**Keywords:** dementia - Alzheimer's disease

**B. SHIFFLETT, S. EDLAND, R. A. BERNIER, E. E. SUNDERMANN, S. J. BANKS. Sex Differences in Cognitive Reserve in Early Alzheimer's Disease: The Impact of Apolipoprotein E Genotype .**

**Objective:** To determine if there are sex-specific differences in APOE genotype effect on rate of cognitive decline in early stage Alzheimer's disease (AD) subjects (amyloid positive preclinical and prodromal AD populations).

**Participants and Methods:** Participants are from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database. Inclusion criteria approximated the screening criteria use in the A4 trial, restricting to subjects who at baseline were CSF  $A\beta$  positive, 65 to 85 years of age, and with a Logical Memory IIA score between 6 and 18. We examined both cognitively normal ( $n=119$ ) and MCI ( $n=131$ ) subjects meeting these criteria. Cognition was measured using the Prodromal Alzheimer's Cognitive Composite (PACC) norming to the cognitive normal  $A\beta$  positive subject in our sample consistent with procedures used in the A4 trial. To test how APOE genotype (E4 yes/no) over time influences cognition, we used mixed effects models with random slope and random intercepts controlling for baseline age by time and education by time. Mixed effects model runs were stratified on sex and diagnosis, so four models in total were ran. All models were run restricting to visits within four and a half years from baseline.

**Results:** Both normal control men (54 subjects) and MCI men (82 subjects) with an APOE E4 allele faster rate of decline on the PACC. On average, E4 positive normal men declined at a rate of about half a point faster than their E4 negative counterparts ( $\beta = -0.57$ ,  $p < 0.001$ ). This trend was also seen in the MCI men ( $\beta = -0.58$ ,  $p = 0.036$ ). Neither the normal control women ( $n=65$ ) and MCI women ( $n=31$ ) had significant effects of APOE by time on PACC score.

**Conclusions:** APOE genotype predicted rate of decline in men but not women in this sample of subjects in the preclinical and prodromal stages of AD. This is further evidence for enhanced cognitive reserve to pathology in women, but extends this to genetic risk. The PACC loads heavily on verbal memory, which has known sex differences. Future studies might look at cognition beyond verbal memory, such as the tests included in the A4 battery. It may also be important to look beyond APOE at other genetic determinants of decline that differ by sex.

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**Keywords:** apolipoprotein E, cognitive reserve, dementia - Alzheimer's disease

**C. PEREIRA, E. DISBROW, T. H. REEKES, A. LAROCHE, B. ARREDONDO, J. SAWYER. Evaluating Racial Disparities in Healthcare System Utilization Among Older Adults with Dementia.**

**Objective:** The understanding of the relationship between healthcare services utilization, older adults with dementia, and racial groups is scarce. We therefore aim to evaluate this relationship by comparing healthcare use and caregiver burden in a culturally diverse population enrolled in the Care Ecosystem Program.

**Participants and Methods:** Community-dwelling persons with dementia (PwD), with at least one emergency department (ED) visit or hospitalization in the previous 12 months, and their primary caregiver (CG) were prospectively enrolled in the Care Ecosystem Program, a care management intervention that provides tailored and intensive support for this population\*. Cross sectional data on baseline measures were used to assess racial disparities in healthcare system utilization and caregiver burden on 134 participants. Frequencies and descriptive analyses were used for demographical description, while Independent Sample t-test and Chi-Square procedures were performed to compare groups on dependent variables, including ED visits, hospitalizations, and caregiver burden measured by the Zarit Caregiver Burden Interview Short Form (ZBI-12). SPSS (version 21) was used for all analyses and a p-value of 0.05 was established.

**Results:** Mean age was 79.4 years (SD=7.9) and a female predominance (60.4%) was observed for the whole sample. No differences were found in age and dementia severity between groups; however, significant relationships were identified in years of education and racial category, with more African American participants having incomplete high school education. For healthcare utilization, African Americans had significantly more ED visits ( $p=0.008$ ) as well as unpreventable ED visits ( $p=0.009$ ) in the year prior to enrollment compared to Caucasian counterparts, both with large effect sizes. No significant differences were found for other outcome measures, but trends are suggested in descriptive analyses. First, Caucasian patients tended to have more hospitalization admissions and a higher rate of requiring hospitalization following an ED visit. Second, African Americans had higher rates of ambulance use. On another note, no significant differences were indicated for caregiver burden between racial groups when considering ZBI-12 total scores. Nonetheless, significant differences were seen on individual items indicative of increased anger feelings ( $p=0.029$ ), reduced social life ( $p=0.047$ ), uncertainty ( $p=0.006$ ), and feeling that they could do more for the patient ( $p=0.016$ ) for Caucasian CG.

**Conclusions:** Healthcare utilization disparities extend to older adults with Alzheimer's disease and related dementia diagnosis. Findings of increased ED visits for African American patients are consistent with literature stating that vulnerable populations rely more on the ED due to reduced healthcare access. Having a limited sample size is one of the limitations of this research, however, it certainly contributes to filling a void, as well as better understanding the healthcare system utilization patterns and needs of older adults with dementia and their caregivers. Future research will focus on understanding the reason for differences in service utilization and caregiver burden trends.

\* Adapted from the Care Ecosystem, [memory.ucsf.edu/Care-Ecosystem](http://memory.ucsf.edu/Care-Ecosystem)

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**Keywords:** dementia - Alzheimer's disease, minority issues

**S. CHAPMAN, J. L. JOYCE, M. BARKER, P. SUNDERARAMAN, S. RIZER, W. C. KREISL, S. COSENTINO. Gender Differences in Subjective Cognitive Decline and Associated Factors.**

**Objective:** Greater cognitive decline and higher rates of dementia have been reported in individuals who endorse female as their gender compared to those who endorse male. The extent to which binary gender plays a role in Subjective Cognitive Decline (SCD), a state purported to precede the onset of clinical Alzheimer's disease (AD), is unclear. Previous studies have shown an inconsistent association between SCD and biomarkers of AD, including sensitive cognitive markers, in part due to the myriad of factors which may influence SCD (e.g., mood, personality). In this study, we examine how gender influences SCD and SCD's association with cognition, as well as psychological factors including depression, anxiety, apathy and personality traits.

**Participants & Methods:** Age, education and race-matched cognitively normal older females (n=66) and males (n=24) were assessed for SCD, depression, anxiety, apathy, the Big Five personality traits (Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism) and cognitive function. Participants had a mean age of 75 years (SD=6) and an average of 16 (SD=2) years of education. SCD was measured via a 20-item age-anchored questionnaire (i.e., cognitive complaints "as compared to others your age"). Depression, anxiety and apathy were assessed with the Geriatric Depression Scale, the Beck Anxiety Inventory and the Apathy Scale. Cognition was measured with the Loewenstein-Acevedo Scales of Semantic Interference and Learning (LASSI-L): cued recall, recovery from semantic interference, retroactive interference and intrusions. Gender was self-reported and binary (male vs. female). Independent sample t-tests were conducted to examine gender differences in SCD. Regression analyses stratified by gender were then conducted to examine the association of SCD with psychological and cognitive outcomes. Models were adjusted for age, race and educational level.

**Results:** There were no differences in endorsement of SCD across binary gender groups ( $p > .05$ ). However, in stratified analyses, SCD significantly associated with cued recall (F:  $b = -.27$ ,  $p = .02$ ; M:  $b = -.29$ ,  $p = .20$ ) and intrusions (F:  $b = .24$ ,  $p = .04$ ; M:  $b = .17$ ,  $p = .44$ ) on the LASSI-L in females only. Models predicting SCD showed that depression (F:  $b = -.33$ ,  $p = .008$ ; M:  $b = .06$ ,  $p = .76$ ) and apathy (F:  $b = .47$ ,  $p < .001$ ; M:  $b = .17$ ,  $p = .44$ ) were significantly associated with SCD in females only while anxiety associated with SCD in both females and males (F:  $b = .35$ ,  $p = .006$ ; M:  $b = .51$ ,  $p = .04$ ). In the personality models, conscientiousness (F:  $b = -.56$ ,  $p < .001$ ; M:  $b = .09$ ,  $p = .67$ ), openness (F:  $b = -.55$ ,  $p < .001$ ; M:  $b = -.13$ ,  $p = .59$ ) and extraversion (F:  $b = -.40$ ,  $p = .002$ ; M:  $b = -.32$ ,  $p = .11$ ) were associated with SCD in females alone.

**Conclusions:** Although no gender differences were observed in the overall endorsement of SCD, stratified analyses showed that SCD's association with cognition was stronger in females. With regard to mood and personality, females showed stronger associations between SCD, depression, apathy, conscientiousness, openness and extraversion but not anxiety which was comparable across groups. Although some subtle differences could have been driven by unequal sample sizes, these preliminary results suggest SCD's associations with cognition and psychological factors differ by gender. To further elucidate gender differences, future research should increase sample sizes, use longitudinal analyses, and include those in non-binary gender categories.

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**Keywords:** memory complaints, mood disorders, cognitive functioning

**S. E. JOHN, C. G. WONG, C. PARKS. Contribution of Executive Functioning to Verbal Memory Abilities.**

**Objective:** Prolific research provides support for medium to strong associations between neuropsychological tests assessing different cognitive domains. Associations between tests may reflect methodological similarities in administration. Likewise, the hierarchical structure of cognition, particularly through the contribution of executive functioning (EF) to other domains, may result in correlations between measures. We sought to evaluate the association of EF and memory abilities in a sample of older adults with mild cognitive impairment (MCI) and Alzheimer's disease (AD) to facilitate interpretation of cognitive performance and better understand the underlying brain networks responsible for early and late learning and delayed recall.

**Participants & Methods:** Baseline neuropsychological data from the Nevada Center for Neurodegeneration and Translational Neuroscience (CNTN) clinical cohort were analyzed. Older adult participants ( $M_{\text{age}} = 72.04$ ,  $SD_{\text{age}} = 6.53$ ) underwent comprehensive neuropsychological assessment as part of a longitudinal prospective study consisting of cognitively normal ( $N = 50$ ), MCI ( $N = 52$ ), and AD dementia ( $N = 11$ ). Participants were diagnosed through a consensus conference that included neuropsychological testing, patient and informant report of symptoms, and neurologic exam. Canonical correlation analyses (CCA) examined the extent to which EF was related to aspects of verbal memory, including early learning, late learning, and delayed recall. Early and late memory factors were assessed using raw scores from the Rey Auditory Verbal Learning Test (RAVLT) first and second learning trials and fourth and fifth learning trials, respectively. Delayed recall was assessed using the scores from the RAVLT long-delay recall and the Logical Memory Delayed Recall. The EF composite factor consisted of scores from Digit Span Backward and Sequencing trials, Letter Fluency, Trail Making Test – part B, Symbol-Digit Modalities Test (SDMT), Letter-Number Sequencing, and D-KEFS Category Switching.

**Results:** Executive functioning was strongly related to all three verbal memory abilities. The variable sets for EF and early learning were strongly associated through only one canonical function of .63 (39.9% shared variance), Wilks'  $\Lambda = .59$ ,  $F(16, 206) = 3.89$ ,  $p < .001$ . The variable sets for EF and late learning were similarly related through one function of .72 (51.8% shared variance), Wilks'  $\Lambda = .44$ ,  $F(16, 206) = 6.57$ ,  $p < .001$ . Delayed recall and EF were also related through a single significant canonical function of .67 (45.0% shared variance), Wilks'  $\Lambda = .52$ ,  $F(16, 206) = 4.93$ ,  $p < .001$ . The standardized canonical coefficients showed that among the EF measures, SDMT and Category Switching were most strongly related to memory measures.

**Conclusions:** Our analyses show a strong contribution of EF to verbal memory abilities, within a clinical sample enriched for memory impairment (MCI and AD). Within this sample, the strength of the association between EF and early versus late versus delayed recall did not vary substantially, highlighting the role of EF throughout memory processes. All three abilities were strongly associated with SDMT and Category Switching tests in particular, supporting use of these measures to aid in interpretation of memory performance.

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**Keywords:** executive functions, memory disorders, mild cognitive impairment

**L. S. GAYNOR, S. M. OLSHAN, A. RAFFALSKI, S. TILLOTSON, J. GULLETT, R. DUARA, D. A. LOEWENSTEIN, R. M. BAUER. Brain Biomarkers of Early Disease Progression Predict Performance on a Translational Cognitive Marker of Alzheimer's Disease.**

**Objective:** Traditional neuropsychological measures used to assess Alzheimer's disease (AD) were not designed to detect subtle cognitive change present in early disease and may lack sensitivity and specificity to early-stage accumulation of AD pathology. Therefore, development and use of tasks that are specific to early sites of AD pathological accumulation can improve detection of early AD. We previously identified a novel, translational visual discrimination paradigm examining perirhinal cortical-dependent behavior that significantly predicted current Pre-Mild Cognitive Impairment (PreMCI) and amnesic MCI (aMCI) status compared to cognitively normal older adults. The present study aims to determine whether brain biomarkers of early AD progression predict performance on this perirhinal cortical-dependent task.

**Participants and Methods:** One hundred fifteen (115) older adults from different diagnostic groups (Cognitively Normal: N = 30; PreMCI: N = 18; aMCI single domain: N = 21; aMCI multiple domain: N = 32; Dementia: N = 14) were selected from the 1Florida Alzheimer's Disease Research Center (ADRC) clinical dataset (56.5% Hispanic/Latinx; 57.4% English-language testing). Structural and resting-state functional magnetic resonance imaging (MRI, rsfMRI) and amyloid imaging were obtained for each participant. Automatic segmentation of the medial temporal lobe (perirhinal cortex, entorhinal cortex, hippocampus) was acquired and manually cleaned. Confirmatory factor analysis was used to create factor scores from volume and cortical thickness measurements. Functional connectivity between these structures was also examined. Amyloid positivity was determined by an expert rater (RD). Each participant also completed the Object Recognition and Discrimination Task (ORDT), a perirhinal cortical-dependent visual oddity discrimination task, and the Clinical Dementia Rating (CDR) scale. Forward stepwise linear regression was performed to determine which demographic, cognitive, and brain biomarker variables predict ORDT performance. Bias-corrected bootstrap confidence intervals were used to determine significance

**Results:** The final model was significant ( $F_{[8,91]} = 12.2, p < 0.001$ ) and explained 47.6% variance in ORDT performance. In terms of volumetric measurements, cortical thickness was positively related to ORDT performance for amyloid positive participants, while the main effect of volume was inversely related to ORDT performance. Further analyses suggest that the main effect of volume accounted for volumetric increase unrelated to AD pathological change. Linear functional connectivity was positively related to ORDT performance, whereas quadratic functional connectivity was inversely related to ORDT performance. These findings suggest that the relationship of functional connectivity to task performance varied across disease states, such that lower or higher than average functional connectivity scores were negatively related to ORDT performance, while average functional connectivity was positively related to ORDT performance. Amyloid positivity was a marginally significant predictor of ORDT performance on its own. CDR sum of boxes and age were also significant predictors, while education was not.

**Conclusions:** Medial temporal lobe volume, linear and quadratic functional connectivity, and cortical thickness in amyloid positive participants were significantly predictive of performance on a perirhinal cortical-dependent test of object discrimination. These findings suggest that deficits in ORDT performance are related to the presence and degree of AD pathology, supporting future use of visual object discrimination tasks to improve detection of older adults at risk of AD.

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**Keywords:** test development, neuroimaging: functional connectivity, visuospatial functions

**D. G. SALDANA, P. A. SUAREZ, X. E. CAGIGAS, M. DÍAZ-SANTOS. Socially Responsible Neuropsychology in Action: Differential Diagnosis of Alzheimer's Disease in a Highly Educated Multilingual Latino Older Adult .**

**Objective:** The Socially Responsible Neuropsychology (SRN) model, a training model applied in our clinic, uses social justice and equity to guide clinical decision-making with the civic duty of ensuring equitable healthcare to underserved communities. Clinically, this translates into broadening the clinical lens from adapting a monolingual and monocultural stance where patients are typically assessed in the language more accessible to the service provider to one where bilingual-multilingual patients are assessed in all languages. Beyond testing patients in several languages, this model challenges clinicians to anchor the neuropsychological evaluation in critical linguistic and cultural factors known to alter the phenotypical expression of neurodegenerative disorders. Multilingualism is one potential mechanism for cognitive reserve delaying the onset of dementia and/or altering the typical presentation. We present a highly proficient polyglot with an Alzheimer's disease differential diagnosis who progressively lost his third acquired language 1-2 years prior to moving to the United States.

**Participants and Methods:** The patient is an 80-year-old, highly educated, multilingual, right-handed male referred by primary care with concerns about memory and word-finding problems. Collateral informant reported that he became progressively quieter and less expressive, while still living in the South American country where he primarily used his L3. Neuroimaging was significant for left anterior temporal atrophy consistent with head trauma before acquiring L3 in young adulthood. No changes were reported in L1 and L2 post-TBI. While he had a complex medical history, neuroimaging was not significant for small vessel ischemic disease or any cerebrovascular accidents/metabolic processes. Subjective and objective measures of language dominance showed greater fluency and proficiency in L1, consistent with collateral's report. A bilingual assessment via telehealth was conducted (focused in L1 with assessment of language and memory in L1 and L2).

**Results:** Results revealed widespread deficits across most cognitive domains with spared functioning, thus meeting diagnostic criteria for Mild Neurocognitive Disorder. Impaired performance across memory retention, confrontation naming, and verbal fluency tasks (with particularly poor semantic fluency compared to letter fluency), and poor insight into his cognitive difficulties, was suggestive of Alzheimer's disease (AD). However, his disproportionately poor performance in aspects of language and executive functioning was also suspicious for a possible Primary Progressive Aphasia (PPA). He was referred to behavioral neurology for comprehensive examination, including neuroimaging (PET) and genetic testing, to clarify diagnosis. **Conclusions:** The SRN model challenged us to be both linguistically and culturally responsive to the patient's unique emic world and guided the expansion of this evaluation to include relevant variables that allowed us to introduce the working clinical hypothesis of a possible PPA, as both PPA and AD share underlying pathology. Although PPA's incidence is higher prior to age 65 in monolingual patients, a working hypothesis for this polyglot patient is whether his proficient lifelong multilingualism delayed the typical phenotypical expression of PPA to such a degree that it is currently obscured by another neurodegenerative process. Nonetheless, the socially responsible ethical duty to assess all

relevant factors allowed us to inform treatment recommendations, given the behavioral presentation and progression differs from typical AD.

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**Keywords:** multiculturalism, neuropsychological assessment, dementia - Alzheimer's disease

**L. S. GAYNOR, A. RAFFALSKI, S. TILLOTSON, S. M. OLSHAN, J. GULLETT, R. DUARA, D. A. LOEWENSTEIN, R. M. BAUER. Brain Biomarkers of Early Alzheimer's Disease Progression Underlie the Relationship Between Diagnosis and Visual Object Discrimination Task Performance.**

**Objective:** In order to improve detection of Alzheimer's Disease (AD)-specific brain changes, it is crucial to identify cognitive tasks supported by brain structures affected by initial stages of AD pathological accumulation. The perirhinal cortex is one of the first and primary sites of pathological tau accumulation in AD. We previously identified a novel, translational visual discrimination paradigm examining perirhinal cortical-dependent behavior that significantly predicted current Pre-Mild Cognitive Impairment (PreMCI) and amnesic MCI (aMCI) status compared to cognitively normal (CN) older adults. Additionally, amyloid positivity, medial temporal lobe volumes, and functional connectivity significantly predicted performance on this task. The present study aims to determine whether brain biomarkers of early AD progression underlie the relationship between different diagnostic groups and task performance, thus suggesting that task performance in these groups is related to AD-specific brain changes.

**Participants and Methods:** One hundred fifteen (115) older adults from different diagnostic groups (CN: N = 30; PreMCI: N = 18; aMCI single domain: N = 21; aMCI multiple domain: N = 32; Dementia: N = 14) were selected from the 1Florida Alzheimer's Disease Research Center (ADRC) clinical dataset (56.5% Hispanic/Latinx; 57.4% English-language testing). Structural and resting-state functional magnetic resonance imaging (MRI, rsfMRI) and amyloid imaging were obtained for each participant. Automatic segmentation of the medial temporal lobe (perirhinal cortex, entorhinal cortex, hippocampus) was acquired and manually cleaned. Confirmatory factor analysis was used to create factor scores from volume and cortical thickness measurements. Functional connectivity was also examined between these structures. Amyloid positivity was determined by an expert rater (RD). Each participant also completed the Object Recognition and Discrimination Task (ORDT), a perirhinal cortical-dependent visual oddity discrimination task, and the Clinical Dementia Rating (CDR) scale. Mediation analysis was performed to determine which demographic, cognitive, and brain biomarker variables underlie the relationship between each diagnostic group and ORDT performance. Diagnosis was dummy-coded with CN as the reference group. Bias-corrected bootstrap confidence intervals were used to determine significance.

**Results:** Fit statistics for the mediation model suggested adequate model fit. Age had a significant effect on the relationship between dementia and ORDT performance. Volume had a significant effect on the relationship between diagnoses of aMCI multiple domain and dementia and ORDT performance. Cortical thickness in amyloid positive individuals had a significant effect on the relationship between diagnoses of aMCI multiple domain and dementia and ORDT performance. Functional connectivity, although significantly related to ORDT performance, did not have a significant effect on the relationship between diagnosis and ORDT performance.

**Conclusions:** Medial temporal lobe volume, cortical thickness in amyloid positive participants, and age had a significant effect on the relationship between diagnoses of aMCI multiple domain and dementia and a perirhinal cortical-dependent test of object discrimination. These findings suggest that, within pathologically heterogeneous groups such as aMCI and dementia, the ORDT may be useful for the identification of older adults with impairment related to AD-specific neurodegeneration. Therefore, this task may be useful for the identification of older adults at risk for AD dementia and could increase the window for therapeutic intervention.

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**Keywords:** test development, visuospatial functions, neuroimaging: structural

**N. TRAN, R. L. DONNELL, D. RODRIGUEZ, T. L. GLOVER, M. A. VASQUEZ, L. CHILDERS, D. C. LEE, M. D. BARNETT. Social Functioning in Dementia, Loneliness, and Life Satisfaction Among Older Adults with Neurocognitive Disorder.**

**Objective:** Many forms of dementia are associated with changes in social functioning (Droes et al., 2016), and decreased social functioning is associated with negative outcomes among patients with dementia (Sommerlad et al., 2017). Little extant research has investigated whether decreased social functioning in dementia is accompanied by subjective distress, specifically feelings of loneliness and reduced life satisfaction. The purpose of this preliminary study was to investigate the relationship between social functioning in dementia, loneliness, and life satisfaction among older adults with neurocognitive disorder.

**Participants and Methods:** Older adults with neurocognitive disorder ( $N = 22$ ) completed the 3 Item Loneliness Scale (Hughes et al., 2004), the Satisfaction With Life Scale (Diener, 1985), and the Social Functioning in Dementia Scale (Sommerlad et al., 2017).

**Results:** Lower social functioning in dementia was associated with greater loneliness and lower life satisfaction.

**Conclusions:** Lower social functioning in dementia appears to be accompanied by subjective distress. Interventions to increase social functioning in dementia may be effective in reducing loneliness and increasing life satisfaction.

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**Keywords:** social processes, outcome, quality of life

**S. ROGERS. The Role of Disinhibition on Cognition in FTD.**

Previous research has shown a high incidence of behavioral disinhibition in patients with frontotemporal dementia (FTD). Many of those with FTD also experience declines in frontal-executive functioning, verbal fluency, and select aspects of memory. However, there is little research exploring how the cognition of those with FTD is specifically impacted by behavioral disinhibition. This study examines how differences in cognition varies with behavior disinhibition among those with FTD.

A total of 20 adults (11 men,  $M$  age = 76.00) with FTD participated in neuropsychological testing as part of outpatient neurology evaluations. The presence of behavioral disinhibition was assessed on a questionnaire and clinical interviews with patients and collateral informants. Participants also completed a battery that included the MoCA, WAIS-IV, WMS-IV, DKEFS, Trailmaking, BNT, COWAT, ROCF, HVLT-R and BVMT-R.

Forty percent of participants demonstrated behavioral disinhibition. T-test analyses revealed that those with behavioral disinhibition performed significantly better on WAIS-IV Arithmetic,  $t(11) = 2.45$ ,  $p < .04$ , WAIS-IV Coding,  $t(11) = 2.25$ ,  $p < .05$ , COWAT FAS,  $t(16) = 2.38$ ,  $p < .04$ , and COWAT Animals,  $t(16) = 2.45$ ,  $p < .03$ , with a trend toward stronger ROCF Copy ( $p = .06$ ) and WAIS-IV Block Design ( $p = .08$ ), than those without behavioral disinhibition.

Although behavioral disinhibition can be deleterious to many aspects of the lives of patients and families of those with FTD, this negative impact does not appear to extend to the realm of cognition. The findings from this study suggest that patients with FTD who experience behavioral disinhibition experience stronger cognition in domains typically impacted by FTD relative to their counterparts who lack this disinhibition. This includes stronger working memory, graphomotor speed, and verbal fluency. It may be that the degradation of regions involved in behavioral disinhibition, such as the orbitofrontal circuit, fosters a release of select cognitive skills, similar to hypervisuality. Alternatively, regions responsible for these stronger cognitive abilities, such as the dorsolateral circuit, may be differentially more intact than the orbitofrontal regions controlling disinhibition. These findings can aid differentiation between FTD subtypes and guide both cognitive and psychopharmacological interventions for patients with and without behavioral disinhibition.

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**Keywords:** disinhibition, cognitive functioning, dementia - other cortical

**R. KESZYCKI, A. S. KAWLES, S. JUTHAPAN, C. COVENTRY, H. ZHANG, C. GEULA, E. ROGALSKI, S. WEINTRAUB, M. . MESULAM, T. GEFEN. Neuropsychiatric phenotypes in PPA and bvFTD due to Pick's disease.**

**Objective:** Frontotemporal lobar degeneration (FTLD) is the second most common neurodegenerative cause of dementia under age 65. Clinically, patients with FTLD frequently present with either primary progressive aphasia (PPA), a language-based dementia, or behavioral variant frontotemporal dementia (bvFTD), a dementia syndrome characterized by changes in compartment and personality. Despite phenotypically distinct clinical features and anatomic loci of atrophy, the 3-repeat form of the FTLD tauopathy known as Pick's disease ("PiD") is a pathology that can underlie both dementia syndromes. Patients with PPA or bvFTD due to PiD may develop prominent neuropsychiatric symptoms (NPS) that accompany cognitive decline. A nuanced understanding of neuropsychiatric phenotypes in individuals with postmortem PiD can provide useful information to guide treatment. In this study, we investigated NPS in PPA and bvFTD patients with autopsy-confirmed PiD at early and late stages of disease progression.

**Participants and Methods:** Participants with autopsy-confirmed PiD and antemortem clinical diagnoses of PPA (N=7) or bvFTD (N=8) were identified from the Northwestern Alzheimer's Disease Center brain bank. All participants underwent longitudinal neuropsychological assessments (M=1.11 years between evaluations) from initial enrollment until death. The Neuropsychiatric Inventory—Questionnaire, an informant-based screener, was used to assess 12 common NPS at each visit. NPS were categorized into three domains based on frequent co-occurrence: 1) *Frontal/Compartmental* (apathy, disinhibition, motor disturbance, and appetite changes), 2) *Affective* (depression, anxiety, elation, and irritability), and 3) *Disruptive/Psychotic* (delusions, hallucinations, agitation, and nighttime behaviors). We compared the average number of *total* and domain-specific symptoms (*Frontal/Compartmental*, *Affective*, *Disruptive/Psychotic*) between PPA and bvFTD subjects at initial and final evaluation.

Additionally, we assessed changes in NPS from initial to final evaluation across all participants with PiD (N=15), regardless of clinical dementia diagnosis.

**Results:** Unpaired Welch's t-tests revealed a significantly greater number of *Frontal/Comportmental* symptoms in bvFTD+PiD compared to PPA+PiD subjects at initial evaluation ( $p<0.05$ ). However, prior to death, *Frontal/Comportmental* symptoms were present in all participants at a level that was nearly equal between bvFTD (M=2.38) and PPA (M=2.29), suggesting a convergence of NPS. At initial evaluation, there were no differences in the number of *Affective* (bvFTD, M=0.75; PPA, M=1.29) or *Disruptive/Psychotic* symptoms (bvFTD, M=0.33; PPA, M=0.29). At final evaluation, the level of *Affective* (bvFTD, M=1.25; PPA, M=1.00) and *Disruptive/Psychotic* symptoms (bvFTD, M=0.50; PPA, M=0.43) were also similar between dementia syndromes. In our analysis of the entire PiD cohort (N=15), paired Welch's t-tests revealed a significant increase in *total* ( $p<0.05$ ) and *Frontal/Comportmental* ( $p<0.01$ ) symptoms from initial to final evaluation. However, *Affective* and *Disruptive/Psychotic* symptoms remained relatively stable.

**Conclusions:** While specific NPS often accompany initial patterns of cognitive or behavioral decline unique to bvFTD versus PPA, they appear to later converge as underlying neuropathology (e.g., PiD) spreads with disease progression. Overall, these findings support the utility of identifying NPS early on and throughout disease course. Future studies will attempt to link anatomic distributions of PiD pathology with unique NPS phenotypes to explore clinicopathologic relationships.

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**Keywords:** dementia - other cortical, neuropsychiatry

**N. SALTIEL, M. ALOSCO, Y. TRIPODIS, J. PALMISANO, B. MARTIN, M. URETSKY, E. NAIR, B. ABDOLMOHAMMADI, A. SHAH, R. NICKS, R. STERN, J. CHERRY, V. ALVAREZ, B. R. HUBER, J. MEZ, A. MCKEE, T. STEIN. Neuropathological Contributors to Cognitive and Neuropsychiatric Symptoms in Brain Donors Exposed to Repetitive Head Impacts .**

**Objective:** Exposure to repetitive head impacts (RHI) has been associated with later-life cognitive symptoms, dementia and neuropsychiatric disturbances. The etiology of these symptoms is unclear and has often been attributed to p-tau pathology from the neurodegenerative disease chronic traumatic encephalopathy (CTE). However, RHI exposure has been associated with multiple neuropathologies beyond CTE including beta-amyloid deposition, Lewy body pathology, cerebral amyloid angiopathy, white matter rarefaction, and neuroinflammation. Cognitive and neuropsychiatric decline is often associated with mixed neuropathologies. Yet, the rate of co-morbid pathologies, and the relative contribution of these pathologies to cognitive and neuropsychiatric symptoms in people exposed to RHI is unknown. Here, we examined the rate of co-occurrence of 12 different neuropathologies and their relative contributions to informant-reported cognitive and neuropsychiatric symptoms in brain donors exposed to RHI.

**Participants and Methods:** The sample included 329 brain donors from the UNITE brain bank. Eligibility criteria for UNITE include a history of RHI exposure and adequate tissue quality. Neuropathologists diagnosed neurodegenerative and non-neurodegenerative disease using established criteria and blinded to clinical information. Donor clinical information was collected retrospectively through family phone interviews and medical record review. Antemortem

dementia was adjudicated via consensus conferences and based on informant-reported clinical presentation; the Geriatric Depression Scale (GDS) measured symptoms of depression; the Barratt Impulsiveness Scale (BIS-11) measured impulse control; and the Behavior Rating Inventory of Executive Function, Adult version (BRIEF-A) assessed behavioral dysregulation and reported executive function. To assess the intercorrelation of pathologies, the frequencies of pathological co-occurrence were compared to a simulated distribution assuming no intercorrelation. Mixed-effect linear models were used to examine the independent contribution of each pathology to the aforementioned scales, controlling for age, race, education, and all other co-morbid pathologies.

**Results:** The sample age range was 13-93 (mean: 57.5 [20.7 SD]). Of the 329 brain donors, 305 (92.7%) had at least one neuropathology present, 261 (79.3%) had at least two, and 179 (54.4%) had at least three. We observed 133 distinct combinations of pathologies, and the neuropathologies were highly intercorrelated ( $p < 0.01$ ). White matter rarefaction and CTE were the most common neuropathologies, occurring in 77.2% and 75.7% of donors, respectively. The degree to which each pathology contributed to cognitive and neuropsychiatric symptoms varied; however, the pathologies that commonly had the greatest contribution to the median variance in scores on the neuropsychiatric scales (GDS, BIS-11, BRIEF-A) included frontotemporal lobar degeneration, hippocampal sclerosis, and CTE. The greatest contributors to dementia were pTDP-43 pathology, Alzheimer's disease, hippocampal sclerosis, and white matter rarefaction; and CTE pathology also independently contributed to dementia.

**Conclusions:** In this sample of brain donors exposed to RHI, there were 133 unique combinations of neuropathologies and the pathologies were highly correlated. This is in contrast to findings from population-based aging studies, and may be a result of the common risk factor of exposure to RHI in these brain donors. Informant-reported cognitive and neuropsychiatric symptoms were associated with multiple neuropathologies, including CTE pathology. These findings emphasize the role of mixed neuropathologies in the clinical syndromes associated with exposure to RHI.

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**Keywords:** dementia - other cortical, aging disorders, head injury (closed)

### **J. T. MARTIN, J. R. ANDERSON, K. R. CHAPMAN, M. SPITZNAGEL. Dementia Caregiver Burden and Communications in a Memory Clinic Setting.**

**Objective:** Informal caregiving for persons with dementia can be associated with burden, or strain associated with the many responsibilities of caregiving. In the case of dementia, the caregiver's role often includes taking responsibility for communications with healthcare providers, such as scheduling appointments and advocating on the patient's behalf. Prior research in another population has demonstrated that elevated burden in the caregiver is linked to greater frequency of clinic communications (i.e., more frequent phone calls or email messages), but this has not been studied in a dementia sample. In the present study, we hypothesized that caregiver burden would be positively associated with caregiver-generated communications and actions in a memory clinic setting.

**Participants and Methods:** Records from 173 continuously enrolled memory clinic patients meeting inclusion criteria were reviewed. At the initial appointment, data including caregiver-reported burden (Zarit Burden Interview; ZBI), neuropsychiatric symptoms (Cohen-Mansfield

Agitation Inventory; CMAI), interview-based activities of daily living (ADL), and brief measures of global cognition (MMSE or MoCA, normed and combined into a single variable, COG) were collected. Two independent raters then recorded the frequency during the next 12 months of caregiver-generated communications at the clinic, including caregiver incoming contacts, outgoing clinic communications to the caregiver or outside agencies to address caregiver requests, and within-clinic communications to address caregiver issues. Pearson correlations examined the relationships between ZBI and communications variables; significant relationships were evaluated using hierarchical multiple regression analyses controlling for the contribution of dementia severity measured using CMAI, ADL, and COG.

**Results:** Pearson correlations showed significant relationships between burden and frequency of outgoing clinic communications ( $r=.16$ ,  $p<.05$ ) and within-clinic communications ( $r=.18$ ,  $p<.05$ ), but no significant relationship for incoming contacts ( $r=.10$ ,  $p=.21$ ). Hierarchical multiple regression analyses indicated that dementia severity accounted for 2.7% of the variance in outgoing clinic communications, and addition of the ZBI did not improve model fit ( $\Delta R^2=.01$ ,  $\Delta F(1, 168)=1.18$ ,  $p=.28$ ); dementia severity accounted for 2.2% of the variance in within-clinic communications, and addition of the ZBI did not improve model fit ( $\Delta R^2=.019$ ,  $\Delta F(1, 168)=3.27$ ,  $p=.07$ ).

**Conclusions:** Small but significant correlations among caregiver burden and outgoing clinic communications and caregiver-generated within-clinic communications were observed; however, after controlling for severity of dementia, caregiver burden did not significantly predict communications variables. Future research should determine if the specific content of some caregiver communications might be more closely related to caregiver burden than others (e.g., calls about behavioral problems compared to prescription refills), and should investigate other potential contributors to memory clinic communications, such as caregiver personality characteristics.

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**Keywords:** caregiver burden

**M. BARKER, M. MANOOCHEHRI, L. FORSBERG, H. HEUER, B. BOEVE, A. BOXER, H. ROSEN, J. GOLDMAN, E. HUEY, S. COSENTINO. Memory and Other Aspects of Cognitive Function Differ Between Genetic Mutations in Prodromal Behavioral Variant Frontotemporal Dementia.**

**Objective:** Although executive dysfunction is the characteristic cognitive marker of behavioral variant frontotemporal dementia (bvFTD), episodic memory deficits are relatively common. However, the degree to which episodic memory is affected in the prodromal disease phase is largely unknown. In a cohort of mildly symptomatic pathogenic mutation carriers with mild behavioral/cognitive changes consistent with prodromal bvFTD, we aimed to investigate patterns of performance on an abbreviated list learning task, with a particular focus on recognition memory. We further aimed to characterize the cognitive prodromes associated with the three major genetic causes of bvFTD.

**Participants and Methods:** Participants included 57 carriers of a pathogenic mutation in microtubule-associated protein tau (*MAPT*,  $N=23$ ), progranulin (*GRN*,  $N=15$ ), or chromosome 9 open reading frame 72 (*C9orf72*,  $N=19$ ), with mild cognitive / behavioral symptoms consistent with prodromal disease. Familial non-carriers were included as controls ( $N=143$ ). All

participants completed a comprehensive neuropsychological examination, including an abbreviated list learning test assessing episodic memory recall and recognition.

**Results:** *MAPT* mutation carriers performed below non-carriers in terms of list recall, and had difficulty discriminating targets from distractors on the recognition memory task, primarily due to the endorsement of distractors as targets. *MAPT* carriers also showed semantic dysfunction (object naming). *GRN* carriers were variable in performance and overall the most dysexecutive of the three carrier groups. Slowed psychomotor speed was evident in *C9orf72* carriers.

**Conclusions:** Identifying the earliest cognitive indicators of bvFTD is of critical clinical and research importance. List learning may be a sensitive cognitive marker for incipient bvFTD in *MAPT* and potentially a subset of *GRN* carriers. Our results highlight that distinct cognitive profiles may be evident in the three mutations during the prodromal disease stage.

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**Keywords:** cognitive functioning, dementia - other cortical, memory disorders

### **R. M. BUTLER PAGNOTTI, D. MECHANIC-HAMILTON. Is Reliable Digit Span (RDS) a Valid Effort Measure in Patients with MCI and Dementia due to Primary Progressive Aphasia?**

**Objective:** Reliable Digit Span (RDS) is commonly used to determine effort and motivation during evaluations of cognitive impairment in older adults. However, false positive errors using the standard RDS cut off of £ 7 increases as cognition declines. We examined the rate of false positive errors in individuals with Primary Progressive Aphasia (PPA) at various RDS cut-off scores. Predictive factors of false positive errors were also examined.

**Participants and Methods:** Participants included 328 patients with PPA (nonfluent PPA [nfPPA] n = 107, semantic variant PPA [svPPA] n = 102, logopenic variant PPA [lvPPA] n = 119; Age M = 65.69, SD = 8.07) and 328 age and education matched controls (Age M = 65.69, SD = 7.94) from the National Alzheimer's Coordination Center (NACC) database. Within the PPA group, 68 participants were diagnosed with mild cognitive impairment (MCI) and 260 were diagnosed with dementia due to PPA. RDS was calculated using the Uniform Data Set version 2 (UDS 2) Digit Span subtest.

**Results:** An ANOVA revealed significant differences in the RDS score between groups, normal controls (M = 11.09, SD = 1.95), nfPPA (M = 7.50, SD = 2.17), svPPA (M = 9.37, SD = 2.25), and lvPPA (M = 7.38, SD = 2.91), ( $F(3, 652) = 11.556, p < 0.001$ ). At an RDS cut off of £ 7, 1.8% of controls, 43.0% of nfPPA, 17.6% of svPPA, and 54.6% of lvPPA failed. At a cut off of £ 6, 0.3% of controls, 25.2% of nfPPA, 10.8% of svPPA, and 35.3% of lvPPA failed. At a cut off of £ 5, 0.3% of controls, 12.1% of nfPPA, 4.9% of svPPA, and 15.1% of lvPPA failed. Additionally, when analyzing RDS scores by level of impairment, 30.9% of patients with MCI due to PPA failed at an RDS cut off of £ 7. A logistic regression indicated total Functional Rating Scale (FRS) score ( $p < .01$ ), Mini Mental Status Exam (MMSE) score ( $p < .001$ ), secondary diagnosis of Alzheimer's disease ( $p < .001$ ), and GDS scores ( $p < .001$ ) were significantly associated with a cut off of £ 7. Total FRS score was the only variable that did not predict RDS scores of £ 6 and £ 5, as there was large variability in functional impairment in individuals who did not pass the RDS.

**Conclusions:** Using the RDS at a standard cut-off of £ 7 leads to high false positive errors and is not a reliable way to measure effort in patients with MCI and dementia, especially in lvPPA and nfPPA variants. Furthermore, adjusting the RDS cut-off to £ 6 or £ 5 continued to result in

significant false positive errors. There were large ranges of functional abilities, from intact to impaired, at each RDS cut-off score. While discrepancies between functional status and cognitive performance are often used in the determination of effort/motivation on neuropsychological evaluations, this relationship may be a less reliable marker in patients with PPAs due to more consistent impact of the disease on RDS scores and less consistent level of functional impairment in this population.

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**Keywords:** demographic effects on test performance, dementia - other cortical, effort

**J. L. HAZELTON, S. FITTIPALDI, M. FRAILE-VAZQUEZ, A. LEGAZ, I. GARCIA CORDERO, M. SOURTY, A. M. IBANEZ, O. PIGUET, F. KUMFOR. Impaired cardiac interoceptive accuracy in behavioural-variant frontotemporal dementia and Alzheimer's disease: An international multi-centre study.**

**Objective:** Whether cardiac interoceptive accuracy, the ability to detect fluctuations in one's own heart rate, is impaired in dementia (frontotemporal dementia, Alzheimer's disease, Parkinson's disease) remains inconclusive. This is despite pathological changes in key interoceptive structures across dementia syndromes, such as the anterior insula and anterior cingulate cortex. The few studies to date, however, have failed to take into account periods of inattention and have used accuracy measures that can be influenced by overresponding. Here, we assessed cardiac interoceptive accuracy in dementia syndromes using a measure of accuracy shown to be a robust interoceptive marker in healthy participants. We hypothesised that all patients would show impaired cardiac interoceptive accuracy than healthy participants.

**Participants and Methods:** 168 participants (51 Alzheimer's disease; 40 behavioural-variant frontotemporal dementia; 24 Parkinson's disease; 53 healthy controls) were recruited across three international research centres (Argentina, Australia, Chile). All participants completed two 2-minute behavioural tasks, whilst simultaneous ECG was recorded. During each task, participants were asked to press a button each time they: 1) detected their own heartbeat, without external cues (Cardiac-interoception); or 2) when they heard a recorded heartbeat (Exteroception). Accuracy was calculated by comparing the frequency of the event in the task (e.g., actual or recorded heartbeat) and the frequency of the participant's response in successive, overlapping 10 seconds windows. To account for periods of inattention, the regularity of participant's responses in each 10 second window was calculated and thresholding for each window was applied in line with signal detection theory. Then, comparison of frequencies were averaged across all windows to give a total measure of accuracy.

**Results:** Our results showed worse cardiac interoceptive accuracy in behavioural-variant frontotemporal dementia ( $p = .002$ ) and Alzheimer's disease patients ( $p = .032$ ) than healthy controls, with no significant differences observed between patient groups ( $p > .99$ ). Cardiac interoceptive accuracy in Parkinson's disease was similar to that of healthy controls ( $p = .17$ ). No significant differences were observed on the exteroception task ( $p = .09$ ).

**Conclusions:** Our results provide the first evidence for impaired cardiac interoceptive accuracy in behavioural-variant frontotemporal dementia and Alzheimer's disease when periods of inattention were accounted for. Contrary to our hypotheses, we did not observe impaired cardiac interoceptive ability in Parkinson's disease, suggesting appropriate interoception when attention is considered. Future neuroimaging research is needed to uncover neural mechanisms driving

these interoceptive impairments unique to each syndrome to further our understanding of interoceptive processes in dementia.

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**Keywords:** dementia - other cortical, dementia - Alzheimer's disease

**M. F. KRUMHOLZ, F. VIQAR, W. TSANG, S. MORDHORST, E. ROSEMAN. COVID Catalyst: A Case Presentation on the Impact of COVID-19 in Posterior Cortical Atrophy.**

**Objective:** Elderly patients appear to be at increased risk for neurological complications resulting from the 2019 coronavirus disease (COVID-19). While the precise mechanisms accounting for these neurological changes is unclear, complications likely result from a combination of immunological and vascular processes (i.e. encephalitis, peripheral organ dysfunction, and cerebrovascular changes). Recently, it is hypothesized that COVID-19 may contribute to accelerated development of neurodegenerative diseases, including increased beta-amyloid accumulation in the pathogenesis of Alzheimer's disease. This case study examines neuropsychological findings from an 83-year-old woman with a history of mild neurocognitive impairment who developed the 2019 coronavirus disease (COVID-19).

**Methods and Participants:** The patient was an 83-year-old, white, female, English speaking woman with 16 years of education. She was assessed by neurology in August 2019 due to cognitive complaints for duration of one year. Presentation was consistent with mild neurocognitive impairment due to delayed recall difficulty on cognitive screen (MOCA 25/30) and reported visual and functional difficulties. Additionally, several vascular risk factors were identified (hypertension, hyperlipidemia, bleeding disorder, and past cardiac activity). Head CT (09/2018) identified chronic microvascular ischemic disease. During hospitalization for disease treatment, she sustained encephalopathy as well as a stroke-like event affecting speech and motor ability. As symptoms resolved, she regained speech abilities more quickly than motor ability, which remains decreased compared to premorbid functioning. Since discharge, she has had a 24-hour health aide. Cognitive screen in June 2020 was seen to decline (MOCA 15/30).

**Results:** Neuropsychological evaluation was conducted three months following COVID-19 recovery. In the context of estimated average baseline intellectual functioning, results were notable for markedly impaired visuospatial perception, and visual discrimination, integration, and construction. On a task of visuospatial integration, she was often unable to discern between various parts of presented stimuli, suggesting possible simultagnosia. Difficulty on some language tasks was likely secondary to visuoperceptual impairment. On a task of mental math, she was able to complete simple addition and subtraction but had difficulty with multiplication, division, and serial subtraction. Strengths included basic attention, verbal learning/memory, single word list reading, and performance of proximal and distal limb gestures. Findings were consistent with mild neurocognitive disorder due to posterior cortical atrophy (PCA) variant of Alzheimer's disease (AD). Neuropsychological results were consistent with FDG PET/MRI neuroimaging findings conducted following COVID-19 recovery.

**Conclusions:** This case demonstrates the utility of neuropsychological evaluation in determining the etiological contributions of COVID-19 on the cognitive functioning of those at risk for, or suffering from, neurodegenerative disease processes. This case appears to support the recent hypothesis that COVID-19 may contribute to accelerated development of neurodegenerative diseases. By closely examining elderly survivors over time, we will advance our understanding of neurodegenerative processes and the possible contributory influence of COVID-19.

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**Keywords:** dementia - other cortical, infectious disease

**M. S. COHEN, M. L. TURMAN, A. E. SAAD, J. SPAT-LEMUS, H. A. BENDER. A Case Study of the Clinical Utility of Parietal Lobe Assessment for Differential Diagnosis of Dementia with Lewy Bodies.**

**Objective:** Diagnosis of Dementia with Lewy Bodies (DLB) is challenging due to symptomatology variance in clinical and neuropsychological profiles. Further, in the early stages of disease progression, Alzheimer's Disease (AD) and DLB can have largely similar neuropsychological profiles, specifically involving memory deficit and temporal lobe dysfunction. One diagnostic indicator that can help differentiate DLB from other dementias is the presence of pronounced visuospatial/visuoconstructional deficits in patients with DLB pathology, implicating parietal lobe dysfunction. In patients with pure DLB, these impairments are notably more severe than those observed in patients with pure AD. As such, there is clinical utility for thorough assessment of parietal lobe function when determining differential diagnosis in a patient presenting with memory difficulty. We describe a case study of a 70-year-old, Spanish-speaking patient who presented with multifocal neurocognitive impairments. Initial assessment implicated temporal lobe neuropathology commonly associated with dementia; detailed assessment of parietal lobe functioning indicated severe dysfunction and striking visuospatial/visuoconstructional issues consistent with DLB pathology. This information clinically correlated with the patient's report of complex hallucinations, falls related to orthostatic changes, and parasomnias. The authors highlight the diagnostic utility of detailed assessment of parietal lobe functioning and argue for the creation of a brief, standardized screening measure of visuospatial functioning to assist with differential diagnosis in patients with suspected neurodegenerative disorders.

**Participants and Methods:** The patient was referred for neuropsychological assessment with services at an outpatient neurology clinic. They were initially administered the Spanish-language version of the Repeatable Battery for the Assessment of Neuropsychological Status - Update (RBANS) and grooved pegboard. Additional assessment of parietal lobe functions, including clock drawing, right/left orientation, finger gnosis, mathematical calculations, and visuoconstructional praxis, as well as a neurobehavioral examination, were performed.

**Results:** Neuropsychological assessment data indicated multi-focal neuropathology impacting multiple cognitive domains, including significant impairments in memory, semantic language, and motor functioning, with considerable visuo-perceptual/visuoconstruction deficits. There was evidence of notable impairment across nearly all tasks of the administered parietal lobe assessment. The severity of visuospatial and visuoconstructional deficits observed was consistent with those highlighted in DLB pathology literature, as well as clinically correlated with other DLB features this patient was experiencing.

**Conclusions:** Detailed assessment of parietal lobe function can be a key differential indicator of DLB pathology when working with patients with suspected dementia-related neuropathology, particularly when a patient's neuropsychological profile is otherwise equivocal. Assessment of parietal lobe function through tasks such as clock drawing and visuoconstruction, finger gnosis, right/left orientation, and mathematical calculations can be easily administered. The authors argue that there is a need for the creation of a brief, standardized measurement of parietal lobe function for this population, particularly for patients with a wide-variety of cultural, linguistic,

and educational experiences, as well as differing levels of cognitive functioning, not only to facilitate differential diagnosis, but also for prognostic value.

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**Keywords:** dementia with Lewy bodies, neuropsychological assessment, parietal lobes

**B. ABDOLMOHAMMADI, M. WHITE, M. URETSKY, E. NAIR, N. SALTIEL, A. SHAH, J. CULHANE, V. ALVAREZ, B. R. HUBER, T. STEIN, A. MCKEE, M. ALOSCO, J. MEZ. Chronic Traumatic Encephalopathy in a Cohort of Military Veterans and Players of American Football in the VA-BU-CLF Brain Bank.**

**Objective:** Chronic traumatic encephalopathy (CTE) is a neurodegenerative disease associated with exposure to repetitive head impacts (RHI) which occur in contact sports and military-related activities. CTE risk is associated with cumulative exposure to RHI from the play of American football and the clinical presentation of CTE has been described primarily in American football players. The relationship between military-related RHI exposure and CTE has not been explored in equal depth. This study aims to describe the clinical and neuropathological characteristics of brain donors exposed to RHI from military service alone along with brain donors exposed to RHI from both military service and American football.

**Participants and Methods:** We examined the clinical and neuropathological characteristics of 177 brain donors from the VA-BU-CLF Brain Bank. 138 donors had dual exposure to American football and military-related RHI. Of those 138 donors, 5 experienced combat, 17 experienced TBI and 7 experienced blast. 39 brain donors were exposed only to military-related RHI, 9 of whom experienced combat, 14 experienced TBI and 10 experienced blast. All 177 donors were subjected to a series of clinical and neuropathological evaluations. Informants of brain donors provided athletic and military histories through a battery of online questionnaires. Retrospective clinical assessments were conducted via structured and semi-structured phone interviews. Neuropathologists diagnosed CTE based on NINDS defined criteria. All clinical and neuropathological evaluations were conducted blinded to one another.

**Results:** Mean (SD) age at death was 69.0 (17.7) years for 39 military-only donors, and 73.1 (15.7) years for 138 military and football-playing donors. 8 (21%) military-only and 102 (74%) military and football-playing donors were neuropathologically diagnosed with CTE. Alzheimer's disease was neuropathologically diagnosed in 9 (24%) military-only and 40 (29%) military and football-playing donors, Lewy body dementia (LBD) in 6 (15%) and 31 (23%), frontotemporal lobar degeneration (FTLD) in 8 (21%) and 20 (15%), and motor neuron disease (MND) in 0 and 1 (1%), respectively. Geriatric Depression Scale (GDS) scores above 4 were seen in 27 (93%) and 90 (90%), respectively, indicating presence of at least mild depressive symptoms. Informant-reported clinical symptoms of PTSD were present in 19 (61%) military-only donors, as compared with 35 (35%) military and football-playing donors. Dementia was present in 16 (49%) military-only and 79 (66%) military and football-playing donors.

**Conclusions:** Individuals exposed to RHI from both military service and American football exhibited high rates of CTE (74%), dementia (66%), and depression (90%) while individuals with only RHI exposure from military service showed high rates of depression (93%) and PTSD (61%), but lower rates of CTE (21%) and dementia (49%). Individual service members experience a wide spectrum of RHI exposures over the course of their military career. In contrast, American football players experience frequent, relatively stereotyped RHI over an

athletic career. Although CTE occurs after military-RHI exposure alone, CTE likely does not account for the high levels of depression and PTSD found in military-service members.

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**Keywords:** dementia - other cortical, brain injury, head injury (closed)

**G. ORTIZ, M. BARKER, K. LAING, A. CHESEBRO, M. MANOOCHEHRI, H. E. SILVERMAN, J. GOLDMAN, A. M. BRICKMAN, E. HUEY, S. COSENTINO. Frontal Default Mode Network Functional Connectivity and Knowledge of Social Norms in Pre-Clinical bvFTD.**

**Objective:** Social cognition becomes markedly impaired in behavioral variant frontotemporal dementia (bvFTD) at the early stages of disease. Indeed, social cognitive dysfunction has been reported in preclinical carriers of genetic mutations in *MAPT* who are destined to develop bvFTD. Previous research showed that hyperconnectivity of the frontal portion of the default mode network (DMN), measured with resting state fMRI, may contribute to social cognitive decrements. However, work is needed to clarify whether specific regions within the frontal DMN contribute to changes in functional connectivity (FC) in preclinical bvFTD, and thus may underpin the relationship between FC and social cognition. Given the central role of the ventromedial prefrontal cortex in supporting aspects of social cognition, we hypothesized that ventral and medial portions of the frontal DMN would be more strongly associated with social cognition than dorsal or lateral portions of the network.

**Participants and Methods:** Twelve preclinical *MAPT* mutation carriers and 32 demographically matched familial non-carriers underwent neuropsychological assessment and structural and functional MRI. We examined social cognition via performance on the Social Norms Questionnaire (SNQ), which gauges knowledge of social norms and is part of the National Alzheimer's Coordinating Center FTD module. A series of exploratory correlations was conducted between the 25 regions of interest (ROIs) that comprise the frontal DMN and SNQ scores to test for any potential region-level brain-behavior relationships. The 25 ROIs span dorsal, ventral, medial, and lateral areas of the prefrontal cortex (PFC).

**Results:** Among the combined group of carriers and non-carriers, frontal DMN FC was inversely associated with SNQ ( $r_{\text{Spearman}} = -0.39$ ,  $p = 0.021$ ), meaning that increased connectivity was associated with poorer social cognition. Within the frontal DMN, there were three ROIs that were significantly correlated with SNQ performance. All three regions were located within the medial prefrontal cortex (mPFC) and spanned the left and right hemispheres (MNI coordinates: [24, 32, 48]; [-20, 44, 38]; [10, 54, 2]).

**Conclusions:** Examining preclinical genetic mutation carriers offers a valuable opportunity to gain insight into the earliest disease-related processes. Early changes in knowledge of social norms, preceding the full presentation of bvFTD, appear to reflect increased frontal DMN connectivity, specifically in the mPFC. Previous research including structural MRI and lesion-based studies have found that the mPFC plays important roles in different aspects of social cognition such as theory of mind and social and affective information processing, which contribute to individuals' knowledge of social norms. The current findings extend this work to FC and identify three specific regions that may hold particular importance for early social cognitive changes in bvFTD. Tracking FC changes may have clinical utility when developing outcome measures for clinical trials targeting early stages of the disease. Although it appears that

there is increased FC early in the disease course, it is possible that decreased FC may be evident later on as the disease develops, possibly even at the time of diagnosis.

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**Keywords:** social cognition, neuroimaging: functional connectivity, dementia - other cortical

**C. O. NESTER, J. TURNER, M. KATZ, E. AYERS, L. A. RABIN, J. VERGHESE, J. MOGLE. Utilizing Daily Diary Report to Assess Subjective Cognitive Concerns in Older Adults with Motoric Cognitive Risk Syndrome.**

**Objective:** Motoric Cognitive Risk Syndrome (MCR) is a predementia condition that combines two clinical presentations independently associated with dementia-risk: slow gait speed and subjective cognitive concerns (SCC). Currently, there is no consensus in the field about how to best assess SCC in MCR, which may limit sensitivity to risk, with crucial implications for ongoing research and clinical care. In this pilot study, we apply a novel approach to investigate SCC in MCR utilizing daily diary report in a cohort of ethnically/racially diverse older adults.

**Participants and Methods:** Participants from the Einstein Aging Study ( $n=230$ ,  $Age=77.0$ ,  $Myears\ education=15.2$ , 64.1% women, 46.8% White) completed in-person cognitive tests, a paper-and-pencil questionnaire of SCC (an expanded 40 item version of The Cognitive Change Index [CCI]), and gait speed assessment. Additionally, they completed daily self-report of SCC (in retrospective and prospective memory and executive functioning cognitive domains) via smartphone for 14 days. Participants were classified as normal ( $n=139$ ), mild cognitive impairment (MCI; cognitive impairment on objective neuropsychological tests, gait speed normal;  $n=59$ ), MCR (gait speed impairment, cognitively normal;  $n=20$ ), and MCR+MCI (Gait and cognitive impairment;  $n = 12$ ). We used one-way ANOVA and independent samples  $t$  tests to characterize and assess SCC, via daily diary (measured in total number of SCC problems reported) and standardized in-person (measured in total CCI score), and objective neuropsychological data by group.

**Results:** Across the 14-day diary report of SCC, individuals with MCR ( $M=165.1$ ) and MCI ( $M=148.2$ ) reported the greatest number of SCC incidents, followed by normal ( $M=117.0$ ), while MCR+MCI ( $M=40.2$ ) reported the fewest. This trend of group differences in SCC endorsement was not observed in standard in-person SCC assessment. In participants with MCR, those who had MCI reported significantly fewer SCC via daily diary assessment than those without MCI,  $t(29)=2.33$ ,  $p=.03$ ;  $d=.66$ ; differences not replicated in the standardized paper and pencil assessment,  $t(30)=0.18$ ,  $p=.86$ ;  $d=.11$ . Performance on objective cognitive measures revealed the unsurprising pattern of lowest neuropsychological performance exhibited by individuals with MCI (alone and with MCR) as compared to those without MCI (normal and MCR).

**Conclusions:** To our knowledge, this is the first study to employ daily diary methods to investigate SCC in MCR. Individuals with MCR+MCI demonstrated poor cognitive functioning with limited insight, as detected by the daily diary assessment of SCC. Traditional paper-and-pencil assessment of SCC did not detect group differences, suggesting that the use of daily diary reporting in this population may be sensitive to meaningful clinical markers of dementia risk. Future research will explore the relationship between baseline SCC in individuals with slow gait and risk for cognitive and functional decline, and incident dementia.

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**Keywords:** self-report, aging disorders, movement

**T. KARPOUZIAN-ROGERS, R. HURLEY, M. SECKIN, N. GILL, S. MOELLER, C. COVENTRY, J. L. REILLY, E. ROGALSKI, S. WEINTRAUB, M. . MESULAM. Task-evoked pupillary response and word frequency in Primary Progressive Aphasia.**

**Objective:** The task-evoked pupillary response (TEPR) is an established physiologically-driven index of cognitive processing. Increases in cognitive demand result in larger pupil dilation (Beatty & Lucero-Wagoner, 2000). Prior studies have demonstrated greater TEPR when attending to low frequency words, indicating greater semantic processing demands for less frequently encountered words (Schmidtke, 2014; Chapman & Hallowell, 2015). The relationship between pupillary responses and semantic processing has not been investigated in individuals with Primary Progressive Aphasia (PPA). This goal of this study was to examine TEPR during an object-word matching task for words with varying levels of word frequency.

**Participants and Methods:** Healthy controls (n = 21), individuals with non-semantic PPA (logopenic PPA, n = 13; agrammatic PPA, n = 16) and individuals with semantic PPA (n = 10) completed a word-to-object matching task in which they were presented with a word visually and aurally, and then selected the correct item from a 16-item array of object pictures. Word categories included animals, fruits and vegetables, items of clothing, and tools. Frequency of words was derived from the English Lexicon Project (Balota et al., 2007). Pupillary response was measured as baseline-corrected percent change in pupil size during the last 200ms of stimulus presentation.

**Results:** Linear mixed-effects model predicting TEPR revealed a group by frequency interaction ( $X^2(2) = 3.3, p = .04$ ) such that the non-semantic PPA group demonstrated greater increases in pupil size in response to low frequency items compared to the control group, while the control and semantic groups did not differ ( $p > 0.5$ ). The number of letters had no effect on pupil dilation, indicating that changes in pupil size were not related to word length.

**Conclusion:** Previous findings have demonstrated a weakened word frequency effect for individuals with greater English proficiency; the minimal pupillary differentiation in controls may therefore reflect a ceiling effect that weakened this frequency difference. In contrast, the weakened differentiation in TEPR by frequency in semantic PPA patients may reflect their inability to understand the meaning of either higher or lower frequency words, thus equalizing their impact on processing resources. Non-semantic patients, on the other hand, have a relatively minimal impairment of word recognition, that can only be detected through difficult chronometric tasks, and interferes mostly with retrieval. This intermediate level of difficulty appears to have magnified the word frequency effect, resulting in increased TEPR. To our knowledge, this is the first study to examine TEPR as an online measure of lexicosemantic processing in PPA, which may have important implications for examining semantic processing in the context of reduced verbal output.

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**Keywords:** aphasia, language: aphasia, semantic processing

**Z. T. GOODMAN, J. S. NOMI, L. KUPIS, L. Q. UDDIN, D. A. LOEWENSTEIN, R. E. CURIEL CID. Differences in Limbic Functional Connectivity Among Offspring of Patients with Alzheimer's Disease.**

**Objective.** Previous work has demonstrated that asymptomatic adults with a parental history of Alzheimer's disease (AD) perform worse on tasks of verbal learning and are more prone to proactive semantic interference compared with adults with no familial history of AD (Sánchez et al., 2017). Further, adults with a parental history of AD exhibited hypoconnectivity of the entorhinal cortex with the medial prefrontal cortex and anterior temporal lobe. This study sought to replicate these previous findings to further elucidate brain connectivity patterns arising prior to the onset of AD diagnosis.

**Participants and Methods.** A total of 46 adults (38 to 59 years,  $M_{age} = 51.09$ ,  $SD = 6.61$ , 70% Female) without primary neurological disorders or significant medical conditions were included in the study. Sixteen participants were asymptomatic offspring with one parent with late-onset AD (O-LOAD) while 30 participants were healthy controls with no familial history of AD; groups were not significantly different with regards to gender or age. Participants completed the Loewenstein-Acevedo Scales for Semantic Interference and Learning (LASSI-L), a list-learning cognitive stress which assesses susceptibility to proactive semantic interference, as well as a 7-minute resting-state fMRI scan. Preprocessing of neuroimaging data included the removal of the first 10 images, slice timing, realignment, normalization to 3mm MNI space, smoothing (6-mm FWHM), ICA denoising (FSL-MELODIC), nuisance covariate regression (white matter, cerebrospinal fluid), and bandpass filtering (0.01 – 0.1 Hz). Time series from regions of interest (ROIs) within each hemisphere were extracted from the entorhinal cortex, anterodorsal thalamic nuclei, posterior cingulate, middle frontal gyrus, hippocampus, insula, and precuneus, following previous work (REF).

**Results.** No significant differences in whole-brain functional connectivity were observed between O-LOAD and healthy controls for the anterodorsal thalamic nuclei; however, both right and left entorhinal cortices were more strongly connected to the right hippocampus and amygdala in O-LOAD participants. Additionally, the right entorhinal cortex demonstrated greater functional connectivity with the medial occipitotemporal gyrus in O-LOAD participants. Next, the strength of functional connectivity was correlated with performance on subscores of the LASSI-L most indicative of proactive semantic interference. Functional connectivity between the majority of ROIs was positively associated with verbal recall and resistance to semantic interference in controls, but not in O-LOAD participants.

**Conclusions.** Consistent with Sánchez and colleagues (2017), we found that the functional connectivity of the anterodorsal thalamic nucleus was not different in healthy individuals and offspring of parents with AD. This study did reveal differential whole-brain functional connectivity of the entorhinal cortex in contrast to that previously observed, with the greatest discrepancy between O-LOADs and controls occurring in connectivity between the entorhinal cortex and right medial temporal regions. Finally, the lack of significant relationships between limbic region functional connectivity and the learning and recall tasks suggests O-LOAD participants may rely on different brain mechanisms when resisting semantic interference. This may provide preliminary evidence for changes in limbic region functional connectivity in individuals at greater risk of AD and prior to diagnosis.

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**Keywords:** neuroimaging; functional connectivity, dementia - Alzheimer's disease, semantic processing

**S. FRAN CZAK, C. J. ZOLLIECOFFER, G. N. MINOR, A. M. BUTTS, J. HENRY, M. BHALLA, M. AGARWAL, Y. WANG, A. NENCKA, J. POMMY, J. REUSS, L. UMFLEET. A Comparison of Visual Assessment and Quantitative Neuroimaging Techniques in Logopenic PPA and Amnesic MCI.**

**Objective:** Historically, diagnosis of primary progressive aphasia (PPA) has relied on neuropsychological or speech language pathology assessments to identify clinical symptoms that differentiate PPA subtypes, with the logopenic variant (lvPPA) being common and heterogeneous (Wicklund et al., 2014). Overlap in neurocognitive profiles across PPA variants often occurs (Sajjadi et al., 2012), and cognitive decline due to amnesic mild cognitive impairment (aMCI) is a common rule out. The pattern of atrophy on MRI may help to differentiate PPA from aMCI; this differentiation process typically relies on radiologist visual assessment. Notably, there are now clinically available, automated MRI analysis software programs (e.g., Neuroreader™) that compare patient regional brain volumes to a normative sample and provide z-scores for various brain regions. To date, no study has examined the clinical utility of Neuroreader™ in an lvPPA patient sample. Therefore, the present study aimed to 1) establish interrater reliability of blinded neuroradiologist MRI assessment, 2) compare Neuroreader™ quantitative volumetric data to neuroradiologist MRI assessment, and 3) determine the accuracy of Neuroreader™ in distinguishing lvPPA from aMCI individuals.

**Participants and Methods:** Twenty-three patients (11 lvPPA, 12 aMCI) were included as participants. All patients presented to a clinical visit at a midwestern U.S. medical center and were evaluated in a general neuropsychology clinic or specialized dementia care clinic which includes neuropsychological evaluation. Data were obtained retrospectively from patient medical records. Patient MRIs were analyzed by Neuroreader™ software and by two blinded neuroradiologists. Neuroradiologists rated 12 brain regions for volume loss and asymmetry. Neuroreader™ software analyzed 44 brain volumes that were subsequently transformed into z-scores. Reported analyses focused on frontal, temporal, and parietal lobes, as they were evaluated by both neuroradiologists and Neuroreader™ software and are frequently subject to neurodegeneration in PPA.

**Results:** Cohen's Kappa coefficient demonstrated fair to substantial agreement between raters ( $k = .349 - .654, p \leq .036$ ). Raters agreed 100% of the time that left asymmetry was absent in frontal, temporal, and parietal regions in lvPPA patients. Within aMCI patients, raters agreed 100% of the time that no left asymmetry was present in frontal or parietal regions but only agreed 83% of the time in temporal left asymmetry ratings. No significant differences emerged between aMCI and lvPPA patients in Neuroreader™ z-scores across left frontal, temporal, or parietal regions. Neuroreader™ z-scores indicated greater left vs. right atrophy for 64% of lvPPA patients in the frontal lobe, 73% in the temporal lobe, and 91% in the parietal lobe. Additionally, left temporal and parietal volumes were reduced significantly more than left frontal volumes in the lvPPA group ( $ps \leq .005$ ).

**Conclusions:** Interrater reliability was fair to substantial (i.e., raters agreed on absence of left > right asymmetry). However, neuroradiologists asymmetry ratings were inconsistent with atrophy patterns detected by Neuroreader™ software and with clinical expectation given known patterns of neurodegeneration in lvPPA. Findings demonstrate the need for further investigations that compare visual MRI assessment with MRI analysis software programs and highlight the potential value of including automated volumetric software to aid clinicians in differential diagnosis.

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**Keywords:** aphasia, neuroimaging: structural

**M. EHMANN, K. EDWARDS, S. RYAN, T. TYSZKOWSKI, A. RAHMAN-FILIPIAK, S. J. PELTIER, B. GIORDANI, H. PAULSON, B. M. HAMPSTEAD. Using Finite Element Modeling to Assess the Variability in HD-tDCS Delivered Current Across the Dementia Spectrum.**

**Objective:** Effective non-pharmacological treatments for cognitive impairment arising from neurologic injury and disease are needed. High definition transcranial direct current stimulation (HD-tDCS) offers one potential option given its ability to modulate brain activity. However, there is significant variability in the effects of HD-tDCS, which we posit are caused by an utter lack of dose-response information. Traditionally, tDCS uses the same montage and “dose” for each individual; an approach that overlooks individual differences in brain morphology that may be exacerbated by age and further by neurodegenerative disease. Recent methodological advances allow us to move beyond this traditional framework by evaluating how much electrical current was *delivered* to the targeted brain regions. Thus, this study focused on the variability in *delivered* electrical current in a large sample of older adults with and without cognitive deficits.

**Participants and Methods:** Individualized head models were created using finite element modeling (FEM) from T1-weighted images of 378 older adults (n=125 cognitively unimpaired; n=206 mild cognitive impairment (MCI); n=47 dementia), sourced from the Research Program on Cognitive and Neuromodulation Based Intervention (RP-CNBI) and the Michigan Alzheimer’s Disease Research Center (MADRC). ROAST software was used to model a 2mA current using a standard center (anode) that was surrounded by four disk electrodes (cathodes) based on RP-CNBI study montages that focused on the left inferior frontal gyrus and the right superior parietal region (anodes at F5 and P2, respectively). We extracted the average EF (V/m) and J(A/m<sup>2</sup>) from a 1cm sphere under the center electrode and used these *delivered* values to evaluate differences as a function of location, age, and diagnosis.

**Results:** Across the entire sample, both EF ( $p < 0.001$ ) and J ( $p < 0.001$ ) were significantly higher at F5 than P2. These values were generally inversely related to age (i.e., lower values with older age) at both locations (EF at F5:  $r = -0.098$ ,  $p = 0.057$ ; J at F5:  $r = -0.117$ ,  $p = 0.024$ ; EF at P2:  $r = -0.136$ ,  $p = 0.008$ ; J at P2:  $r = -0.137$ ,  $p = 0.007$ ). One-way ANCOVA controlling for age with Bonferroni-adjusted post-hoc showed a significant difference between diagnostic groups at F5 in both EF ( $p = 0.005$ ,  $\eta^2 = 0.029$ ) and J ( $p = 0.002$ ,  $\eta^2 = 0.034$ ) and at P2 in both EF ( $p = 0.030$ ,  $\eta^2 = 0.018$ ) and J ( $p = 0.008$ ,  $\eta^2 = 0.025$ ). Specifically, both EF (F5:  $p = 0.006$ ; P2:  $p = 0.035$ ) and J values (F5:  $p = 0.002$ ; P2:  $p = 0.022$ ) were significantly lower in those with MCI relative to the cognitively unimpaired. There were no significant differences between the dementia group and any other groups at either location, possibly due to our sample size.

**Conclusions:** In a sample of participants along the neurodegenerative spectrum, *delivered* current differed substantially by location, age, and diagnosis. These findings demonstrate that the traditional “one-size fits all” approach fails to achieve uniform stimulation across head/brain locations, especially in those with cognitive impairment. Thus, individualized models offer an important tool that can enhance rigor in this line of research.

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**Keywords:** aging disorders, neurostimulation, neuromodulation

**F. MORELLO GARCÍA, M. DIFALCIS, S. LEIVA, R. F. ALLEGRI, A. R. FERRERES. Assessment of Reading and Writing Impairments in Spanish-Speaking Patients with Semantic Variant Primary Progressive Aphasia.**

**Objective:** Diagnostic criteria for semantic variant primary progressive aphasia (svPPA) include the presence of acquired surface dyslexia or dysgraphia. The study of these impairments in Spanish-speaking patients is incipient, affecting diagnosis. In addition, the diagnostic consensus recommends certain tasks. For acquired dysgraphia it is possible to follow these guidelines since heterographic homophony is one of the characteristics of Spanish so writing is considerably irregular. However, most Spanish words are regular for reading, therefore, other tasks should be used to assess acquired dyslexia. The aim of this study is to report the usefulness of a set of tests that would allow the identification of acquired surface dyslexia and dysgraphia in Spanish-speaking patients with svPPA.

**Participants and methods:** Single-case study of a Spanish-speaking patient with imaging-supported svPPA (predominant left temporal lobe atrophy, affecting temporal pole and medial temporal lobe). Tests used: reading of words and nonwords (accuracy and reaction times), lexical decision with pseudohomophones, homophone comprehension and writing to dictation of words and nonwords.

**Results:** Results obtained are compatible with acquired surface dyslexia and dysgraphia: loss of lexical advantage in reaction times although conserved reading accuracy, pseudohomophone effect in lexical decision, low performance in homophone comprehension, regularity effect in writing to dictation with generation of phonologically plausible errors and preserved performance in nonwords.

**Conclusions:** Reading of words and nonwords and lexical decision with pseudohomophones are useful tests for identification of acquired surface dyslexia in svPPA. The good reading accuracy of the patient with the loss of lexical advantage in reaction times can be interpreted as the result of an alteration in the reading lexical route. Moreover, pseudohomophone effect evidences that the patient performed lexical decision task through phonological mediation, which also provides data in favor of a lexical-orthographic alteration. Homophone comprehension task is not suitable for svPPA since it is not possible to define whether low performance is due to difficulties in lexical-orthographic information or semantic impairments. With regards to acquired surface dysgraphia, the use of writing to dictation that manipulates the lexicality and regularity of the stimuli is sufficient. In conclusion, our results evidence that is possible to test all the svPPA diagnostic criteria in Spanish-speaking patients.

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**Keywords:** dementia - other cortical, neuropsychological assessment, demographic effects on test performance

**G. M. MASHINCHI, E. C. HICKS, H. HEPPNER, C. MCFARLAND. Cognitive Reserve and Sex Differences in an Alzheimer's Disease Population.**

**Objective:** Problems with memory are generally the first sign of Alzheimer's disease (AD), but significant decline in other areas of cognitive functioning are also evident. The rate of decline in cognitive abilities is not equivalent for all individuals, as some AD patients are able to remain

functional and independent longer than others despite having the same presence of cognitive decline. One theory as to why this inequivalence occurs is the cognitive reserve theory (CR). Factors such as leisure activity participation, occupational attainment, age, and educational attainment have been used as proxies of CR. The present study sought to investigate any differences between memory, executive functioning, and verbal fluency tasks using the CR proxies age and education within an AD sample. Sex differences were also examined as research has noted that females perform better on verbal tasks, and males perform better on visuospatial tasks.

**Participants and Methods:** 251 AD patients ( $M = 102$ ,  $F = 149$ ;  $M_{age} = 76.68$ ,  $SD = 8.11$ ) completed the Wechsler Memory Scale-IV (WMS-IV), Trail Making A and B, and Animal Fluency neuropsychological assessments. The WMS-IV was used as a measure of memory, Trail Making A and B were used as measures of executive functioning, and Animal Fluency was used as a measure of verbal fluency. Individual univariate ANOVA analyses using a Bonferroni adjustment ( $p = .017$ ) were conducted to examine the differences between scores of memory, executive functioning, and verbal fluency based on the predictor variables: sex, education, and age. Due to the archival nature of the data, the variable sex was coded as binary.

**Results:** Results indicated a statistically significant difference between males' scores on the Animal Fluency cognitive assessment ( $M = 11.30$ ,  $SD = 5.00$ ) and females' scores on the Animal Fluency cognitive assessment ( $M = 9.56$ ,  $SD = 4.13$ ;  $F = 9.06$ ,  $Adj. R^2 = 0.03$ ,  $p = .003$ ). Results also indicated a statistically significant difference between age groups' scores on Trail Making Test B, with the 80-89 age group averaging the highest amount of errors ( $M = 4.01$ ,  $SD = 3.00$ ,  $n = 81$ ;  $F = 3.71$ ,  $Adj. R^2 = 0.05$ ,  $p = .006$ ). No statistically significant results were found: 1) between sexes for memory or executive functioning; 2) between age groups for memory or verbal fluency tasks; or 3) between education attainment levels for memory, executive functioning, or verbal fluency.

**Conclusions:** Our findings corroborate the use of age as a proxy for CR, specifically for executive functioning tasks. Surprisingly, our results contradict past research that noted females perform better on verbal tasks, as we found that males had higher scores on a verbal fluency task at a statistically significant level. This disputing finding highlights the need for additional research examining sex differences in cognitive functioning of AD patients. Our nonsignificant results regarding differences in memory, executive functioning, and verbal fluency stemming from educational attainment may denote the importance of examining other CR proxies to explain differences in the rate of cognitive decline in an AD population.

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**Keywords:** cognitive reserve, aging disorders, dementia - Alzheimer's disease

**Y. CHUANG, M. CHIU, T. CHEN, Y. CHANG, H. CHANG, Y. LAI, T. CHENG, M. HUA.**  
**Own-Age Effect on Facial Emotion Recognition in Normal Elderly People and Individuals with the Preclinical and Demented Alzheimer's Disease.**

**Objective:** The issue of whether there exists an own-effect on the facial recognition in normal individuals, particularly in the elderly remains equivocal. Moreover, currently the literature of this issue in pathological aging is little. The present study was thus to explore the issue in both of healthy older people and patients with Alzheimer's disease (AD).

**Participants and Methods:** In study 1, 58 healthy adults (27 older and 31 younger ones) were recruited; in study 2, there were 27 healthy older adults and 80 patients, including those with

memory complaints (SCD), mild cognitive impairment (MCI), and AD. All participants received the Taiwan Facial Emotion Recognition Task (FER Task), and a clinical neuropsychological assessment.

**Results:** There were no significant performance differences on the FER test among our subject groups, except for sadness recognition in which our MCI and AD patients' performances were remarkably lower than their healthy counterparts. The own-age effect was not significantly evident in healthy younger and older adults, except for recognizing neutral photos. Our patients with MCI and AD tended to have the effect, particularly for the sad recognition in which the effect was significantly evident in terms of error features (mislabeling it as anger in younger-face and neutral in older-face photos).

**Conclusions:** Our results displayed no remarkable own-age effect on facial emotional recognition in the healthy elderly (including SCD). However, it did not appear the case for MCI and AD patients, especially their recognizing those sadness items, suggesting that an inclusion of the FER task particularly involving those items of low-intensity emotion in clinical neuropsychological assessment might be contributory to the early detection of AD-related pathological individuals.

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**Keywords:** mild cognitive impairment

**D. M. JACOBS, G. M. PEAVY, S. J. BANKS, C. GIGLIOTTI, E. A. LITTLE, D. SALMON. Use of Interactive Video Technology Among Participants in Alzheimer's Disease Research: Implications for Remote Assessment.**

**Objective:** To evaluate the practical feasibility of remote neuropsychological assessment in longitudinal cohort studies of cognition in aging.

**Participants and Methods:** All currently active participants (N=450) in the UC San Diego Shiley-Marcos ADRC longitudinal study were surveyed. Participants had been previously diagnosed with dementia (N=121; 27%), cognitive impairment or MCI (CI-MCI: N=68; 15%), or normal cognition (NC: N=261; 58%) based on a standardized in-person dementia evaluation. A 9-question online survey assessed access to high-speed internet and videoconferencing-capable technology, experience with video chat/conferencing; smartphone use; and willingness to complete cognitive testing remotely via videoconferencing or smartphone. Two versions of the survey were constructed: one to be self-completed by NC participants and one to be completed by the informant/study partner about the participant if the participant had CI-MCI or dementia. Both versions were available in English and Spanish. The initial survey request was sent by e-mail; if no email address was on file or if no response was received within two weeks of the email request, then up to three attempts were made to complete the survey by telephone.

**Results:** The survey was completed by N=369 participants/informants (82%). Those who completed the survey (or had it completed for them) had slightly but significantly more education ( $16.2 \pm 3.0$  vs.  $15.3 \pm 3.3$  years;  $p < .05$ ); were more likely to have normal cognition (surveys were completed for 89% of NC, 78% of CI-MCI, and 69% of dementia participants;  $p < .001$ ); and were less likely to be Latino (completed for 84% of non-Latino and 71% of Latino participants;  $p < .01$ ). Survey completers and non-completers did not differ by age (overall average =  $76.9 \pm 8.1$ ) or sex (overall 58% female).

Overall, 88% of responders had reliable high speed internet; 77% had a computer, tablet, or smartphone that they could use for remote testing; 60% reported that they use video technology

to interact with friends and colleagues; 72% would be willing to do cognitive testing via video; and 59% would be willing to do brief (burst) cognitive testing on their smartphone. Not surprisingly, device access was higher among those with NC (85%) or CI-MCI (85%) than those with dementia (52%) ( $p < .0001$ ), as was willingness to do remote cognitive testing (NC: 84%; CI-MCI: 74%; Dementia: 39%;  $p < .0001$ ). Latinos were significantly less likely than non-Latinos to have reliable high-speed internet (79% vs. 89%;  $p < .05$ ) or a video-compatible device (57% vs. 82%;  $p < .001$ ) but were comparable in their willingness to do remote cognitive testing. Desktop/laptops (68%) and smartphones (52%) were more frequently used for video chats than tablets (27%). Zoom (71%) and Facetime (45%) were the most frequently used platforms, followed by Skype (18%) and WhatsApp (9%).

**Conclusions:** Access to requisite technology for remote neuropsychological assessment and willingness to do cognitive testing via video or smartphone were high among non-demented ADRC participants, but low among dementia patients. Latino participants had less access to technology but comparable willingness to do testing remotely. Remote cognitive assessment using videoconferencing or smartphone technologies is a practicable option for nondemented participants, however, additional resources will be required to ensure representative participation of Latinos.

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**Keywords:** assessment, aging disorders, dementia - Alzheimer's disease

### **E. C. HICKS, C. FLANAGAN. Tech Support: Utilizing a Computerized Measure to Screen for Alzheimer's Disease.**

**Objective:** The need for early detection of Alzheimer's disease has been well established, and the use of computerized screening instruments for early detection has begun to draw attention. Computerized screening measures have great benefits, such as enhanced standardization, ability to be administered without intensive training, automated scoring and reporting, and decreased examiner influence on scores. GrayMatters is a self-administered computerized screening measure that employs two tasks: Visual Delayed Recognition and Delayed Alternation. These tasks measure visual memory and executive functioning. GrayMatters has previously been shown to have acceptable reliability and validity, and the aim of this study was to reevaluate the concurrent validity of GrayMatters due to the release of updated memory assessments and population changes over time.

**Participants and Methods:** To evaluate the concurrent validity of GrayMatters, archival data from 251 individuals with Alzheimer's disease was gathered from the Texas Neuropsychology Clinic. Data collected consisted of participant's GrayMatters, Wechsler Memory Scale-IV (WMS-IV), Mini Mental Status Examination (MMSE), and Trail Making A and B scores. Participant's GrayMatters Composite scores were correlated with WMS-IV, MMSE, and Trail Making A and B scores using Pearson product-moment  $r$  correlations. Higher GrayMatters Composite scores predict pathology, thus the hypotheses for the study were as follows: 1) GrayMatters Composite score will be significantly, negatively correlated with both the WMS Delayed Memory Index and Visual Memory Index, 2) GrayMatters Composite score will be significantly, negatively correlated with MMSE score, and 3) GrayMatters Composite score will be significantly, positively correlated with Trail Making A and B completion times.

**Results:** A Pearson  $r$  correlation comparing GrayMatters composite score with WMS-IV Delayed Memory and WMS-IV Visual Memory supported Hypothesis 1. GrayMatters composite

score was weakly correlated with WMS-IV Delayed Memory Index,  $r(249) = -.21$ ,  $p < .001$ , and moderately correlated with WMS-IV Visual Memory Index,  $r(249) = -.372$ ,  $p < .000$ . Additional analyses revealed a weak correlation between GrayMatters composite score and WMS-IV Auditory Memory Index,  $r(249) = -.255$ ,  $p < .000$ , a moderate correlation between GrayMatters composite score and WMS-IV Immediate Memory Index,  $r(249) = -.414$ ,  $p < .000$ , and a strong correlation between GrayMatters composite score and WMS-IV Visual-Working Memory Index,  $r(19) = -.618$ ,  $p < .003$ . GrayMatters Composite score was significantly, moderately correlated with MMSE scores,  $r(249) = -.488$ ,  $p < .000$ , supporting Hypothesis 2. Hypothesis 3 was also supported as GrayMatters Composite score was moderately, positively correlated with Trail Making part A completion time,  $r(246) = .474$ ,  $p < .000$ , and moderately, positively correlated with Trail Making part B completion time,  $r(222) = .316$ ,  $p < .000$ . All correlations were statistically significant at the  $p < .01$  level.

**Conclusions:** The purpose of the study was to evaluate the concurrent validity of GrayMatters. Findings indicate that GrayMatters Composite score is consistent with all WMS-IV Indices scores, MMSE scores, and Trail Making A and B completion times. This study provides support for the validity of the GrayMatters system as a screener for Alzheimer's disease.

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**Keywords:** computerized neuropsychological testing, test validity, dementia - Alzheimer's disease

### **K. LENGU, M. T. PADGETT, T. TYSKOWSKI, B. M. HAMPSTEAD, R. SPENCER. Learning Ratio is Better than Raw Learning Slope for Classifying Cognitive Impairment in Older Adults Across the AD Spectrum.**

**Objective:** The present study examined the validity of the Verbal Learning Ratio (VLR) Index for the RBANS in a mixed sample of cognitively unimpaired older adults ( $n = 45$ ), those with amnesic mild cognitive impairment ( $n = 136$ ), and those with dementia of the Alzheimer's type ( $n = 13$ ). **Participants and Methods:** We used receiver operating characteristic (ROC) area under the curve (AUC) analyses to demonstrate the diagnostic classification accuracy of the VLR index relative to the more widely used Raw Learning Score (RLS) method. We also examined the relationships among these indices, traditional RBANS measures (i.e., Immediate Memory and Delayed Memory indices – IM and DM), and the volumes of brain regions related to memory using NeuroQuant-based MRI volumetry. **Results:** ROC analyses indicated the VLR index discriminated between older adults with and without cognitive impairment ( $AUC = 0.851$ ) at a level higher than the RLS method ( $AUC = 0.680$ ), performing more comparably to the traditional RBANS memory indices, IM ( $AUC = 0.921$ ) and DM ( $AUC = 0.927$ ). Relative to RLS, the VLR Index more strongly correlated with relevant brain volumes, including hippocampal volume ( $r = 0.378$ ,  $p < 0.001$  vs.  $r = 0.241$ ,  $p = 0.014$ ) and inferior lateral ventricle size ( $r = -0.288$ ,  $p = 0.003$  vs.  $r = -0.086$ ,  $p = 0.390$ ). Additionally, the VLR Index demonstrated incremental validity, predicting hippocampal volume above that accounted for by the traditional IM Index alone ( $\Delta R^2 = 0.036$ ,  $p = 0.040$ ), whereas the RLS approach did not ( $\Delta R^2 = 0.027$ ,  $p = 0.075$ ). **Conclusion:** These results provide support for the use of learning ratio (VLR) over traditional raw learning slope (RLS) methods to inform clinical diagnosis of cognitive impairment in older adults.

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**Keywords:** aging disorders, neuroimaging: structural, psychometrics

**E. PUGH, J. STEWART, L. CARTER, M. CALAMIA, O. CARMICHAEL, R. L. NEWTON JR. Beliefs, Understanding, and Barriers Related to Dementia Research Participation among Older African Americans.**

**Objective:** The United States Census Bureau projects that the African American population will be one of the fastest growing over the next 30 years and prior research indicates that this population may be at higher risk for developing dementia in late life. However, low representation of African Americans has been reported in dementia research studies. Little is known about African American adults' beliefs about, and knowledge of, dementia; and it is not clear how these beliefs and knowledge impact participation in dementia research. **Participants and Methods:** We conducted focus groups among older African American adults to examine understanding of dementia and barriers influencing their willingness to participate in a clinical trial on physical activity and dementia risk reduction. Four focus groups were completed with a total of 51 older African American adults in southern Louisiana. The average age of participants was 68 years; there were 39 female and 12 male participants. **Results:** Participants exhibited awareness of several risk and protective factors related to dementia, including family history of dementia, lack of cognitive engagement, and sedentary lifestyles. Further, participants expressed willingness to participate in a clinical trial of strategies to lower the risk of developing dementia. Barriers to research participation included invasive procedures, pharmaceutical interventions, mistrust of investigators, inadequate compensation, and long study duration. **Conclusions:** Given the high relevance of dementia research to older African Americans, their knowledge of dementia, and their willingness to participate in dementia research once barriers are addressed, it is imperative to continue to identify and remediate factors contributing to the poor representation of African Americans in dementia research.

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**Keywords:** cross-cultural issues, dementia - Alzheimer's disease, minority issues

**S. B. PUDUMJEE, P. MARTIN, R. L. UTIANSKI, J. R. DUFFY, H. M. CLARK, H. BOTHA, W. L. JENNIFER, K. A. JOSEPHS, M. M. MACHULDA. Associations of The Rey-O Complex Figure-Copy with Other Measures of Executive Function in Progressive Apraxia of Speech and Progressive Agrammatic Aphasia.**

**Objective:** Prior studies within our group have found that Progressive Agrammatic Aphasia (PAA) can be associated with executive functioning deficits, particularly in those with comorbid Apraxia of Speech (AOS) denoted as AOS+PAA (Butts et al., 2018). Further, individuals with circumscribed Primary Progressive Apraxia of Speech (PPAOS) were relatively cognitively intact compared to their counterparts with AOS+PAA (Polsinelli et al., under review). The Rey-Osterrieth Complex Figure-Copy Trial (ROCF-C) is often regarded as a visuomotor task, but it has significant executive demands in the form of planning, organization, and integration of information. This study examines the differences in associations between the ROCF-C with measures of neuropsychological, neurobehavioral, speech/language, and motor functioning across these three diagnostic groups (PAA, AOS+PAA, and PPAOS).

**Participants and Methods:** Participants included those with a diagnosis of PAA (n = 13), AOS+PAA (n = 39), or PPAOS (n = 42) based on consensus diagnosis from speech-language

pathologists. All participants underwent comprehensive speech/language, neurological, and neuropsychological evaluations. ROCF-C associations with eleven clinical tests related to executive, non-executive, (including speech/language), and motor domains were examined using ordinary linear regressions predicting ROCF-C scores based on the Mayo Older Adult Normative Studies (MOANS) by clinical test score and diagnostic group.

**Results:** Tests that assess aspects of executive functioning [Frontal Assessment Battery (FAB), Trail Making Test – Part B (TMT-B) MOANS score, and Visual Object and Space Perception Battery (VOSP) Cube Analysis] showed greater associations with the ROCF-C than their relatively non-executive and motor counterparts [e.g. VOSP Incomplete Letters, Western Aphasia Battery (WAB) Praxis, and Unified Parkinson’s Disease Rating Scale- Parts I-III (UPDRS I-III)]. Large effect sizes characterized these relationships; an increase of 5 units on each the executive functioning measures was associated with a corresponding increase of  $\geq 2$  MOANS scaled score on the ROCF-C independent of diagnostic group. Furthermore, PAA and AOS+PAA groups were compared to the PPAOS group using neuropsychological tests to predict ROCF-C performance. The extent to which PAA and AOS+PAA groups had lower mean scores than the PPAOS group was attenuated when accounting for common variance between ROCF-C and tests with an executive function component (e.g., TMT-B, FAB, or VOSP Cube Analysis). Although some non-executive tasks [Trail Making Test – Part A (TMT-A), VOSP letters, and the Neuropsychiatric Inventory-Questionnaire (NPI-Q)] were also associated with ROCF-C performance, group differences (i.e., PAA and AOS+PAA groups showing poorer performances on the ROCF-C compared to the PPAOS group) remained after accounting for the common variance in each of these measures.

**Conclusions:** Compromised executive functioning likely accounted for differences between PPAOS and PAA or AOS+PAA group performances on the ROCF-C. This adds to prior research from our group showing that executive dysfunction is more prominent in those with PAA or AOS+PAA than PPAOS and supports the notion that the ROCF-C can be impacted by executive in addition to visuomotor deficits in these disorders that present with aphasic symptoms. Future investigation with larger samples will allow more nuanced, test-wise analyses to further delineate the associations between measures of executive dysfunction across these diagnostic groups.

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**Keywords:** agrammatism, aphasia, executive abilities - abnormal

### **S. M. DEMETROPOLIS, S. R. SCROEDER, A. PARIKH. Are language and cognition strongly linked in people with aphasia?**

**Objective:** In neurotypical individuals, hearing a spoken word (such as “dog”) can boost non-linguistic cognition more so than hearing an environmental sound (such as “woof-woof”). For example, when asked to quickly determine whether an auditory cue (e.g., either “motorcycle” or <vroom-vroom>) matched a presented picture (e.g., an image depicting a Harley Davidson motorcycle), neurotypical participants were faster to respond when hearing the spoken word than when hearing the environmental sound (Edmiston & Lupyan, 2015). Here, we examine whether this ‘word advantage’ extends to individuals who have aphasia. It is possible that individuals with aphasia, particularly those with lexical and semantic deficits, will not show a word advantage, given a reduced ability to access words and their associated conceptual features (potentially including visual characteristics of the named concept).

**Participants and Methods:** Participants were administered the Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) and the WAB-R (Kertesz, 2007) to ensure a specific diagnosis for the type of aphasia. Then, participants were seated in front of a laptop with an external response box. An auditory word (e.g., cat), or environmental sound ("meow") was presented to the participant followed by a colored picture (e.g., cat). The stimuli were randomized in which the auditory word or environmental sound was presented before or at the same time as picture. Response times and accuracies were computed throughout the duration of the experiment.

**Results:** Preliminary scores on the cognitive screening of the MMSE revealed statistical significance between the groups with the adults with aphasia demonstrating an average of 25.6 (9.3) and healthy adults scoring a 29.6 (0.3) average ( $p < 0.05$ ). The WAB-R scores revealed statistical significance for the subtest for auditory visual comprehension score ( $p < 0.05$ ) and marginal significance for the naming and word finding score and aphasia quotient ( $p = 0.08$  and  $p = 0.09$ , respectively). Initial testing and data has included testing 5 healthy adults (3 males; 2 females; age range: 65 years to 79 years;  $M = 73$ ,  $SD = 30.5$ ) with the following results indicating a word advantage. In other words, the participants are faster at audio-visual matching when the audio is a spoken word ("cat") versus an environmental sound ("meow"). Thus far, the mean response time for the healthy adults was 1,707 milliseconds when the audio was a spoken word, whereas the mean response time was 1,820 milliseconds when the audio was an environmental sound. Thus far, there are 3 participants (2 anomic, 1 Wernicke's according to the WAB-R), 2 males; 1 female; age range 42 to 49 years;  $M = 45.3$ ,  $SD = 12.3$ ) aphasia that demonstrate a "word advantage" (i.e., faster when the auditory cue was a spoken word rather than environmental sound), but the word advantage is smaller than it is for the neurotypicals.

**Conclusions:** The results of the study will expand our understanding of how aphasia influences cognitive functions beyond language as well as the degree to which language and cognition are linked in the human mind. In addition, our study has treatment implications such as how do nonlinguistic cognitive subskills predict naming therapy outcomes.

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**Keywords:** aphasia, language: aphasia, cognitive

### **M. GARLAND, J. VAIDYA, D. TRANEL, D. WATSON, J. FEINSTEIN. Who Are You? The Study of Personality in Patients with Anterograde Amnesia.**

**Objective:** Little is known about the role of declarative memory in the ongoing perception of one's personality. Acquired anterograde amnesia following focal brain injury to the medial temporal lobes is a rare condition that creates a unique target for investigation, particularly with regard to how amnesic patients maintain and update their sense of self in the context of their inability to form new declarative memories.

**Participants and Methods:** We studied seven patients with severe anterograde amnesia following bilateral damage to the medial temporal lobe. We examined the stability and accuracy of their personality ratings on the Big Five Inventory over five retest periods (ranging from 1 day to 1 year) and assessed self-other agreement with their caregiver using person-centered analyses. Caregiver ratings were obtained at baseline and then again at two-months. At 1 year after baseline, caretakers retrospectively rated how they remembered the patients during the year before their brain injury using the same questionnaires.

**Results:** The amnesic patients' self-ratings were highly stable over time, with mean correlation coefficients across the retest intervals ranging from  $r = .51$  to  $r = .94$ . Yet, self-other agreement with the caregivers was remarkably low ( $r = .21$  at baseline and  $r = .22$  at two-months), and only attained normative levels when caregivers were asked to rate what the patient was like prior to their brain injury ( $r = .58$ ). Thus, the amnesic patients maintained a keen sense of who they were before the injury, but failed to form an accurate perception of who they are now.

**Conclusions:** These findings suggest that the ability to form new declarative memory is not required for maintaining a stable sense of self, but is important for updating one's sense of self over time.

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**Keywords:** amnesia, personality, brain injury

### **Symposium 06: Social Cognition across the Lifespan**

**Chair: Skye McDonald**

**Presenters: Vicki Anderson, Miriam Beauchamp, Christine Padgett, Olivier Piguet, Sarah E. MacPherson**

**11:00 AM - 12:00 PM**

#### **S. MCDONALD, V. ANDERSON, M. BEAUCHAMP, C. PADGETT, O. PIGUET, S. E. MACPHERSON. Social Cognition across the Lifespan.**

Social cognition is the ability to recognise and interpret social cues in order to understand others. Clearly, disorders of social cognition will disrupt successful interpersonal function. There is growing awareness of the breadth of clinical disorders that are impacted by poor social cognition. These range from developmental and pediatric conditions, through to acquired brain damage in adulthood and dementias in older age. In this symposium we present novel paradigms for examining social cognition in a range of disorders across the lifespan.

Vicki Anderson introduces The Paediatric Evaluation of Emotions Relationships and Socialization (PEERS) for assessing social cognition and discusses its ability to characterise deficits in children with Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD) and Anxiety. Miriam Beauchamp focuses in on moral reasoning, discussing how and where problems with this social ability manifest in children and youth with ADHD, ASD, as well as Tourette's Syndrome, Traumatic Brain Injury (TBI) and Depression. In adults, Christine Padgett uses The Awareness of Social Inference Test (TASIT) to examine how social cognitive impairment impacts functional outcomes in males versus females with TBI and other forms of acquired brain injury. Moving to the older age group, Olivier Piguet discusses how people with frontotemporal dementia differ from those with Alzheimer's in terms of emotion and decision making while Sarah McPherson introduces a new test of affective and cognitive Theory of Mind suitable for people with dementia.

Overall, we hope to demonstrate that assessing social cognition has important theoretical and clinical applications, yielding new insights into brain function and how clinical disorders manifest as well as better tools for diagnosis and management.

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**Keyword:** social cognition

#### **V. ANDERSON. Evaluating social competency using PEERS with paediatric clinical populations.**

**Background:** Mature social skills are important for developing and sustaining rewarding relationships and quality of life. However, there are currently no comprehensive, ecologically valid assessment tools of children's social skills, thus limiting the accurate assessment of the social domain. The Paediatric Evaluation of Emotions Relationships and Socialization (PEERS) is an app-delivered assessment tool designed to address these gaps in paediatric social skills assessment.

**Participants and Methods:** Typically developing children (TDC, n=529), 5-15 years old were compared with children with attention deficit hyperactivity disorder (ADHD, n=56), Autistic Spectrum Disorder (ASD, n=46) or Anxiety Disorder (AD, n=35) on PEERS. Cognitive, social and behavioural questionnaires were completed by parents.

**Results:** Compared to TDC, the ADHD group demonstrated lower cognitive efficiency, with more errors and faster completion times, while the ASD group showed poorer emotion recognition and lower moral maturity and decision-making. Children with AD had elevated internalising behaviors and emotional symptoms, but intact social skills.

**Conclusions:** Findings suggest that PEERS is able to identify social profiles in children with neurodevelopmental and psychiatric diagnoses. Such 'precision-based' approaches represent a crucial addition to the current diagnostic labels and provide a nuanced profile of abilities that adds important information to more accurately guide intervention and treatment.

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#### **M. BEAUCHAMP. Socio-moral reasoning in youth with acquired and neurodevelopmental conditions.**

**Objectives:** Social cognition, defined as the ability to recognize, manipulate and behave with respect to socially relevant information (Adolphs, 2001), is underpinned by the functioning of a distributed network of brain regions known as the social brain. Thus, structural or functional disturbance to these networks could affect the way children reason and respond in social interactions and contexts. As such, there is increasing evidence that conditions affecting the development and integrity of the brain result in socio-cognitive deficits (Beauchamp, 2017). Among socio-cognitive abilities, moral reasoning (MR) is a uniquely human socio-cognitive ability based on the conventions that govern social interactions and the ability to generate social judgments and choose between right and wrong. It is a critical aspect of the way in which youth make judgements and decisions when faced with socio-moral conflicts. This presentation was designed to showcase the results of a series of studies in which socio-moral reasoning abilities were investigated in children and adolescents with acquired and neurodevelopmental conditions.

**Participants and Methods:** Children and adolescents with Traumatic Brain Injury (n=43), Tourette's Syndrome (n=30), Attention Deficit Hyperactivity Disorder (n=30), Autism Spectrum Disorder (n=30) and Depression (n=38) were assessed for socio-moral reasoning.

**Results:** The findings indicate that while there is evidence that socio-moral reasoning may be affected by disruptions to the brain, this is not universal across conditions.

**Conclusions:** A range of underlying clinical, cognitive, social and behavioral contributors need to be considered in accurately predicting outcome and identifying those at-risk for socio-cognitive impairments.

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### **C. PADGETT. Social Cognition and Psychosocial Outcomes after Acquired Brain Injury – Does Gender Make a Difference?**

**Objective:** Acquired brain injury (ABI) impairs social cognition, which impacts on psychosocial outcomes. Males may be more vulnerable to social cognitive impairments than females. This study investigated the interaction between sex and social cognition following ABI, and whether these factors are predictive of psychosocial outcomes.

**Participants and Methods:** Adults with ABI from trauma (150), stroke (29), multiple sclerosis (51), myalgic encephalomyelitis/chronic fatigue (33) or other (20) (57% male) were compared on The Awareness of Social Interference Test Shortened (TASIT-S). 39 ABI participants (m = 42, f = 31) also completed self-report measures of social cognition: the Social Emotional Questionnaire (SEQ) and Interpersonal Reactivity Index (IR), and psychosocial functioning, the Sydney Psychosocial Reintegration Scale (SPRS).

**Results:** Only the TBI participants performed more poorly than control participants on TASIT-S. They also performed more poorly comparatively to all other ABI groups. Performance did not differ according to sex. Separate regressions for males and females were conducted. For males, work/leisure outcomes were predicted by TASIT-S Social Interference Minimal Test (SIMT) subscale; relationship outcomes were predicted by TASIT SIMT, the SEQ Emotional Empathy (EE), and Emotional Recognition (ER) subscales. Living skills were predicted by informant reports of SEQ ER. There were no significant predictors for females.

**Conclusions:** Impairments in social cognition occur most consistently in TBI regardless of sex. However, it appears that psychosocial outcomes are differentially affected according to sex. These results highlight the need for sex differences and social cognition to be considered in ABI research and interventions.

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### **A. L. MANUEL, D. ROQUET, R. LANDIN-ROMERO, F. KUMFOR, R. M. AHMED, J. R. HODGES, O. PIGUET. Differential impact of emotion on decision-making in behavioural-variant frontotemporal dementia and Alzheimer's disease.**

**Objective:** At the behavioural level, negative and positive emotions modulate decision-making in opposite directions, with negative emotion resulting in more impulsive decisions whereas positive emotion tends to have the opposite effect. At the neural level, decision-making and emotion processing share a number of brain regions including the ventromedial-prefrontal cortex (vmPFC) and the amygdala. The objective of the study was to resolve how decision-making and emotions interact using a lesion model approach.

**Participants and Methods:** Study participants included individuals diagnosed with behavioural-variant frontotemporal dementia (bvFTD, n=18), who typically present with deficits in decision-making and emotion processing and atrophy of the vmPFC, individuals with Alzheimer's disease (AD, n=12) who tend to have preserved emotion processing and exhibit atrophy in limbic structures, and age-matched healthy controls (CTRL, n=15). Participants completed a delay discounting task during which they were asked to choose between a hypothetical immediate reward and a later but greater, reward. Prior to each decision, participants were cued with a positive, negative or neutral picture and asked to vividly imagine witnessing the event.

**Results:** As anticipated, behavioural findings showed that bvFTD patients were more impulsive than AD and CTRL and did not show any emotion-related modulation of delay discounting rate. In contrast, AD patients showed an emotion-specific modulation of delay discounting as reflected by increased impulsivity when primed by negative emotion. This increased impulsivity was associated with reduced integrity of the bilateral amygdala in AD but not in bvFTD.

**Conclusions:** Altogether, our results indicate that decision-making and emotion interact at the level

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**S. E. MACPHERSON, R. BAKSH, B. AUYEUNG, S. ABRAHAMS. Assessing Social Cognition in People with Dementia: The Edinburgh Social Cognition Test (ESCoT).**

**OBJECTIVE:** Few tests of social cognition examine more than one or two social cognitive abilities within the same test, limiting their representation of our social abilities. We developed the Edinburgh Social Cognition Test (ESCoT) as a new test of social cognition that assesses affective and cognitive ToM as well as inter- and intrapersonal understanding of social norms using animated interactions (Baksh et al., 2018). In the current study, we examine whether the ESCoT has the potential to be useful in examining social cognitive impairments in people with dementia.

**PARTICIPANTS AND METHODS:** Twenty-five people with dementia aged 53 to 78 years and 25 age- and educated-matched controls aged 48 to 78 years were administered the ESCoT, the Reading the Mind in the Eyes (Baron-Cohen et al., 2001), and the Social Norm Understanding Questionnaire (Rankin, 2008).

**Results:** People with dementia performed significantly more poorly than healthy controls on affective ToM, inter- and intra-personal understanding from the ESCoT and the Social Norm Understanding Questionnaire. Using a ROC curve analysis, we demonstrated that the ESCoT total score and interpersonal understanding of social norms were most effective at differentiating people with dementia from healthy controls compared to existing tests.

**Conclusions:** The ESCoT was sensitive to social cognition impairments in people with dementia compared to controls. The ESCoT may have clinical value as a test of social cognition in dementia and future work should examine ESCoT performance in different dementia subgroups.

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**Symposium 07: Diversity Factors in Clinical Neuropsychology: Pre- and Post-Coronavirus 2019 (COVID-19) Challenges****Chair and Presenter: Lynette Abrams-Silva****Presenters: Rebecca Avila-Rieger, Aikisha Harley, Cynthia Funes, Michelle Miranda****11:00 AM - 12:00 PM****L. ABRAMS-SILVA, R. AVILA-RIEGER, A. HARLEY, C. FUNES, M. MIRANDA.  
Diversity Factors in Clinical Neuropsychology: Pre- and Post-Coronavirus 2019 (COVID-19) Challenges.**

Neuropsychologists are directed to practice within the boundaries of competence, to use assessments appropriate to the language and culture of those being assessed, and to understand and describe limitations of test results and interpretation. However, even pre-COVID-19, there were no standardized guidelines regarding how to fulfill these directives in practice or training. From culturally appropriate test items, to differential validity concerns, to interpretation of scores within linguistic, educational, and sociocultural context, and all the nuances in between, clinical neuropsychology has long struggled to keep pace with the rapidly diversifying world population. In 2020, the public health crisis caused by COVID-19 exacerbated these challenges. Recent sociopolitical events as well as the pandemic and its health ramifications have demonstrated that at every level of education, training, and practice, diversity factors must be thoroughly addressed if cultural competence is to be attained, particularly given the new demands of tele-neuropsychology, which arrived suddenly and with added, unique challenges. The following abstracts follow the thread of diversity-related issues running through clinical neuropsychology, from pre-COVID-19 to post-COVID-19 practices, and suggest initial steps that might be taken to improve overall cultural competence in the field.

The first abstract provides an example of the variability of some pre-COVID-19 practices, in examining the consideration and incorporation of ethnicity/race details in the practice of clinical neuropsychology. While cultural competence has been increasingly encouraged, no standardized methods regarding where to include these and other diversity-related variables, or how to incorporate them into case conceptualization, have been established. The next abstract addresses pre- and post-COVID-19 issues that include questions of differential validity, particularly when measures are re-developed and re-normed from mono-lingual English-speaking populations to mono-lingual Spanish-speaking populations, and further complicated by remote administration. Important questions are examined regarding both test equivalence and administration modality equivalence. The third abstract addresses another practice spanning the pre- and post-COVID-19 eras: the incorporation of medical interpreters for use with non-English-speaking populations. One rarely-examined aspect of these evaluations is the increased time, skill level, and effort they demand. Finally, the fourth abstract examines emotional distress in the time of COVID-19 in a sample of Spanish-speaking patients, raising questions regarding cognitive functioning and recommending careful interpretation of post-COVID-19 cognitive profiles.

While pre-COVID-19 practices in neuropsychology were variable, there remains the possibility of increased variability introduced by a public health crisis and the use of tele-modalities.

Ultimately, the new challenges arising due to COVID-19 have complicated the pursuit of cultural competence in the field of neuropsychology. Recommendations suggested in this symposium

include increased standardization in the documentation and consideration of basic demographic information such as race/ethnicity; additional research on test equivalence between English and non-English measures, along with examinations of modality equivalence of the same; greater appreciation of the demands of performing an evaluation with an interpreter, and finally, examining what implications these new psychosocial stressors have on the growing Spanish-speaking population of the United States.

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**Keywords:** cross-cultural issues, test validity, assessment

**R. AVILA-RIEGER, M. IAMPIETRO. Inclusion of Cultural Considerations and Diversity Factors in Neuropsychological Reports.**

**Objective:** Professional guidelines are lacking for the provision of culturally-competent neuropsychological services. This places decision-making on individual clinicians and creates inherent variability in how a patient's sociocultural context is incorporated into the assessment and written report. This pilot project examined trends in inclusion of cultural and diversity factors in clinical neuropsychological reports.

**Participants and Methods:** Survey data were collected from Children's Hospital of Philadelphia (CHOP) pediatric neuropsychologists. Survey questions explored inclusion frequency and location of specific cultural and diversity factors, and special approaches to score interpretation and considerations of assessment limitations.

**Results:** Neuropsychologists (14/15 completed) consistently included age and sex variables, while only 14% always documented race/ethnicity. The majority included cultural and diversity factors in the relevant history, but information was not consistently mentioned in the report referral, summary/impressions, or recommendations. Over 80% reported using special approaches to interpret neuropsychological performance, but only 36% include a dedicated report section addressing cultural and diversity factors. 100% have commented on possible assessment limitations due to language proficiency, while fewer acknowledge potential limitations due to patient acculturation (64%) or race/ethnicity (40%).

**Conclusions:** Findings reveal inconsistencies regarding inclusion of even basic demographic factors in neuropsychological reports. Findings also reveal inconsistencies between clinical consideration of individual factors, and the representation of this in the written product. This has implications for the understanding of important cultural factors by the report reader. The extent to which the current data represent the greater neuropsychological community will be explored and better understood through future research efforts.

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**A. HARLEY, S. MASON, J. RENGIFO, R. HIRST, Y. BENSIDI-SLIMANE, S. PEERY. Impact of In-Office versus Tele-Neuropsychology on Basic Auditory Attention in an English- and Spanish-Speaking Sample: A Pilot Study.**

**Objective:** Tele-Neuropsychology (teleNP) has been validated in controlled clinical and research settings; in-home studies are limited. We examined the relationship of two well-correlated basic auditory attention measures between in-office and teleNP administrations: longest digit span forward (LDSF) and Trial 1 (T1) of a wordlist.

**Participants and Methods:** Participants included 32 in-office (59% females) and 32 teleNP (66% females) English- and Spanish-speaking patients matched for gender, age, education, premorbid IQ, language, and diagnosis. Variables assessed included T1 of a wordlist and LDSF. TeleNP visits were conducted in patients' homes without in-person assistance from clinical staff.

**Results:** Results of hierarchical regression revealed that LDSF significantly predicts T1 ( $F(1,62) = 6.08, p = 0.02$ ) and accounts for 8.9% of T1 variation in demographically matched samples. When administration setting is added, the model remains significant ( $F(2,61) = 1.01, p = 0.04$ ). Setting explains an additional 1.5% of the variance, but is not a significant contribution to the model (Sig.  $F$  change = 0.32). Further, the analysis demonstrates that LDSF is the best predictor of T1 ( $\beta = 0.48, t(62) = 2.57, p = 0.01$ ) and administration setting is not a significant contributor ( $\beta = 0.56, t(62) = 1.00, p = 0.32$ ).

**Conclusions:** Results demonstrate that LDSF predicts T1 regardless of administration setting, providing support for teleNP validity in both English and Spanish. Our findings contribute to the growing body of literature supporting teleNP, as the need increases for valid alternatives to face-to-face evaluations. Limitations included small sample size.

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### **C. FUNES, M. MIRANDA, F. ARIAS. Characterizing Effort Involved in Non-English Interpreter-Mediated Neuropsychological Evaluations .**

**Objectives:** In the United States (US), the growth of cultural and linguistic diversity surpasses the number of competent bilingual neuropsychologists. Ethical guidelines require clinicians to rise to the challenge of assessing non-English speaking patients. This pilot project aims to quantify the effort involved in conducting interpreter-mediated neuropsychological assessments. We hypothesized that: (1) interpreter-mediated models will involve additional effort (i.e., time) relative to standard evaluations and (2) differences will emerge in telephone-interpretation (TI) versus in-person (IP) interpreter models.

**Participants and Methods:** 14 interpreter-mediated assessments from two medical centers within the southwestern US were utilized for analysis. Five assessments employed TI and nine used IP. 14 English-language evaluations comprised a comparison sample, matched for age, education, and referral question. One-way ANOVAs were used to evaluate time differences in aspects of the evaluation, including preparation, face-to-face time, and wrap-up time.

**Results:** A significant difference was observed for total time involved in completing the evaluations ( $p < .001$ ). Preparation time involved significantly more effort with IP and TI than in standard evaluations ( $p = .001$ ). With regard to face-to-face time, IP evaluations took the most time ( $p = .001$ ), while TI and standard practice did not differ. Wrap-up time was significantly longer for IP & TI when compared to standard practice ( $p < .0001$ ).

**Conclusions:** Our preliminary findings suggest that interpreter-mediated models appear to require increased time, resources and skills. These findings have professional implications and highlight the need for further research in this area. A common model for clinical work on interpreter-mediated assessments is proposed, and education on the time-commitment is provided.

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**M. MIRANDA, F. ARIAS, J. RENGHIFO, A. HARLEY, S. PEERY. Higher Rates of Mood Disturbance During COVID-19 Among a Sample of Latinos.**

**Objective:** With the arrival of the coronavirus SARS-CoV-2 virus to the United States, came an extraordinary change in daily living. Vulnerable populations such as Hispanic/Latino(a)s experience unique challenges, with difficulties maintaining social distance if they are an essential worker, stress around socioeconomic factors, and pre-existing health disparities that render them increasingly vulnerable to coronavirus 2019 (COVID-19)-related morbidities and mortality.

**Participants and Methods:** A cross-sectional analysis examined emotional distress in 30 Spanish-speaking patients, 15 pre-COVID-19 and 15 during-COVID-19, presenting for cognitive testing at the University of Utah and San Francisco Neuropsychology. To the extent possible, patients were matched by gender, age, education, and referral question. Psychiatric assessments included the Beck Depression Inventory (BDI) and the Beck Anxiety Inventory (BAI).

**Results:** Fifty-three percent were females and 100% were Spanish dominant and evaluated in Spanish. The mean age was  $57.3 \pm 14.13$  and education ranged from 1-20 years ( $M = 11.0 \pm 5.3$ ). Prior to COVID-19, mean BDI score was  $9.5 \pm 8.8$ , mean BAI score was  $8.7 \pm 9.64$ . During COVID-19, mean BDI score was  $18.2 \pm 10.3$ , mean BAI score was  $12.8 \pm 7.50$ . Some group differences reached statistical significance (BDI  $t(27.9) = 2.49, p = 0.018$ ) and others did not (BAI  $t(24.46) = 1.24, p = 0.23$ ).

**Conclusions:** Our preliminary findings suggest that Spanish-speaking patients presenting for neuropsychological assessment during COVID-19 are experiencing significant emotional distress, which may be used to inform diagnostic conclusions and guide interventions. It is imperative that we assess mental health among Spanish-speaking patients. Future studies should examine these associations in a more robust sample and ascertain their impact on cognitive performance.

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**Plenary D: Adaptive Constructive Processes in Memory, Imagination, and Creativity**

**Presenter: Daniel L. Schacter**

**12:00 PM - 12:55 PM**

**D. L. SCHACTER. Adaptive Constructive Processes in Memory, Imagination, and Creativity.**

Adaptive constructive processes play a functional role in cognition but can also produce distortions or errors as a consequence of doing so. According to the constructive episodic simulation hypothesis, simulation of future and other hypothetical experiences depends importantly on episodic retrieval processes that allow individuals to draw on the past in a manner that flexibly extracts and re-combines elements of previous experiences, but they may also be responsible for specific kinds of memory errors. This talk will consider both cognitive and neural evidence from studies of episodic remembering, future imagining, and creative thinking that reveal the operation of adaptive constructive processes and provide clues concerning their nature and function.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Explain the concept of adaptive constructive processes 2) Describe cognitive and fMRI studies of remembering the past and imagining the future, divergent creative thinking, and memory distortion 3) Analyze approaches to manipulating the involvement of episodic retrieval processes in cognitive tasks that are not typically considered to be episodic memory tasks.

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### **Invited Symposia 3: Advancements in Tele-Neuropsychology Practice and Training During COVID-19**

**Chair: Julija Stelmokas**

**Presenters: David Marra, Dawn Bowers, Amber Rochette, Franchesca Arias, Cristina A. F. Román, Diomaris E. Safi, Ana Linda Díaz Santos, Munro Cullum, and Lana Harder**

**1:00 PM - 1:55 PM**

#### **M. CULLUM, L. HARDER. History and Evidence for Tele-neuropsychology Across the Lifespan.**

**Objective:** The objective of this presentation is to provide an overview of the literature on teleNP and will include a brief history of teleNP procedures, models of service delivery (e.g., home-based teleNP, in-clinic teleNP, hybrid model), and a review of the neuropsychological tests that have been studied using videoconference administration in adult and pediatric samples.

**Methods:** Utilizing modern technology creates promising opportunities to increase access to care for patients and more recently, promotes physical distancing in the context of a global pandemic. Tele-neuropsychology (teleNP) is growing in its evidence base and broad clinical implementation. Efforts to pursue and evaluate this service modality have been accelerated during the COVID-19 pandemic.

**Results:** Tele-neuropsychology has been established as a feasible, valid, and satisfactory way to evaluate patients. While the majority of current research focuses on and validates the use of teleNP in adult samples, more recent research provides support for pediatric tele-neuropsychology.

**Conclusions:** TeleNP offers opportunities to create access to specialty care for patients across the lifespan but there are many factors to consider when establishing such services. Limitations and future directions for research on teleNP will be briefly discussed.

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#### **D. MARRA, D. BOWERS. Rapid Deployment of Teleneuropsychology (teleNP) into Clinical Practice: A Research-Based Approach.**

**Objective:** To describe how the University of Florida (UF) rapidly implemented an adult teleneuropsychology (teleNP) practice during the initial days of the COVID-19 pandemic, while incorporating contemporary research to inform best teleNP practices given various validity concerns, including use of measures designed for face-to-face (FTF) assessments.

**Methods:** In early March 2020, we conducted an updated systematic review of teleNP studies with older adults and cross-over designs; NP measures were judged as having strong, moderate, or limited/insufficient evidence for use in teleNP practice. Concurrently, we deployed infrastructure resources for adapting stimuli and protocol development for teleNP Zoom platforms. To understand how COVID-19 affected clinical practice, two electronic surveys of neuropsychologists were administered between 3/26/2020 and 3/30/2020.

**Results:** While results from the systematic review (k=19 studies) provided strong support for teleNP validity for numerous cognitive tasks, few studies used an ‘in-home’ model, as required by COVID-related ‘stay at home orders.’ In this context, we developed a two-tier approach that initially assessed the appropriateness of teleNP, followed by formal evaluation. At UF, more than 335 teleNP assessments were completed prior to transitioning back to FTF evaluations. Results from the survey showed that most clinicians (N=496) immediately moved towards remote service provision, with 46% economically affected by the pandemic.

**Discussion:** While UF was able to resume a robust NP assessment service during the height of the COVID-19 pandemic, the challenges were many. These include service provision to low income/rural communities and lack of large scale, normative teleNP data for older adults. Such research is currently underway.

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#### **A. ROCHETTE, J. STELMOKAS. Clinical neuropsychology practice survey during COVID-19 within the United States: Service delivery and decision-making.**

**Objective:** Identify factors that influenced service delivery changes and examine barriers and provider satisfaction with teleneuropsychology (teleNP).

**Participants and Methods:** Licensed, clinical neuropsychologists within the United States were recruited via neuropsychology-specific listservs (July 7-August 7, 2020).

**Results:** A total of 261 individuals completed the survey. Most (76%) reported delivering in-person testing in some capacity at the time of our survey. Relatively more private practitioners identified concerns with privacy/confidentiality (45.2% vs. 17.9%;  $\chi^2(2)=6.99, p<.05$ ), legal issues (47.6% vs. 17.9%;  $\chi^2(2)=8.06, p<.05$ ), and an undesirable precedent for legal/forensic cases (59.5% vs. 15.4%;  $\chi^2(2)=17.54, p<.001$ ) compared to non-VA/medical practitioners. Multiple resources informed teleNP protocols, such as professional organization guidelines (87.6%), literature review (75.9%), webinars (72.4%), and consultation (68%). Several factors influenced test selection, including normative data availability (70.1%), test familiarity (66.4%), administration time (63.5%), and evidence base (60.6%). Reported barriers to continuing teleNP after COVID-19 included need for improved teleNP norms (85.9%), increased options for domain coverage (84.7%), further validation studies (84.1%), and improved patient access to technology (74.1%).

**Discussion:** TeleNP may not be compatible with all settings and/or referrals. Respondents employed multiple resources in aggregating their teleNP protocols and considered multiple factors when selecting tests. These responses highlight the complex and varied decision-making utilized by respondents to adapt to changes in service delivery. Considering the many benefits of teleNP, future research addressing some of the potentially modifiable factors (e.g., technology access, attitudes regarding teleNP) and significant development needs for teleNP itself (i.e., improved teleNP norms, further validation studies, etc.) is needed.

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**F. ARIAS, C. A. ROMÁN. COVID-19-related Shifts in Clinical Practice Among Neuropsychologists Providing Services to Monolingual and Bilingual Spanish-speaking Patients .**

**Objective:** While national and international organizations mobilized to offer support and document challenges to tele-neuropsychology (TeleNP) with diverse groups during the COVID-19 pandemic (IOPC, 2020; The STAR Consortium, 2020), the impact on clinical practice remains poorly understood. The current study aimed to assess how COVID-19 influenced clinical practice for cross-cultural neuropsychologists.

**Methods:** A 40-item survey was administered via listservs (April- August 2020) to providers working with monolingual and bilingual Spanish-speaking patients. Information about demographics; professional background; time spent providing services to monolingual and bilingual Spanish-speaking patients as well as time spent providing TeleNP before and after February 2020 was collected.

**Results:** Respondents (n=106) were predominantly female (84%) and non-white (53%). Most respondents had >10 years in practice (56%), held doctoral degrees in clinical psychology (86%), practiced within academic medical centers (54%), and provided services in English and Spanish (58%). Prior to February 2020, respondents provided 35 hours a week of neuropsychological services with 15% of that time dedicated to telephone-based TeleNP. After February 2020, respondents provided 22 hours a week of neuropsychological services with 75% of that time dedicated to TeleNP. Challenges identified included 1. Limited access to test/norms; 2. Reduced institutional resources; and 3. test security. Patient-related barriers to TeleNP included: 1. Reduced familiarity with technology; 2. Space limitations for home-based TeleNP; and 3. Lack of access to internet.

**Conclusions:** COVID-19 shifted clinical practice among licensed providers, resulting in increased provision of services via virtual modality. Despite this increase, TeleNP and patient related barriers persist, highlighting the

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**D. E. SAFI, A. L. DÍAZ SANTOS. The Impact of COVID-19 on Neuropsychology Trainees in Cross-Cultural Settings: Challenges and Opportunities.**

**Objective:** Although face-to-face supervision is the gold standard for teaching the core skills of professional practice in neuropsychology (Stucky et al., 2010), the COVID-19 pandemic has prompted providers to identify alternative ways to continue to foster professional development for trainees. This study expands on prior literature documenting trainees' experience (Guidotti Breting et al., 2020) during the COVID-19 pandemic. It examines practice trends and attitudes about teleneuropsychology (TeleNP) among trainees providing neuropsychological services to the Spanish-speaking community. **Methods:** A 40-item survey was administered to trainees of varying levels. Questions related to demographics, attitudes regarding TeleNP, and the influence of COVID-19 on training activities were included. **Results:** Preliminary results (n=20) revealed respondents were predominantly female (90%), non-white (57%), with a mean age of 32 (SD = 2.3) years. Most held master's degrees (67%), practiced within academic medical centers (64%),

and provided services in Spanish and English (66%). For most respondents (98%), training activities have changed as a result of COVID-19. Over 83% are now involved in some form of TeleNP, though only 21% had prior TeleNP experience/training. Conclusions: Our preliminary results suggest that among trainees in cross-cultural settings day-to-day activities have changed as a result of the pandemic, and most of their training now involves provision of some form of TeleNP. Resources to support trainees as they develop skill in remote administration of neuropsychological tests include: (1) Formal training; (2) Practice guidelines from national organizations; and (3) Support for the norm development. Additional recommendations to support trainees' development will

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### Paper Session 12: Aging & Assessment

1:00 PM - 2:00 PM

#### **K. A. MARTINEZ, H. A. CLARK, S. LAVIGNE, J. QUATTLEBAUM, R. W. SCHROEDER, P. MARTIN. The Dot Counting Test Is Not Associated With Memory in Older Adults With Mild Cognitive Impairment or Mild Dementia.**

**Objective:** Although generally robust, some memory-based performance validity tests (PVTs) demonstrate elevated false positive rates when applied to individuals with significant memory impairment/dementia. The Dot Counting Test (DCT) is one of the few stand-alone PVTs that is not memory-based and, thus, might be less impacted by notable memory impairment and dementia. Relatedly, Martin, Schroeder, and Olsen (2020) found that the DCT E-score maintained adequate specificity in groups of individuals with mild cognitive impairment (MCI) and mild dementia given use of appropriate cutoffs, although cutoffs in moderate to severe dementia were prohibitively high. The current study further investigated characteristics of the DCT by examining whether it is related to memory in individuals with MCI or mild dementia.

**Participants and Methods:** Participants were 200 validly-performing patients who completed dementia evaluations at an outpatient memory disorders clinic and met criteria for MCI ( $n = 100$ ; mean age = 71.64; mean education = 13.26) or mild dementia ( $n = 100$ ; mean age = 74.08; mean education = 13.37). All participants minimally completed the DCT and the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). As expected, both groups showed impairments on the RBANS Delayed Memory Index (MCI mean = 83.95,  $SD = 16.61$ ; mild dementia mean = 60.32,  $SD = 16.97$ ) and Immediate Memory Index (MCI mean = 84.35,  $SD = 14.28$ ; mild dementia mean = 68.60,  $SD = 16.26$ ). Pearson correlations were used to assess for relationships between the DCT E-score and RBANS Immediate Memory and Delayed Memory indices for each group, with findings of  $p < .05$  considered significant.

**Results:** The average DCT E-score fell within proposed cutoffs for the MCI group ( $M = 12.01$ ,  $SD = 3.50$ ) and the mild dementia group ( $M = 14.53$ ,  $SD = 5.42$ ). The DCT E-score in the mild dementia group was not correlated with the Delayed Memory Index ( $r = -.04$ ,  $p = .692$ ) nor the Immediate Memory Index ( $r = -.11$ ,  $p = .299$ ). Similarly, the DCT E-score in the MCI group was not associated with the Delayed Memory Index ( $r = .04$ ,  $p = .694$ ) nor the Immediate Memory Index ( $r = -.072$ ,  $p = .478$ ).

**Conclusions:** The DCT was not associated with immediate or delayed memory in individuals with either MCI or mild dementia. Although previous research (Martin et al., 2020) has indicated

the need for slightly higher E-score cutoffs in patients with mild dementia versus MCI (>21 versus >16, respectively), such a need does not appear to be due to an association between the DCT and memory functioning. These results provide support for the utility of nonmemory-based PVTs in patients with notable memory impairment and for using PVTs from multiple domains in assessing performance validity to avoid overreliance on any one domain that might be affected by significant cognitive impairment.

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**Keywords:** neuropsychological assessment, memory disorders, effort

**E. M. FORMANSKI, C. DION, A. DAVOUDI, K. RODRIGUEZ, K. HEILMAN, D. LIBON, J. J. TANNER, C. PRICE. Digit Misplacement within Clock Drawing May Be a Novel Marker of Mental Planning.**

**Objective:** Placing digits accurately within a clock requires semantics as well as sustained visual attention and planning. Digit placement within a clock drawing test may, therefore, be a unique and relatively rapid measurement of mental planning for older adults and particularly those with reduced attentional neuronal networks. Two study aims: 1) To examine digit placement accuracy relative to standard neuropsychological measures assessing semantics and visual reasoning, such that higher scores on tests of semantics and visual planning would associate with less misplacement (negative relationship), 2) Explore how digit placement accuracy may associate with functional activation between the Basal Nucleus of Meynert (a structure uniquely involved in acetylcholine production and necessary for attention/ memory function) and whole brain activation as measured by functional magnetic resonance imaging (fMRI). We examined hypotheses for both command and copy clock drawing conditions.

**Participants and Methods:** From two NIH investigations we identified a set of 157 non-demented older adults who had completed digital Clock Drawing Test (dCDT) to command and copy, comprehensive neuropsychological assessment, and a brain fMRI with a period of 24 hours. Digit misplacement was determined by calculating each digit's degree of absolute deviation from ideal placement around the clock face. Neuropsychological measures were combined into standardized composites of: processing speed (Digit Symbol, Stroop Word reading subtest), working memory (Letter Number Sequencing, Digit Span backwards), semantics (Boston Naming, Animal Fluency), memory (Logical Memory Delay, Hopkins Verbal Learning Test-Revised Delay), and visual attention/reasoning (Matrix Reasoning, Judgement of Line Orientation, Rey Osterrieth Complex Figure Copy). CONN Toolbox provided preprocessing and quality assurance for the assessment of Basal Nucleus of Meynert (BNM)-whole brain activation specific to digit placement accuracy. The primary covariates included a premorbid cognitive reserve composite based on vocabulary, reading for regularly/irregularly spelled words, and years of education.

**Results:** Participants were  $68.96 \pm 6.46$  years of age, had approximately 16 years of education ( $15.97 \pm 2.77$ ) and included 50% split by sex. Aim 1: After controlling for the cognitive reserve composite and conducting a Benjamini-Hochberg correction for multiple comparisons, partial correlations showed the expected negative relationship between command digit misplacement and the semantic and visual reasoning composites ( $r = -.218$ ,  $p = .003$ ;  $r = -.267$ ,  $p < .001$ , respectively). Copy digit misplacement only associated with visual attention/reasoning ( $r = -.217$ ,  $p = .003$ ). Aim 2: Command digit misplacement associated with reduced functional connectivity between the BNM and the anterior cingulate cortex (FDR-corrected  $p = 0.0002$ ).

**Conclusions:** Findings support hypotheses that clock drawing digit placement associates with standardized neuropsychological measures of semantics and visual attention/reasoning, and uniquely associates with activation between the BNM and the anterior cingulate gyrus. The anterior cingulate gyrus is involved in spatial attention and as mentioned above, the misplacements of digits may be related to impairment in this network. Future directions include exploring how digit misplacement may be a behavioral marker of prodromal neurodegenerative disease, and particularly diseases with known changes to the cholinergic system and anterior cingulate cortex. Funding: R01 AG055337; R01 N5082386; NSF 13-543; R01 NR014810

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**Keywords:** test validity, neuroimaging: functional connectivity, anterior cingulate

### **N. E. KURNIADI, Y. SUCHY, M. NIERMEYER. Branching Condition of the Color-Word Interference Test Enhances Prediction of Meta-Tasking in Community-Dwelling Older Adults.**

**Objective:** Meta-tasking (MT) is an aspect of executive function (EF) that involves the ability to apply “if-then” rules and interleave sub-goals of one task with those of another. MT is crucial for successful execution of multiple tasks in daily life. Traditional tests of EF fail to adequately measure MT, as evidenced by patients’ lapses in daily function despite intact performance on such measures. This study examined whether Condition 4 of the Color Word Interference Test (CWIT-4; the inhibition/switching condition that requires branching) predicted MT beyond Condition 3 (CWIT-3; inhibition only condition) and beyond other subtests from the Delis-Kaplan Executive Function System (D-KEFS) that have a switching condition.

**Participants and Methods:** Ninety-eight non-Hispanic white community-dwelling older adults completed (a) the D-KEFS CWIT, (b) an ecologically valid measure of MT, and (c) switching conditions of the D-KEFS Trail Making, Verbal Fluency, and Design Fluency subtests. Raw times for completion and total number of errors were used in the analysis.

**Results:** Time to completion ( $R^2 = .161, p = .001$ ) on CWIT-4 accounted for variance in MT above and beyond CWIT-3 completion time ( $R^2 = .059, p = .016$ ). Total errors ( $R^2 = .135, p = .004$ ) on CWIT-4 also accounted for variance in MT above and beyond CWIT-3 total errors ( $R^2 = .054, p = .021$ ). Additionally, CWIT-4 completion time ( $R^2 = .206, p = .013$ ) and total errors ( $R^2 = .141, p = .009$ ) accounted for variance in MT above and beyond other DKEFS switching conditions ( $R^2 = .041, p = .268$ ). CWIT-4 completion time ( $R^2 = .176, p = .008$ ) continued to significantly predict MT when demographics and general cognition were added to the model.

**Conclusions:** The results provide support for novel use of the DKEFS CWIT-4 as an ecologically valid measure of MT in community-dwelling older adults. Among these individuals, CWIT-4 is more strongly associated with MT than are other D-KFES tasks. Future research should examine whether CWIT-4 relates to lapses in instrumental activities of daily living among older adults above and beyond other EF tests, to determine its potential clinical utility for predicting functional independence, identifying potential safety risks, and informing treatment for older adults.

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**Keywords:** ecological validity, executive functions, activities of daily living

**A. EISENSTEIN, D. S. KAUFMAN, X. E. CAGIGAS, F. SABB, R. M. BILDER. Task-Switching Abilities in Bilinguals: The Importance of Language Dominance and Acculturation.**

**Objective:** Prior research has demonstrated a bilingual advantage over monolinguals in cognitive tasks measuring executive control, mostly in conflict resolution and response inhibition. However, evidence to support this bilingual advantage in mental set-shifting is mixed. The current study utilized a visual, cued task-switching paradigm to explore switch costs in a large community sample consisting of English monolinguals and English/Spanish bilinguals. Within the bilingual sample, degree of bilingualism was hypothesized to correlate with switch cost. For participants born outside the U.S., we also examined acculturation factors, such as time spent in the U.S. since immigration.

**Participants and Methods:** Participants consisted of 868 adults (Age:  $M = 31.36$ ,  $SD = 8.52$ ; Education:  $M = 14.78$ ,  $SD = 2.04$ ) recruited through the Consortium for Neuropsychiatric Phenomics (CNP, UL1DE019580, PL1MH083271). Participants were evenly divided by gender (429 male) and primarily Caucasian ( $n = 620$ ), with 465 who were monolingual in English and 403 who were bilingual in English and Spanish. Most of bilingual participants identified as Hispanic/Latino ( $n = 378$ ), and 106 of these individuals immigrated to the U.S. from another country. Along with other neurocognitive measures, participants completed a computerized task-switching paradigm, which required them to identify objects based on their shape or color, as prompted by alternating visual cues. For bilinguals, the degree of language dominance was measured as a ratio of English to Spanish verbal fluency scores (i.e., dominance index).

**Results:** Demographically, monolingual and bilingual participants significantly differed in racial/ethnic backgrounds and education levels, creating confounds in the group comparisons of monolinguals and bilinguals. The language dominance index was correlated with the number of years since immigration for non-U.S. born bilinguals, such that more time spent in the U.S. was associated with greater dominance in English. As expected, participants were slower to respond on task-switching trials that involved switch cues, creating switch costs that were largest for trials with short delays between cues and the targets. For bilinguals, switch costs on short-delay trials were significantly associated with time spent in the U.S. and the language dominance index, such that those who were more dominant in English tended to have less switch costs compared to those who were more dominant in Spanish. This relationship between language dominance and switch cost was significant even after controlling for speed and time since immigration.

**Conclusions:** Results of the current study suggest that task-switching ability in English/Spanish bilinguals was associated with their degree of language dominance and acculturation. A large number of our bilingual participants were born outside the U.S., and the more time they spent in the U.S. was associated with greater levels of English dominance and reduced switch costs. These findings suggest that the broader cognitive effects of bilingualism can be impacted by factors related to acculturation, which may help to explain some of the variability seen in prior studies. Future research should further examine the role of acculturation and language dominance in bilinguals, in order to better determine how these factors contribute to executive control abilities like task-switching.

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**Keywords:** bilingualism, reaction time, multiculturalism

**I. BARNES MARRERO , J. C. MARCEAUX, K. J. MCCOY. Exploring the Effect of Bilingualism on Rapid Naming.**

**Objective:** With the increasing number of individuals who are bilingual in the United States, there is a greater need to understand the impact of bilingualism on both cognitive test performance and cognitive functioning. In the current study, performance on speeded auditory and visual naming tasks was examined across monolingual (English only) and bilingual (English-Spanish) veterans. It was hypothesized that bilingual veterans would have reduced naming scores and more tip-of-the-tongue (TOT) responses as compared to monolingual peers.

**Participants and Methods:** In this retrospective, cross-sectional study, we analyzed data from 173 veterans (118 English monolingual, 55 English-Spanish bilingual) referred for outpatient neuropsychological evaluation. Participants were primarily male (86.7%;  $n = 150$ ), with a mean age of 59 years ( $SD = 12.52$ ), and a mean education of 13 years ( $SD = 2.99$ ). One hundred and five participants had a neurocognitive disorder (71 monolingual [60%] and 34 bilingual [62%]), per the Diagnostic and Statistical Manual of Mental Disorders - Fifth Edition. There was no significant difference in the presence of cognitive impairment between groups. Groups were compared on demographic factors (i.e., age, education, gender, self-reported language status, race/ethnicity) and performance on the following measures: Visual Naming Test (VNT), Auditory Naming Test (ANT), and Woodcock-Johnson III Rapid Picture Naming (RPN). Variables of interest were total score for each measure; VNT and ANT provided additional variables for TOT (delayed but accurate retrieval of the target word). A series of analyses of covariance (ANCOVA) were conducted, controlling for age, processing speed, and/or education.

**Results:** Despite groups having no difference in presence of cognitive impairment, there were significant differences in performance across naming variables. Specifically, significant group differences ( $p < .001$ ) and a large effect size ( $\eta^2 = .16$ ) were found on the ANT total accuracy, and significant group differences ( $p < .001$ ) and a small effect size ( $\eta^2 = .05$ ) were found on the ANT TOT. Bilingual veterans exhibited lower naming scores and more TOT responses than monolingual peers. Groups did not differ on RPN total accuracy, VNT total accuracy, and VNT TOT (all  $p > .1$ ).

**Conclusions:** Significant group differences exist among veterans who are bilingual (English-Spanish) and monolingual (English only) on a task of auditory naming, with reduced accuracy in naming to descriptions and greater time to produce a verbal response (i.e., more TOTs) among those who are bilingual. Notably, the groups were comparable with respect to presence of cognitive impairment, age, and gender; additionally, education and speed of processing did not account for group differences. Our study highlights that individuals who are bilingual may perform lower on measures requiring rapid auditory naming. These findings do not reflect cognitive or language impairment in bilinguals. The degree to which culture and other variables (e.g., acculturation, linguistic background, language proficiency) influence our results is unclear and requires further exploration.

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**Keywords:** bilingualism, assessment, naming

**P. LAO, I. C. TURNEY, J. AVILA-RIEGER, J. M. VONK, M. ARCE RENTERÍA, D. SEBLOVA, A. CHESEBRO, K. LAING, J. M. BEATO, E. AMARANTE, A. PACHECO, K. NIEVES-QUINONES, A. CABRERA, S. SEEHRA, R. FLORES, M. MARTINEZ, J. FLEURIMONT, J. GUTIERREZ, N. SCHUPF, R. P. MAYEUX, J. J. MANLY, A. M.**

**BRICKMAN. Cognitive performance in middle-aged adult children is related to parental brain health across race/ethnicity groups.**

**Objective:** A family history of Alzheimer's disease (AD) increases risk for AD in an individual by 1.5-to 3-fold. Heritability of AD risk may be due in part to the aggregation of neurodegeneration and cerebrovascular changes with cognitive phenotypes within families, which may differ across race and ethnicity and language groups. The purpose of this study was to determine the extent to which cognitive functioning in middle-aged adults is associated with prospectively-evaluated (i.e., as opposed to relying on retrospective recall) neurodegenerative and cerebrovascular neuroimaging markers linked to risk for clinical AD in their parents, and the extent to which these associations differ by race/ethnicity/language.

**Participants and Methods:** Middle-aged children enrolled in the Offspring study (n=362; 53.5±10.5 years old; 12% Non-Hispanic White, 27% Non-Hispanic Black, 27% Latinx tested in English, 34% Latinx tested in Spanish; 66% women; 13.4±3.5 years education) were administered the NIH Toolbox, a computerized neuropsychological battery, in their preferred language. Older adults were a subset of the Washington-Heights Inwood Columbia Aging Project (77.8±6.8 years old; 75% women; 10.0±4.7 years education) who underwent T1w- and T2w-MRI and who had a child enrolled in the Offspring study. We tested the associations of parental MRI measures reflecting neurodegeneration (hippocampal volume and cortical thickness) and cerebrovascular disease (white matter hyperintensity (WMH) volume, presence of infarcts) with cognitive tests scores in Offspring participants. We further stratified the models by race/ethnicity/language as a proxy for social advantage.

**Results:** Lower attention test scores in the middle-aged Offspring study participants were associated with greater WMH volume in their parents, particularly among Latinx participants tested in Spanish. Non-Hispanic Black Offspring study participants whose parents had MRI evidence of infarct had lower scores on attention tests than those without parental evidence of infarct.

**Conclusions:** Lower cognitive test performance in offspring is associated with imaging markers of vascular disease among parents, differently across race and ethnicity and language groups. These results support future work in identifying familial clusters at-risk for AD transmission through cerebrovascular disease, which may be due to shared vascular risk factors, shared environmental/social factors, or likely a combination of both. Existing treatment strategies for vascular disease may provide one pathway to reduce observed AD risk transmission disparities.

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**Keywords:** cerebrovascular disease, ethnicity, neuroimaging: structural

**Poster Session 6: Concussion/TBI**

**1:00 PM - 2:00 PM**

**J. PASSLER, A. SANDER, N. R. TEMKIN, J. BARBER, T. INVESTIGATORS .  
Depression in Older Adults 12 Months Following Traumatic Brain Injury.**

**Objective:** To investigate depression 12 months post traumatic brain injury (TBI) in older and younger adults.

**Participants and Methods:** Prospective longitudinal cohort study of persons with medically documented mild, moderate, and severe TBI and orthopedic injury controls followed for 12

months post-injury. Inclusion criteria for the current analyses included those with primary outcome data at 12-month follow-up: 1,505 participants with TBI and 299 orthopedic controls. The main outcome measure was the Patient Health Questionnaire-9 (PHQ-9).

**Results:** PHQ-9 scores were significantly lower for orthopedic controls ( $M = 3.59$ ) as compared to those with TBI ( $M = 4.78$ ) in the full sample ( $B = -1.28, p = .001$ ). However, there was no significant difference in the age-group effect on the PHQ-9 between orthopedic controls and those with TBI ( $B = -0.88, p = 0.60$ ). For those with TBI, PHQ-9 scores were significantly lower for older adults ( $M = 3.2$ ) as compared to younger adults ( $M = 5.0$ ) ( $B = -1.63, p < .001$ ); the modifying effect of age group was not significant for education, sex, race/ethnicity, psychiatric history, substance use, or GCS severity predictor variables. The odds of older adults falling in the major depression vs. no depression group was significantly lower (decreased by 56%) as compared to younger adults ( $OR = 0.44, p = .001$ ).

**Conclusions:** Older adults 12 months post-TBI endorse lower depressive symptoms than their younger counterparts and are less likely to experience major depression; however, treatment is needed for the subset with depression.

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**Keywords:** traumatic brain injury, depression, aging (normal)

### **M. P. PROUDFOOT, J. N. HERSHAW, M. L. ETTENHOFER. The Influence of Depressive and Post-Traumatic Symptoms on Neuropsychological Performance in TBI.**

**Objective:** Persistent cognitive symptoms following traumatic brain injury (TBI) are a significant problem for military service members and can negatively affect many functional domains and overall quality of life. Previous research has demonstrated that psychiatric symptoms can influence neuropsychological performance in TBI patients. Assessment and treatment of persistent cognitive symptoms would benefit from identifying various contributing factors, which may include psychiatric comorbidities. Self-reported depressive and post-traumatic symptoms are of particular relevance to military patients, as they are more prevalent in military populations than civilian populations. The purpose of this analysis is to examine the contribution of depressive and post-traumatic symptoms to neuropsychological performance in patients with persistent symptoms following mild and moderate-severe TBI.

**Participants and Methods:** Nineteen patients with mild TBI ("mild;" 39.5 months post-injury [ $SD = 34.1$ ]), 15 patients with moderate-severe TBI ("moderate;" TSI: 57.3 months post-injury [ $SD = 42.4$ ]), and 24 uninjured controls completed a brief neuropsychological battery that included WAIS-IV Symbol-Digit Coding, Symbol Search, and Digit Span (forward, backward, and sequencing), Trailmaking Tests A and B, and the Hopkins Verbal Learning Test-Revised (HVLT-R). Three participants (1 mild, 2 control) were excluded from analysis for suboptimal effort (Reliable Digit Span  $\leq 7$ ). Self-reported depressive and post-traumatic symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CES-D) and the Post-Traumatic Stress Disorder Checklist-Military Version (PCL-M). Hierarchical regression analyses (HRA) were used to evaluate the incremental variance accounted for by TBI diagnosis and self-reported psychiatric symptoms. Separate HRAs were performed using the scaled scores or T scores associated with each test as the outcome variable.

**Results:** CES-D score and TBI diagnosis together explained more variance than TBI diagnosis alone for Symbol Digit Coding scaled score,  $\Delta R^2 = .079, F(1,55) = 5.026, p = .029$ , and Trails A T-score,  $\Delta R^2 = .071, F(1,55) = 4.321, p = .042$ . A marginally-significant trend for improved

prediction of Trails B T-score was observed with CES-D score and TBI combined compared to TBI diagnosis alone,  $\Delta R^2 = .059$ ,  $F(1,55) = 3.619$ ,  $p = .062$ . A marginally-significant trend was also found wherein PCL-M score and TBI diagnosis explained more variance in the HVL T Total Recall T-score than TBI diagnosis alone,  $\Delta R^2 = .050$ ,  $F(1,55) = 2.899$ ,  $p = .094$ . No other neuropsychological outcomes were better predicted by the addition of psychiatric symptoms to the model.

**Conclusions:** Results suggested that depressive symptoms and TBI combined significantly account for 6-8% more variance in measures of attentional performance than TBI alone. Conversely, post-traumatic symptoms and TBI combined significantly accounts for 5% more variance in memory performance than TBI alone. These results suggest that psychiatric comorbidities influence cognitive performance in patients who report persistent symptoms following TBI. Critically, our results suggest that depressive and post-traumatic symptoms uniquely contribute to cognitive deficits following TBI. The distinction between these two types of psychiatric symptoms should be taken into account when assessing long-term outcomes of TBI, particularly in military populations where both depressive and post-traumatic symptoms are highly prevalent.

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**Keywords:** depression, post-traumatic stress disorder, traumatic brain injury

### **L. PÉREZ-LÓPEZ, T. P. MORRIS, M. COLL-ANDREU, J. A. LÓPEZ I LÓPEZ. Adaptation of a Cognitive Stimulation Program for a Blind Patient with Acquired Brain Injury: A Case Report.**

**Objective:** Cognitive stimulation is the most common intervention used to maintain, improve or rehabilitate cognitive functioning in patients with acquired brain damage. Several types of stimulation training interventions are available. These interventions are based mainly on the use of visual and verbal exercises, so most of them cannot be applied to aphasic patients suffering from blindness. The objective of this study was to perform an adapted cognitive stimulation program adequate for the rehabilitation process of a blind patient with aphasia and cognitive deficits.

**Participant and Methods:** A 59-year-old male, highly educated, working as an accountant, right-handed. He suffered three heart attacks with a 45-minute anoxia in February 2013. After hospital discharge, he was left with severe cognitive impairment, particularly a severe motor aphasia, as well as total blindness. He has been doing 90 minutes a week of individualized cognitive stimulation since February 2018 in an outpatient neurorehabilitation center in Barcelona (INA Memory Center)

The sessions were focused on the following areas: language stimulation, short-term and long-term memory, working memory, selective attention, calculation, time estimation, decision-making, mental flexibility, inhibition, categorization.

The instruments used for this patient's rehabilitation were based on existing cognitive stimulation exercises, which are normally based on visual inputs and require writing responses, which were modified to adapt to the specific characteristics of the patient. Specifically, the therapist's modifications consisted in tailored-made exercise instructions and progressive adaptation of the degree of difficulty. All exercises were presented verbally. In this way, the participant gave his responses verbally and the therapist guided him, by redirecting and

correcting the mistakes he made. The degree of difficulty increased or decreased as the participant progressed in the objectives set.

**Results:** Since the beginning of the implementation of the outpatient adapted cognitive stimulation intervention the patient has shown significant improvements in spontaneous naming, phonological fluency, semantic fluency, repetition, calculation, memory, attention and executive functions. These progressive improvements are reflected both quantitatively, based on the measurements taken using neuropsychological tests, and qualitatively, according to the observations and evaluations of a reference family member and the subject's own appraisal.

**Conclusions:** The creation of new materials and the adaptation of traditional neuropsychological rehabilitation programs are feasible ways to address the cognitive rehabilitation of blind people for whom there are no standardized materials and programs available. In addition, the evolution of this case suggests that these “ad hoc” tools are effective in contributing to the rehabilitation process.

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**Keywords:** cognitive rehabilitation, aphasia, hypoxia

### **M. SPLIT, K. L. VICKERS, A. C. GRAEFE, K. J. MANNING, M. T. SCHULTHEIS. Virtual Reality Driving Simulation: An Innovative Tool for Assessing the Cognitive Demands of Driving After Brain Injury.**

**Objective:** Clinical assessment of driving ability following acquired brain injury (ABI) remains highly dependent upon on-road driving evaluations, which are often limited to gross measures of driving performance unlikely to fully capture the cognitive demands of driving (i.e., pass/fail ratings). Virtual Reality Driving Simulation (VRDS) allows safe evaluation of complex driving scenarios and offers novel metrics of driving performance that may better define the relationship between cognition and driving. As such, determining the cognitive correlates of VRDS driving performance metrics in ABI would enhance the clinical application of VRDS. The current study examined the relationship between measures of VRDS driving performance and cognition in individuals with ABI and healthy controls.

**Participants and Methods:** VRDS driving performance from 17 adults with ABI and 25 healthy controls (HC) were analyzed. All individuals completed a VRDS drive that included a curved, two-lane rural road segment and completed a neuropsychological battery that included measures of attention, processing speed, working memory, executive function, and visuospatial skills. Bivariate Pearson correlations were utilized to explore the relationship between driving behavior (i.e., mean speed, variability in speed, and variability in lane position) and cognitive performance across groups (ABI versus HC).

**Results:** For the HC group, average speed was negatively associated with visual perception (Useful Field of View [UFOV] divided attention;  $p < .01$ ), while greater variability in speed was positively associated with visual perception (UFOV selective attention;  $p = .03$ ) and negatively associated with attention (Digit Span Forward;  $p = .04$ ). Among the ABI group, greater average speed was associated with poorer visual perception (Motor-Free Visual Perception Test – Revised [MVPT-R];  $p = .02$ ). However, the most notable relationships in this group were driven by greater variability in lane position and poor performances in several aspects of visuospatial function, including visual perception (Block Design;  $p < .01$ ), visuoconstruction (Rey Figure Copy;  $p = .03$ , Clock drawing;  $p < .01$ ), and visuospatial memory (Rey Figure Delayed Recall;  $p = .04$ ). There was also a relationship between greater variability in lane position and poor

executive function (Trails B;  $p = .02$ ). There were no significant associations between variability in lane position and neuropsychological performance in the HC group, nor variability in speed and neuropsychological performance in the ABI group.

**Conclusions:** VRDS offers a clinical and research tool that can be used to determine the contributions of cognition to driving performance. Assessment of lane position variability may be a sensitive tool for gauging the cognitive demands of driving, which is a measure that can be easily gathered through the use of VRDS, but is lacking from current, traditional tools. Clinicians may wish to conduct a thorough assessment of visual spatial functions and visual spatial memory, as its impact on driving performance may be especially valuable in ABI populations.

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**Keywords:** cognitive, driving, brain injury

### **C. ZACHAR-TIRADO, J. DONDERS. Clinical utility of the GAD-7 in identifying anxiety disorders after traumatic brain injury.**

**Objective:** To determine if the GAD-7 is of incremental value, predicting a final diagnosis of an anxiety disorder after traumatic brain injury (TBI).

**Participants and Methods:** Retrospective analysis of archival data of 100 patients with TBI, who underwent neuropsychological evaluation 1-12 months after injury. A Receiver Operating Characteristic analysis was used to determine the optimal cut-off point for clinically significant symptoms on the GAD-7. A hierarchical logistic regression analyses was then conducted to determine the relative contributions of premorbid psychiatric history, injury severity, and GAD-7 results in predicting a final diagnosis of anxiety disorder.

**Results:** A GAD-7 cut-off point of  $\geq 7$  yielded the best combination of sensitivity and specificity regarding a final diagnosis of anxiety disorder. Within hierarchical logistic regression models, injury severity did not statistically significantly add to the effect of prior psychiatric history in predicting a final diagnosis of anxiety disorder. When the GAD-7 was added, it made a statistically significant contribution in accounting for such a final diagnosis and increased sensitivity from 71% to 91%.

**Conclusions:** The GAD-7 holds diagnostic utility as a screening measure for anxiety disorders in patients with TBI. It should not be used in isolation but as part of a more comprehensive interview and history. A potential cut-off of  $\geq 7$  could provide clinicians with a better determination of clinically significant anxiety symptoms in a post-TBI population. However further analysis would be needed within other sample populations. Clinicians can benefit in using the GAD-7 to assist in earlier identification and timelier treatment of symptoms of anxiety. This in turn, may allow for improved treatment in the management of patient's TBI-related symptoms.

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**Keywords:** traumatic brain injury, anxiety

### **A. FAHEY, K. M. BAIN, E. A. CRITCHFIELD. Assessment of Awareness of Functional Ability Across TBI Severity .**

**Objective:** Inaccurate awareness of deficits poses a significant obstacle during rehabilitation following TBI. While research in self-awareness and TBI has generally focused on those with moderate to severe TBI, illness perceptions have been shown to maintain post-concussive

symptoms, which may negatively affect the accuracy of assessment of ability and deficits in those with mild TBI. Additionally, there is a paucity of research examining the variability of self-awareness across functional domains between those with mild, moderate, and severe TBI.

This study sought to examine the relationship of time since injury (TSI), TBI severity, and self-awareness following TBI as assessed by the Mayo-Portland Adaptability Index-4 (MPAI-4), across Total Score and domains of Ability, Adjustment, and Participation in individuals with TBI participating in a residential rehabilitation program.

**Participants and Methods:** Retrospective analysis of medical records and MPAI-4 self report and staff consensus ratings were conducted on 101 veterans and service members admitted to a VA community reintegration rehabilitation program. Level of awareness was computed as MPAI-4 provider consensus score minus self-report MPAI-4 score, for the total score and for each of the Ability, Adjustment, and Participation index scores. Time since injury was dichotomized as 1) one year or less post-injury, and 2) greater than one year post-injury.

**Results:** Discrepant ratings were found among all severities of TBI across the MPAI-4 total score and index domains. Interestingly, those with mild TBI endorsed greater impairments than providers, with the greatest discrepancies on total MPAI-4 ( $M = -10.53$ ,  $SD = 5.28$ ) and the Ability subscale ( $M = -6.81$ ,  $SD = 2.58$ ). Those with moderate and severe TBI reported less impairment on the MPAI-4 than providers, with the greatest discrepancies on total MPAI-4 ( $M = 22.51$ ,  $SD = 3.16$ ) and the Adjustment subscale ( $M = 10.68$ ,  $SD = 1.40$ ) for those with severe TBI, and on the Adjustment subscale ( $M = 4.17$ ,  $SD = 2.93$ ) for those with moderate TBI. The effect of time varied across domains and those who were more than one-year post-injury displayed greater self-awareness relative to those less than one year post-injury ( $p < 0.05$ ), with the greatest discrepancy on the Ability subscale ( $M = -4.09$ ,  $SD = 2.37$ ), and on total MPAI-4 ( $M = 11.52$ ,  $SD = 3.55$ ), Adjustment ( $M = 5.90$ ,  $SD = 1.58$ ), and Ability ( $M = 5.17$ ,  $SD = 1.19$ ) subscales for those one year or less post-injury.

**Conclusions:** These findings are reflective of an inaccurate awareness of one's ability in those with mild TBI, albeit in the opposite direction of those with moderate and severe TBI. Additionally, our findings highlight the importance of measuring awareness of functional ability across TBI severity. Though rehabilitation research often combines those with moderate and severe TBI, the differences in awareness across these functional domains highlight the need to examine symptoms and outcomes of these groups separately. From a clinical standpoint, our results indicate assessment of awareness for those with mild TBI is one good first step in developing a treatment plan and may improve long-term outcomes for this group. Clinicians can benefit from using the MPAI-4 to assess self-awareness when selecting the appropriate interventions.

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**Keywords:** awareness, traumatic brain injury, cognitive rehabilitation

**A. GRANT, D. S. KAUFMAN, P. ROSKOS, J. D. GFELLER, R. D. BUCHOLZ. Cognitive Reserve, Neuropsychological Abilities, Emotional Status, and Functional Outcomes in Military Veterans and Civilians Following Traumatic Brain Injury.**

**Objective:** Traumatic brain injury (TBI) can cause significant cognitive, behavioral, and emotional changes, which can have an adverse impact on persons' functional outcomes (Ponsford et al., 2008). Cognitive Reserve (CR) has been found to be a protective factor in neurodegenerative conditions (Bennet et al., 2003; Hindle et al., 2016) and more recently has

been found to be a protective factor in persons with TBI (Raymont et al., 2008; Leary et al., 2018). Prior studies have investigated the relationship between CR and neuropsychological and mood variables, but less so with functional outcome (Leary et al., 2018). An abundance of research demonstrates the relationship between TBI and mood symptoms (van der Horn, et al., 2016; Williamson et al., 2013), particularly in military populations (Hoge et al., 2004; Lew et al., 2009). Thus, the present study further examined if CR, neuropsychological outcome, and mood symptomatology predicted functional outcome in separate samples of military veterans and civilians with TBI.

**Participants and Methods:** The present study was retrospective in nature and included 57 military veterans with TBI (M-TBI) and 58 civilians with TBI (C-TBI). Data was collected as part of a larger Department of Defense funded study. Injury severity ranged from mild to severe and all participants were evaluated several years following their injury. All participants completed several measures of mood symptomatology, comprehensive neuropsychological testing and completed measures related to CR and functional outcome. The Glasgow Outcome Scale – Extended (GOS-E) served as the primary measure of adaptive functioning or functional outcome. A series of correlation analyses and hierarchical regression analyses were completed.

**Results:** Results of this study indicated the mood symptomatology was the strongest predictor of functional outcome in the M-TBI group and second best predictor in the C-TBI group. Regarding the neuropsychological variables, measures of processing speed were most strongly associated with the GOS-E in both groups. CR was associated with some neuropsychological variables and certain mood variables in both groups, but not with functional outcome.

**Conclusions:** The study results highlight the substantive impact that mood symptomatology has on functional outcome, beyond that of CR and neuropsychological performance, in both groups. Early assessment of cognitive and mood symptoms allows for the early provision of appropriate treatment including psychological therapy and learning of compensatory strategies (Gould, Ponsford, & Spitz, 2014) and the present study highlights the importance of such assessments. CR variables were not found to be related to functional outcome in the current study. However, our findings did indicate that measures of functional outcome were related to neuropsychological variables, as seen in prior research (Leary et al., 2018).

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**Keywords:** traumatic brain injury, cognitive reserve, post-traumatic stress disorder

**W. T. MCCUDDY, K. ZANE, M. LEE, L. MILLER, D. SCARISBRICK, M. HAUT, J. MAHONEY. Non-Frontal Brain Tumors and Fronto-Executive Dysfunction: A Voxel-Based Lesion Symptom Mapping Pilot Study.**

**Objectives:** While it is well known that brain lesions in regions other than the frontal lobes can cause fronto-executive dysfunction, less is known about the specific pathways that lead to such network-based disruption. Given that fronto-executive dysfunction plays a primary role in an individual's independence and overall quality of life, quick and accurate identification of patients at risk of such dysfunction secondary to brain tumor is critical for planning and optimizing patient care. The current study, utilizing voxel-based lesion symptom mapping (VLSM), explored the extent to which frontal signs can emerge from damage to regions outside the frontal lobes. Results were conceptualized based on disruption to white matter pathways and resting state functional networks.

**Participants and Methods:** A retrospective observational cohort of 13 de novo patients (nine females, mean age = 53.15) who underwent gross total resection of primary glioblastoma comprised the dataset. A standardized neurobehavioral exam (NBE) was performed within three months of surgical resection. The NBE screened multiple cognitive and neurobehavioral abilities with focus on quantifying fronto-executive dysfunction. Postoperative MRI scans and (3D)Slicer software were used to segment tumor resection cavities. VLSM was performed on scores obtained from NBE performance to localize fronto-executive dysfunction. Correction for multiple comparisons was attempted with an FDR-corrected  $p < 0.05$  threshold and permutation testing. Lesion-symptom maps were subsequently overlaid on tractography reconstructions of white matter pathways from an established database of healthy individuals (Rojkova et al., BSF 2015) and a network parcellation map derived from resting state connectivity (Yeo et al., 2011).

**Results:** Given the small pilot sample, tumor coverage was limited but sufficient for analysis in portions of the left temporal, parietal, and occipital lobes. VLSM analysis revealed the left posterior temporal-parietal junction (comprised of posterior portions of superior temporal gyrus, middle temporal gyrus, and angular gyrus) was significantly associated with NBE frontal score ( $p < .05$ ), though results did not survive correction for multiple comparisons. The resulting lesion-symptom location overlapped with three resting-state networks including default mode, ventral attention, and somatomotor. A portion of lesioned voxels was also found in eight major white matter tracks, with the greatest proportion of lesioned voxels in the arcuate, superior longitudinal, and fronto-occipital fasciculi.

**Conclusion:** Damage to regions of the temporal-parietal junction may be involved in the presence of fronto-executive dysfunction possibly due to alterations in default mode and ventral attention networks via damage to major white matter tracts that project to the frontal lobes. Primary findings did not produce results that survived correction for multiple comparisons, likely due to small sample size. Nevertheless, findings were consistent with descriptive functional and structural results linking the posterior temporal-parietal junction to prefrontal cortex. Continued investigation to increase sample size was warranted in that multimodal imaging approaches and network-based conceptualization may allow earlier identification and intervention for patients with executive deficits secondary to focal brain lesions.

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**Keywords:** brain tumor, executive functions, neuroimaging: structural

**J. THOMAS, M. MICALLEF, K. A. BROWN, M. R. UDALA, M. LIBBEN.**  
**Understanding Age, Gender, and TBI Severity Influence on Verbal and Visual Memory Performance.**

**Objective:** Studies suggest that a number of demographic factors can affect cognitive functioning post traumatic brain injury (TBI; Karr et al., 2014). While research is mixed, some findings suggest that memory performance following TBI may differ between men and women (Moore et al., 2009). The Buschke Selective Reminding Test (SRT; Buschke, 1973) is a neuropsychological test that assesses verbal learning and memory. Few studies have examined the impact of demographic variables on SRT performance. The purpose of this research was to understand the influence of age, gender, and TBI severity on measures of verbal and visual memory following traumatic brain injury.

**Participants and Methods:** The sample ( $N = 140$ ; females  $n = 38$ ) consisted of patients who had experienced a TBI and were referred for a neuropsychological evaluation at a private

practice clinic in Western Canada. Tests analyzed included scores on the Rey-Osterrieth Complex Figure Test (RCFT; Osterrieth 1944; Rey 1941) and the Buschke Selective Reminding Test (SRT; Buschke, 1973).

**Results:** A multivariate multiple linear regression analysis was performed to determine if age, gender, and TBI severity could serve as predictors for RCFT and SRT scores. Gender ( $F(1, 68) = 1.53, p = 0.22$ ), age ( $F(1, 68) = 3.05, p = .053$ ), and TBI severity ( $F(2, 138) = 1.49, p = 0.21$ ) were not significant predictors for RCFT scores; however, age ( $F(1, 66) = 3.46, p < .05$ ) and TBI severity ( $F(2, 134) = 2.38, p < .05$ ) significantly predicted SRT scores. Gender was not a significant predictor for scores on the SRT ( $F(1, 66) = 0.79, p = .54$ ).

**Conclusions:** Overall, results suggest that increased age and TBI severity may predict poorer verbal learning and memory performance for patients with TBI and lend support for the SRT as a useful measure of verbal learning and memory.

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**Keywords:** traumatic brain injury, demographic effects on test performance

**C. L. ROPER, A. A. FEDIO, B. D. DINKLOCKER, M. THOMAS, N. PATEL, A. ARULANANDAM, M. THYEN, P. FEDIO. Individuals with ABI Teach Graduate Students About Their Lived Experience.**

**Objective:** This study assessed the benefits to clinical psychology graduate students of listening to individuals with acquired brain injury (ABI) speaking about their trauma and recovery process.

**Participants and Methods:** Thirty-four graduate students rated their knowledge about ABI and their proficiency in working clinically with survivors of ABI before and after listening to the patients' presentations. Students also rated their own clinical skills. Independent samples t-tests compared ratings of students with high vs. low clinical skills ( $p < .05$ ) based on median split analyses. Pre/post free responses regarding what students would (did) learn, utility of information shared by the speakers, and goals of the speakers were coded and analyzed ( $\chi^2, p < .05$ ).

**Results:** Clinical skills that consistently differentiated students who learned most about ABI-related problems from the speakers were the abilities to help clients recognize their own emotions and to help clients take an active role in their health. Students with lower (vs. higher)

baseline self-rated proficiency in these skills gained significantly greater appreciation from the speakers for post-ABI problems regarding clear thinking, motivation, and changes in their sense of self. Overall, students' appreciation for post-ABI problems with memory, language, and mood/anxiety was not influenced by clinical skill level. Lower (vs. higher) student ratings of ability to help clients take an active role in their health also yielded post-presentation higher endorsement of students feeling more proficient in working clinically with survivors of ABI. Students expected to increase their knowledge by listening to the speakers, and afterwards acknowledged they had also gained appreciation for themes of invisible injuries and patient care. Students expected the speakers' information to enhance their current and future clinical skills. Students with stronger skills in communicating empathy were more likely to change their responses from pre to post to reflect more abstract gains such as increased personal self-awareness and desire to learn more. Students anticipated that speakers' goals would primarily be related to advocacy and enjoyment in sharing their experiences. Students with stronger skills in applying knowledge of brain-behavior relationships were more likely to change their post responses to reflect even greater endorsement of advocacy efforts of the speakers.

**Conclusions:** Students with weaker (vs. stronger) clinical skills in helping clients to recognize their own emotions and take an active role in their health benefited from listening to individuals with ABI, specifically in learning about abstract changes accompanying brain injury in the areas of motivation/thinking and self-identity. Similarly, following ABI speakers' presentations, those students reported feeling more proficient in working clinically with people with brain injuries. All students learned about invisible injuries and patient care. Students with stronger (than weaker) sophisticated skills involving empathy and neuropsychological conceptualization reported improving their self-awareness and better appreciated advocacy efforts of the speakers. These findings support the broad range of benefits to clinical psychology graduate students of learning firsthand from individuals with ABI. Students developed a unique appreciation of the patients' lived experience which enhanced the students' clinical knowledge, awareness of self and others, and confidence in their clinical skills with the brain injury population.

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**Keywords:** brain injury, everyday functioning, stroke recovery

### **Y. LIU, K. HUANG, T. CHANG, T. LEE, M. HO. Influences of White Matter Lesions and Cognitive Reserve on the Relationships Between Carotid Artery Stenosis and Cognitive Functions .**

**Objective:** Cognitive reserve (CR) has been implicated to play an important role in moderating cognitive impairments brought about by various brain pathologies. Carotid artery stenosis (CAS) can cause cognitive impairments has long been documented, but patients with CAS often present with cerebral infarcts and white matter lesions (WMLs), which also have significant impacts on cognitive performance. How to disentangle the effects of these factors on cognition is challenging. We proposed a conceptual moderated mediation model to examine the role of CAS, infarcts, WMLs, and CR in cognitive functions.

**Participants and Methods:** A total of 152 patients with CAS (134 males), aged between 51 and 83 years old, participated in this study. In addition, 64 volunteers (57 males), aged between 54 to 81 years old, enrolled as the control group. A battery of neuropsychological tests that tap specific cognitive domains such as memory, executive function, visuospatial and constructional

functioning, processing speed, and manual dexterity were administered. All participants' raw scores were transformed to  $T$  scores and then were pooled to derive a mean  $T$  score for each corresponding cognitive domain. The estimated premorbid fluid intelligence based on each participant's age and years of education was used as the proxy measure of CR. The severity of CAS was used as a predictor variable, whereas the severity of infarcts and WHLs were used as a covariate and mediator variable, respectively, to predict the mean  $T$  scores of specific cognitive domains for testing the proposed moderated mediation model.

**Results:** Patients with CAS performed significantly worse than the control group on most tests ( $ps < .05$ ), but there were no significant differences in all neuropsychological test scores between patients with bilateral CAS and unilateral CAS ( $ps > .19$ ). Except for visuospatial function, the moderated mediation model turned out to be statistically significant on all domains ( $F_s > 3.32$ ,  $ps < .001$ ), with coefficient of determination ( $R^2$ ) ranging from .16 to .33. The direct effects of CAS were only significant on predicting manual dexterity and processing speed ( $\beta_s = -.048$ ,  $ps < .009$ ). The results showed WHLs in the periventricular areas mediated the effects of CAS on predicting verbal recall ( $p = .02$ ), manual dexterity ( $p = .03$ ), and visual executive function ( $p = .04$ ). Estimated premorbid fluid intelligence moderated the relationships between WMLs in the periventricular areas and verbal recall ( $p = .03$ ), manual dexterity ( $p = .02$ ), and visual executive functions ( $p = .04$ ), whereas it only moderated the relationship between WMLs in the deep white matter areas and constructional ability ( $p = .04$ ). The estimated premorbid fluid intelligence also moderated the direct effect of CAS on processing speed ( $\beta = 0.01$ ,  $p = .04$ ).

**Conclusions:** The effects of CAS on cognition may not be a simple causal relationship. Severity of WMLs plays a role in mediating this relationship. In addition, CR could moderate the relationships between CAS, WMLs, and certain specific cognitive domains, but not all cognitive domains.

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**Keywords:** cognitive reserve, carotid artery disease, neuropsychological assessment

**S. F. SORG, V. C. MERRITT, A. L. CLARK, K. A. HOLIDAY, E. OZTURK, K. L. HANSON BONDI, D. M. SCHIEHSER, L. DELANO-WOOD. Greater Self-Reported Memory Difficulties are Associated with Lower Frontal and Temporal Lobe Cortical Thickness in Veterans with Histories of Mild Traumatic Brain Injury.**

**Objective:** Memory problems are the most frequently endorsed post-concussive cognitive difficulties reported by Veterans with histories of mild traumatic brain injury (mTBI). Examinations of the functional validity of such ratings have generally shown poor associations between subjective reports of memory problems and objective performance on tests of memory. However, few studies have examined the associations between subjective reports of memory difficulties and neuroimaging markers of brain morphometry. In this study, we investigated whether reported ratings of prospective and retrospective memory problems in Veterans with histories of mTBI are associated with objective performance on a sensitive word list memory task, and examined associations between these measures and cortical thickness measures in TBI-vulnerable frontal and temporal cortices.

**Methods:** 41 Veterans with a history of remote mild TBI completed the Prospective-Retrospective Memory Questionnaire (PRMQ), the Post-Traumatic Stress Disorder Check-List

(PCL), the California Verbal Learning Test-2<sup>nd</sup> edition (CVLT-II), and they underwent a 3T T1 structural MRI. All participants demonstrated sufficient effort on testing. Cortical thickness in *a priori* frontal and temporal lobe regions of interest (ROIs) was estimated using FreeSurfer. Multiple regression adjusting for age and PCL scores examined associations between PRMQ scores and CVLT-II performance. Multiple regression adjusting for age, PCL score and intracranial volume examined associations between cortical thickness and PRMQ and CVLT-II scores.

**Results:** After adjusting for the above covariates, the PRMQ Total Score negatively correlated with cortical thickness across multiple regions including the left rostral anterior cingulate ( $\beta=-.412, p=.04$ ), and right inferior temporal ( $\beta=-.517, p=.004$ ), right middle temporal ( $\beta=-.579, p=.001$ ), right parahippocampal ( $\beta=-.434, p=.03$ ), right rostral middle frontal ( $\beta=-.384, p=.024$ ) gyri and the right rostral anterior cingulate ( $\beta=-.536, p=.005$ ). An identical pattern of associations was observed for the prospective and retrospective subscales. Although CVLT-II Long Delay Free Recall scores did not significantly correlate with cortical thickness, CVLT-II Total Learning T-scores positively correlated with right inferior ( $\beta=.392, p=.02$ ) and middle ( $\beta=.386, p=.018$ ) temporal gyri. Finally, as expected, total PRMQ scores were not significantly associated with CVLT-II Learning or Recall scores ( $p>.10$ ).

**Conclusions:** Results show that self-reported ratings of memory difficulties are associated with underlying brain morphometry in Veterans with a history of mTBI. Importantly, the pattern of results observed suggests that self-reported indices of memory dysfunction may be more sensitive to variability in cortical thickness across several regions than objective tests of memory used in this study. These findings suggest that aspects of one's experience with memory difficulties do relate to objective brain measures, though they may not be captured by objective neuropsychological assessment. Future studies are needed in order to better disentangle subjective memory complaints and objective performance on memory tasks, as well as their association with observed brain changes in Veterans with mTBI histories.

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**Keywords:** traumatic brain injury, memory complaints, neuroimaging: structural

**P. Y. LITVIN, D. W. LOPEZ-HERNANDEZ, R. RUGH-FRASER, A. BUENO, W. OLMOS, S. SARAVIA, N. GRAUB, R. CERVANTES, E. TORRES, A. BICHLMEIER, J. KNIGHT, B. CUI, F. ZAKARIAN, S. FATOORECHI, S. MANGASSARIAN, D. J. HARDY, P. M. VESPA, D. A. HOVDA, H. RAD, E. WAITE, J. FUSTER, D. BUDDING, E. WOO, M. J. WRIGHT. Word Frequency on Fluency Tasks as Predictors of Outcome in Moderate-to-Severe Traumatic Brain Injury.**

**Objective:** Lexical ability is thought to be resistant to decline post traumatic brain injury (TBI), indicative of premorbid ability, cognitive reserve, and outcome. We evaluated the use of low frequency words on verbal fluency tasks as a predictor of outcome after a as assessed by the Mayo-Portland Adaptability Inventory, 4<sup>th</sup> revision (MPAI-4).

**Participants and Methods:** Performance on letter and animal fluency (Delis-Kaplan Executive Function System) was assessed in acute TBI survivors (ATBI;  $n = 26$ ) and chronic TBI survivors (CTBI;  $n = 30$ ). The total t-score MPAI-4 assessed functional outcomes following TBI (functional ability, adjustment, participation). ATBI participants were tested 6 months post-injury and CTBI participants were tested 12 months or more post-injury. The TBI groups suffered moderate-to-severe brain injuries determined by estimates of posttraumatic amnesia

(PTA). Word frequency was referenced for each word produced on the letter and animal fluency tasks using 2 corpora—iWeb Corpus (Davies, 2018) and Corpus of Contemporary American English (COCA; Davies, 2018). Four word-frequency variables were used in the analysis: 1) average of the 3 lowest letter frequency words referenced using the iWeb (IWEB-L) and 2) the COCA (COCA-L), 3) average of the 3 lowest animal frequency words referenced using the iWeb (IWEB-A) and 4) the COCA (COCA-A).

**Results:** The groups were well matched on age, ethnicity, education, PTA estimates, and WTAR,  $ps > .05$ , but not for gender,  $p = .046$ . Controlling for gender, ANCOVAs were conducted to determine group differences (ATBI vs. CTBI) on the 4 word-frequency variables and there were no differences between groups,  $ps > .05$ . A series of hierarchical regressions were conducted for all 4 word-frequency variables for each TBI group separately and also together. Years of education was entered first, PTA second, estimated verbal intelligence third, and the word frequency variable was entered last. Regressions that included all TBI groups revealed that the following word-frequency variables predicted MPAI-4 scores: IWEB-A (18% of the variance,  $p = .007$ ), COCA-L (14% of the variance,  $p = .024$ ), and COCA-A (18% of the variance,  $p = .007$ ). For the CTBI group only, the following word-frequency variables predicted MPAI-4 scores: IWEB-A (26% of the variance,  $p = .024$ ), COCA-L (24% of the variance,  $p = .033$ ), and COCA-A (30% of the variance,  $p = .015$ ). Education, PTA, WTAR, and IWEB-L were not predictive of MPAI-4 ratings. No variables were predictive of functional outcome for ATBI.

**Conclusions:** Three of the four-word frequency variables were significant predictors of functional outcome for TBI overall and for CTBI, above and beyond education, PTA, and WTAR. Word frequency during fluency tasks appears to be more predictive of functional outcome later in the recovery stages than during the early stages (ATBI). The COCA corpus may be a better corpus for predicting functional outcome than the iWeb since COCA incorporates spoken words while the iWeb is based exclusively on web pages.

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**Keywords:** brain injury, verbal abilities, cognitive rehabilitation

**R. RUGH-FRASER, D. W. LOPEZ-HERNANDEZ, P. Y. LITVIN, S. MANGASSARIAN, S. FATOORECHI, A. ARZUYAN, H. RAD, E. WAITE, D. BUDDING, P. M. VESPA, D. A. HOVDA, D. L. MCARTHUR, D. PLURAD, J. FUSTER, D. J. HARDY, E. WOO, M. SCHMITTER-EDGEcombe, M. J. WRIGHT. Examining Various Methods of Executive Ability from Trail Making Test Part B in Traumatic Brain Injury Survivors.**

**Objective:** Traumatic brain injury (TBI) is associated with deficits in executive ability. The Trail Making Test (TMT) is a commonly-used test of psychomotor sequencing (Part A; TMT-A) and of set-shifting ability (Part B; TMT-B). Researchers have investigated different methods to optimally use TMT-B for detecting TBI-related executive difficulties. We investigated three different measures of executive ability derived from TMT-B.

**Participants and Methods:** The study sample consisted of 34 acute TBI (ATBI), 29 chronic TBI (CTBI), and 48 healthy comparison (HC) participants. ATBI patients were tested within 6 months after injury, while CTBI patients were tested 12 months or more post-injury. Participants were administered both TMT-A and TMT-B, and total time for completion was recorded. All participants passed two performance validity tests. A series of ANCOVAs, controlling for age were conducted to evaluate group differences. That is, TMT-B raw score (i.e., seconds to complete TMT-B), the raw score difference (in seconds) between TMT-A and TMT-B of the

TMT (TMT-BA), and the difference between a predicted TMT-B score (TMT-BP) and the obtained TMT-B score (TMT-BBP). Correlations between TMT-B, TMT-BA, and TMT-BBP and other executive functioning tests (i.e., The Delis-Kaplan Executive Function System letter fluency, category fluency, switching fluency, and Stroop Color Word Test Color-Word) were evaluated.

**Results:** ANCOVAs revealed that the HC and CTBI group outperformed the ATBI group on TMT-B and TMT-BBP,  $p_s < .05$ ,  $h_{ps}^2 = .13-.14$ . Additionally, the HC outperformed the ATBI group on TMT-BA,  $p = .001$ ,  $h_p^2 = .12$ . For ATBI participants, all three TMT-B, TMT-BA, and TMT-BBP were significantly correlated with all executive functioning tests,  $r_s = -.55$  to  $-.42$ ,  $p_s < .05$ . For CTBI participants, TMT-B and TMT-BBP were significantly correlated with letter fluency, category fluency, and Stroop Color Word Test, Color-Word task,  $r_s = -.62$  to  $-.40$ ,  $p_s < .05$ , while TMT-BA for CTBI was significantly correlated only with category fluency and Stroop Color Word Test Color-Word,  $r_s = -.58$  to  $-.38$ ,  $p_s < .05$ . For HC participants, TMT-B and TMT-BBP correlated with switching fluency and Stroop Color Word Test Color-Word tasks,  $r_s = -.48$  to  $-.33$ ,  $p_s < .05$ , while TMT-BA was only correlated with switching fluency for this group,  $r = -.39$ ,  $p < .05$ .

**Conclusions:** We found that HC outperformed the ATBI group on all three TMT variables. The CTBI outperformed the ATBI on TMT-B and TMT-BBP. In our TBI sample, both TMT-B and TMT-BBP correlated with more executive functioning measures than TMT-BA, which suggests that TMT-B and TMT-BBP are likely better measures of executive ability than TMT-BA for both HCP and moderate-to-severe TBI.

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**Keywords:** traumatic brain injury, executive functions, psychometrics

### **P. LANDAU, P. DUQUETTE, S. R. HOOPER. Misconceptions About Traumatic Brain Injury: A Survey of Endorsements by North Carolina School Psychologists.**

**Objective:** Previous literature in the area of educational services for students with traumatic brain injury (TBI) highlights critical gaps in training on TBI among school-based professionals. The misunderstanding of pediatric TBI is particularly concerning for school psychologists who are tasked with identifying and providing evidence-based services to students with TBI in the school setting. The current study was conducted to assess school psychologists' misconceptions regarding TBI and their perceived competency working with this population of students.

**Participants and Methods:** A sample of 145 school psychologists in the state of North Carolina was surveyed on 27 common misconceptions about TBI.

**Results:** Results indicate that this group performed significantly better on 4 of 11 items compared to North Carolina school psychologists surveyed in 2006. High rates of endorsement of misconceptions were identified on items related to recovery, amnesia, and the nuanced sequelae of pediatric TBI. School psychologists who completed the NC TBI training program and those with more years of work experience endorsed fewer TBI-related misconceptions. Education level, personal exposure to TBI, and number of TBI cases had little effect on the rate of misconceptions. In regards to perceived sufficiency of training, only 57% of survey respondents report feeling prepared to meet the needs of students with TBI. This was noticeably higher than the 16% perceived sufficiency rate reported by North Carolina school psychologists

in 2006. School psychologists who completed the NC TBI training program and professionals with more exposure to TBI cases were more likely to rate their training on TBI as sufficient.

**Conclusions:** Current findings suggest that NC school psychologists show improvements in some aspects of TBI knowledge and perceived preparedness over the past 10-15 years, though many still continue to endorse high rates of misconceptions on TBI and report the need for additional training in this area. This study provides initial support for the implementation of the NC TBI training program and continues to highlight the need for additional training on TBI for practicing school psychologists.

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**Keywords:** traumatic brain injury, child brain injury

**G. KIM, S. SECK, S. GLAZER, H. GUZMAN, K. VANNATTA, W. CUNNINGHAM, E. WILDE, K. YEATES, K. HOSKINSON. Resting State Connectivity in the Theory of Mind Network in Children with Traumatic Brain Injury.**

**Objective:** Childhood traumatic brain injury (TBI) is a prominent public health concern, resulting in roughly 640,000 emergency department visits in the U.S. annually. Even after recovery, children with TBI suffer from long-term neurocognitive morbidities, including difficulties with social-cognitive skills such as perspective taking and social information processing. Previous studies have shown that the temporo-parietal junction (TPJ), medial prefrontal cortex (MPFC), and posterior cingulate (PC) play imperative roles in supporting Theory of Mind (ToM), a critical component of social cognition. Reduced connectivity among these three regions may contribute to poor social cognition, including ToM. In this study, we examined the associations between ToM performance and resting state connectivity among these regions in children and adolescents with TBI.

**Participants and Methods:** Twenty-three participants (15 males,  $M_{age}=12.02$ ) with TBI (7 severe TBI, 4 moderate TBI, and 12 complicated-mild TBI) completed the Jack and Jill cognitive ToM task and underwent magnetic resonance imaging (MRI) including a resting state fMRI sequence on a Siemens Prisma 3Tesla scanner. Resting state connectivity among TPJ, MPFC, and PC was assessed using the CONN Toolbox seed-to-voxel analysis.

**Results:** Overall, participants' performances on trials requiring ToM versus control trials did not differ significantly, though the difference exceeded a medium effect size (ToM=64.67% vs. control=86.96%,  $d=-0.57$ ). The three different injury severity groups did not perform differently from one another on ToM [ $F(2,20) = 0.78, p=.47$ ]. Participants showed high cross-region correlation in the following pairs ( $ps<.01$ ): TPJ/MPFC ( $r=.74$ ), TPJ/PC ( $r=.64$ ), and MPFC/PC ( $r=.87$ ). However, we found no significant associations among seed-to-voxel based brain region correlations and ToM task performance ( $ps=.32-.85$ ).

**Conclusions:** In this study, children with TBI did not perform differently on ToM and the control task, though the performance difference did trend in the expected direction. While cross-region associations amongst TPJ, MPFC, and PC were robust, we did not find a strong correlation between ToM performance and the magnitude of these cross-region associations. Some limitations such as small sample size and the lack of a control group for comparison were present and may have impacted our ability to detect statistically significant associations. Future research, including next steps for this study, should compare brain connectivity in these same regions between healthy age-matched controls and children with TBI.

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**Keywords:** theory of mind, neuroimaging: functional connectivity, traumatic brain injury

**W. A. SCHRAEGLE, C. A. AUSTIN, T. NYMAN, K. MOONEY, K. JONES. Utility of WISC-V Reliable Digit Span (RDS) in Detecting Noncredible Performance in Pediatric mTBI.**

**Objective:** High rates of noncredible effort in youth with mild traumatic brain injury (mTBI) have been well documented. The Medical Symptom Validity Test (MSVT) is a commonly-used stand alone performance validity test and the Reliable Digit Span (RDS) is an embedded indicator of noncredible effort. While Kirkwood and colleagues (2011) demonstrated good utility of WISC-IV Digit Span scores in detecting failure on the MSVT in pediatric mTBI, these indicators have not yet been examined on the WISC-V. This study sought to replicate Kirkwood et al.'s findings with the WISC-V.

**Participants & Methods:** The study included 96 youth with mTBI (53% male) ages 8 to 16 years ( $M = 13.33$ ,  $SD = 2.02$ ) evaluated in an interdisciplinary, hospital-based mTBI clinic, for whom WISC-V Digit Span and MSVT data were available. Participants were coded as either passing ( $n = 79$ ) or failing ( $n = 17$ ) the MSVT, based on scores of  $\leq 85\%$  on any one of the three validity conditions. Failure of the MSVT was used as the criterion for noncredible effort. The ability of WISC-V Digit Span scores to discriminate those who failed the MSVT was examined via receiver operating characteristic (ROC) curve analyses.

**Results:** This sample's MSVT failure rate (18%) was consistent with that reported by Kirkwood et al. (17%). Credible and noncredible effort groups did not differ by demographics or preinjury factors. Those with noncredible effort ( $M = 7.65$ ,  $SD = 2.62$ ) performed significantly worse on Digit Span Sequencing than those with credible effort ( $M = 9.42$ ,  $SD = 3.07$ ;  $p = .03$ ). Group differences were not observed on other Digit Span scores. RDS showed a poor AUC (.614). An RDS cutoff score of  $\leq 6$  correctly classified 65% of the sample; only 28% below the cutoff failed the MSVT. Age-corrected Digit Span Sequencing scores showed somewhat more favorable utility, with a fair AUC (.691). Digit Span Sequencing only correctly classified 59.77% of the sample, with 37% below the cutoff failing the MSVT. Both indicators had poor sensitivity (RDS = 23.5%; Sequencing = 41.2%). Age-corrected Digit Span Forward and Backward scores demonstrated no discriminatory ability (AUC = .575 and .534).

**Conclusions:** Digit Span Sequencing was found to have minimal utility in identifying those who failed the MSVT. However, other Digit Span indicators demonstrated no discriminative utility. Thus, Digit Span Sequencing (which was not on the WISC-IV) may be a relatively stronger embedded effort indicator than RDS but should not be used in isolation. While Digit Span cutoff scores and the MSVT failure rate were consistent with Kirkwood et al., WISC-V Digit Span classification statistics were far lower. This likely reflects smaller differences in performance between credible and noncredible groups, which may be partly related to shorter time since injury (on average, 26.25 days following injury) and smaller sample size. The present findings highlight the need for continued research with larger samples of youth with mTBI as well as ongoing consideration of the continuum of effort.

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**Keywords:** mild traumatic brain injury, effort

**E. STOLZ, C. G. VAUGHAN, J. URBAN, M. E. KELLEY, C. WHITLOW, J. STITZEL, G. A. GIOIA. Evidence Based Assessment to Support Return to School Following Concussion .**

The Concussion Learning Assessment and School Survey, 3rd Edition (CLASS3) was developed to capture the nature and severity of student academic needs following concussion. This study examined the measure's reliability and validity in a group of healthy uninjured pediatric athletes. 35 males (age 10-18) and their parents completed the measure before and following the season. Mean time between ratings was 4.47-months. The CLASS3 Academic Problems Scale consists of ratings for symptoms interfering with school and new/worsening academic complaints (0-42). Results indicated minimal academic problems with little variation pre-post season (Parent mean difference=0.36,  $p=0.657$ ; Self mean difference=0.22,  $p=0.803$ ). Internal consistency reliability for the scale was high for parent (pre-season  $\alpha=0.898$ , post-season  $\alpha=0.877$ ) and self-report (pre-season  $\alpha=0.901$ , post-season  $\alpha=0.777$ ). Test-retest reliability was low to moderate (parent  $r=0.596$ , self  $r=0.450$ ), likely due to restricted score range. There was a moderate relationship with the Post-Concussion Symptom Inventory (parent: pre-season  $r=0.651$ , post-season  $r=0.598$ ; self-report: pre-season  $r=0.660$ , post-season  $r=0.668$ ). Low test stability is likely due to a low base rate of academic problems in healthy students. Estimates of convergent validity were fair. The CLASS3 may be useful for capturing meaningful academic challenges following concussion.

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**Keywords:** traumatic brain injury, academic achievement, psychometrics

**E. DENELSBECK, B. MARCOPULOS. Student beliefs about what factors influence their GPA .**

**Objective:** The current study investigated what students believed had an effect on GPA, and if these beliefs differed based on concussion history. Understanding relationship between concussions and students concerns about their academic performance can help universities support students with concussion histories or current concussions (Killiam et. al., 2005; Brooks et. al., 2016; Collie, McCrory & Makdissi, 2006; Belanger, Spiegel, & Vanderploeg, 2009; Brooks et. al., 2013).

**Participants and Methods:** Participants (N=252) were recruited through Participant Pool, an online platform used at James Madison University. In addition to gathering demographic information about each participant, the online Qualtrics survey assessed concussion history using the Texas Evaluation of Concussion History (TECH) (Cullum et. al., 2018) and depression, anxiety, and stress with the Depression, Anxiety, and Stress Scale (DASS-21) (Lovibond & Lovibond, 1195). The participants' academic performance was estimated by self-reported GPA at James Madison University.

Due to incomplete questionnaire data, 31 participants had to be removed. The majority of participants were female (71.0%). Of the participants, most were freshman (57.6%), 13.8% of participants were sophomores, 5.4% were juniors, and 18.3% were seniors. Participants' ages averaged at 19.52 years old.

**Results:** Of the 252 students in this sample, 80 students reported having a history of concussions. Of these 80 students, only 7 students reported that they believed their concussion history affected their academic performance. Most students with a concussion history did not think that it had significantly affected their academic performance. Stress and anxiety were most

often reported as having an affect on academic performance in both the concussion history and no concussion history groups. Even among the students who believed their concussion history affected their academic performance they reported stress and anxiety as significantly affecting academic performance. There were no differences in depression and learning disabilities affecting academic performance among the three groups.

**Conclusions:** Concussion history did not appear to have a significant effect on student beliefs of academic performance in this sample of university students. Students did not think that depression or learning disabilities generally had a strong negative affect on their academic performance. Contrary to expectations, students with a concussion history did not often report that they believed their concussion history affected their academic performance. In this sample, there was a concussion prevalence of 31.7%. Previous studies reported a concussion prevalence of 51.7% (Meske et. al., 2019). This study provided insights regarding the relationship between concussions, concussion history, and students perception of academic performance in college students.

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**Keywords:** academic achievement, brain injury

### **A. J. FLYNN, G. Y. NAVARRO, H. K. BASEHORE. PTSD Symptoms, not TBI, predict Suicidal Ideation and Suicide Attempts in a Veteran Population.**

**Objective:** Suicide rates among veterans are significantly higher than the general public, as veterans are twice as likely to die by suicide than civilians. Despite a large body of research on veterans and suicide risk and prevention, there is a surprising lack of research that has examined how common psychological and neurological comorbidities in veteran populations, such as PTSD and TBI, collectively influence suicidality in veterans. Of the research that has been conducted, findings remain inconclusive. Some research supports that any associations between TBI and suicidality can best be explained by comorbid PTSD while other research suggests that TBI confers its own risk for increasing suicidal thoughts and behaviors. This ambiguity in the literature may be attributable to varied methods and definitions for assessing TBI. To elucidate these equivocal findings, a semi-structured interview for TBI was used. Importantly, this method has been suggested to be comparatively better to other TBI identification methods. Using this TBI identification method, we investigated how the presence of TBI and PTSD symptomology predict past suicidality in a veteran population.

**Participants and Methods:** 142 (94% male) veterans were recruited from a residential substance use treatment program at a northeast VA Medical Center. TBI history was assessed via the Ohio State TBI Identification Method (OSU), which is a semi-structured interview that elicits lifetime TBI history. TBIs were classified as whether participants ever reported loss of consciousness following an impact to their head. PTSD symptomology was assessed via the Posttraumatic Stress Checklist for the DSM-V (PCL-5). Suicidal ideation and attempt history were assessed via a screening tool for the Structured Clinical Interview for the DSM-V (SCID-5). Two logistic regression models were conducted to examine how PTSD symptomology and TBI history predict past suicidal ideation and attempted suicide, respectively.

**Results:** The logistic regression model for suicidal ideation was significant,  $\chi^2(2) = 18.83$ ,  $p < .0001$ , with the model explaining 16.6% of the variance in past suicidal ideation and correctly classified 68% of cases. The logistic regression model for suicide attempt was significant,  $\chi^2(2) = 17.00$ ,  $p < .0001$ , with the model explaining 15.4% of the variance in past suicidal attempts and

correctly classified 62.7% of cases. In both models, PCL total score was a significant predictor (both  $p$ 's < .001), while the presence of a past TBI was a not significant as a predictor.

**Conclusions:** These results suggest that PTSD symptomology is a more robust predictor of reported suicide attempts and past suicidal ideation than a history of TBI. This result parallels previous research which suggests that PTSD is a greater influence on the development of suicidality than TBI, and extends the literature by incorporating a semi-structured interview to assess TBI history. One limitation of this research is a failure to consider TBI severity, which may explain why TBI history was not a significant predictor in the regression models. Future research should assess TBI severity and utilize longitudinal designs that can better determine the relative influence of TBI and PTSD on the development of suicidality.

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**Keywords:** traumatic brain injury, transdisciplinary research, psychopathy

### **E. M. MCCONATHEY, C. LEVITCH, M. LIPTON, M. ZIMMERMAN. Short-Term Heading Exposure Impacts Processing Speed in College Soccer Players.**

**Objective:** Recent studies found that athletic conditioning or training may have several cognitive benefits for adult soccer players, including enhanced processing speed. However, these benefits may be attenuated by an athlete's level of exposure to repetitive head impacts ("heading"). It is unclear if a similar relationship exists for other cognitive domains, such as executive functioning. The objective of this study was to determine if varying degrees of heading exposure in college-aged soccer players impacted an individual's performance on a task of processing speed and executive functioning compared to healthy undergraduate students.

**Participants and Methods:** Division 1 varsity and club team university soccer players ( $N=50$ , mean age=19.58, female=50%) and healthy undergraduate students ( $N=218$ , mean age=20.45, female= 69%) completed a neuropsychological battery that included the Delis-Kaplan Executive Function Systems (D-KEFS) Color-Word Interference (CWI) task. The CWI task is a timed paper and pencil test that measures an individual's ability to identify either the color that a word is printed in or the name of the word as quickly as they can. Both processing speed (trials 1 and 2) and executive functioning (trials 3 and 4) are measured in this task. Soccer players completed a questionnaire to determine level of heading exposure during the prior 2 weeks and were divided into low ( $n=25$ , range=0-39) and high ( $n=24$ , range=40-450) heading groups based on these results.

**Results:** Across trials 1 and 2 (processing speed), the mean reaction time for the low heading group was 1.53 seconds faster ( $M=21.62$ ,  $SD=3.21$ ) than for the high heading group ( $M=23.15$ ,  $SD=2.24$ ) and 1.88 seconds faster than the non-soccer player group ( $M=23.50$ ,  $SD=3.69$ ) ( $\eta^2=.03$ ,  $p=.021$ ). Across trials 3 and 4 (executive functioning), the mean reaction time for the low heading group ( $M=44.18$ ,  $SD=7.10$ ) was not significantly different from the high heading ( $M=45.54$ ,  $SD=6.03$ ) or the non-soccer player groups ( $M=46.66$ ,  $SD=7.98$ ) ( $\eta^2=.015$ ,  $p=.15$ ).

**Conclusions:** Similar to prior findings of a relationship between repetitive heading events and processing speed in adult athletes, lower heading exposure in college soccer players conferred a relative benefit in reaction time compared to both college soccer players with higher levels of heading and control subjects. However, this pattern of findings was not found for a more complex inhibition/switching task. These findings suggest that athletic performance in college-aged athletes may improve certain aspects of neuropsychological performance, but extensive exposure to repetitive heading events may temper such benefits among soccer players.

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**Keywords:** sports-related neuropsychology, cognitive processing, executive functions

**S. SCIULLI, N. D. SILVERBERG, W. J. PANENKA, L. KWAN, V. PURCELL, A. AQUINO. Cognitive Performance Under Distraction Following Mild Traumatic Brain Injury.**

**Objective:** Neuropsychological testing is typically normal three or more months after a mild traumatic brain injury (mTBI), even in patients with lingering cognitive complaints. The traditional set-up for neuropsychological evaluations (e.g., a quiet, distraction-free office) might undermine their sensitivity to detecting impairments that the patient experiences in daily life. The present study evaluated cognitive performance under experimentally induced distraction, a task designed to mimic the common subjective complaint of difficulty tuning out background noise. We hypothesized that patients with mTBI would perform like controls on standard neuropsychological testing but worse than controls on the experimental distraction task.

**Participants and Methods:** Thirty-eight patients with mTBI (mean age = 36.1 years; 53% male) and 33 trauma controls with injuries not involving the head (TC; mean age = 34.5 years; 64% male) were recruited from an urban Canadian emergency department. All study participants completed a story memory task that included an auditory distraction (Schnabel & Kydd, 2012) as well as the NIH Toolbox Cognition Battery (under standard conditions) and the Rivermead Post Concussion Symptoms Questionnaire at 6 months post-injury. Demographic and injury variables, including the Injury Severity Score, were extracted from acute care medical records.

**Results:** The mTBI and TC groups had comparable demographic profiles (age, education level, sex, ethnicity), Injury Severity Scores (mean=6.3 vs. 4.6), and length of hospital stay (median=2.9 vs. 3.1 days). In regression modeling with the NIH Toolbox Cognition Battery age-adjusted fluid composite score as the response variable, the effect of group (mTBI vs TC) was significant,  $F(1,63) = 6.21$ ,  $p = .015$ , with the mTBI group performing worse (mean=103.1,  $SD=14.4$ ) than the TC group (mean=113.2,  $SD=16.1$ ). Adding potential confounds to the model (age, sex, ethnicity, education, Injury Severity Score, severity of cognitive symptoms endorsed on the Rivermead Post Concussion Symptoms Questionnaire) minimally influenced the group coefficient estimate. With the distraction task as the response variable, the effect of group was non-significant in both unadjusted [ $F(1,68)=.220$ ,  $p=.641$ ] and adjusted regression models. The mTBI (mean=55.6,  $SD=15.0$ ) and TC (mean=54.5,  $SD=13.5$ ) groups performed similarly on the distraction task. Caucasian (vs. other) ethnicity, higher education attainment, and lower Injury Severity Score was associated with better performance on the distraction task.

**Conclusions:** The experimental distraction task, designed to be more ecologically valid and sensitive to mTBI, did not distinguish between patients with mTBI and controls, whereas standard neuropsychological testing with the NIH Toolbox Cognition Battery did, the opposite pattern to what was hypothesized. This study suggests that more ecologically valid assessment paradigms are not necessarily better able to identify cognitive impairment long after mTBI than traditional neuropsychological tests.

**Sources of Support:** Brain Canada

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**Keywords:** concussion, test reliability

**T. J. MEREDITH-DULIBA, J. SCHAFFERT, N. DIDEHBANI, J. HART, H. ROSSETTI, C. LOBUE, M. CULLUM. Depressive Symptoms and Head Injury Exposure in Cognitively Normal Retired NFL Players.**

**Objective:** Prior research suggests that repetitive concussions may increase the risk of depressive symptoms in aging. This study sought to investigate the potential association between head injury exposure and specific depressive symptom clusters in retired National Football League (NFL) players.

**Participants and Methods:** Data from NFL retirees (aged 34-79;  $M=54.28$ ,  $SD=11.71$ ) were collected from a larger prospective cohort study. After a neurological exam, clinical interview, and neuropsychological testing, all retirees in the current study were deemed cognitively normal via consensus diagnosis. As part of a larger clinical battery, the Beck Depression Inventory-2<sup>nd</sup> edition (BDI-II) was completed as a measure of depressive symptoms. We evaluated whether total BDI-II scores (Range: 0 to 38,  $M=10.30$ ,  $SD=9.71$ ) and somatic, cognitive, and affective symptom clusters, using the Buckley Three Factor Model (Buckley et al., 2001) were correlated with head-injury exposure using Pearson correlations. Head-injury exposure was measured using five variables, including number of concussions, number of concussions with loss of consciousness (LOC), years playing professionally, games played, and games started. P-values were adjusted to .01 level to reduce the possibility of type 1-error.

**Results:** Cognitively normal NFL retirees on average played 7 years professionally ( $SD=3.56$ ), were in 104 total games played ( $SD = 52.59$ ), started 64 total games ( $SD = 54.83$ ), and reported having 5 concussions ( $SD = 4.53$ ) and  $< 1$  with LOC ( $SD = .47$ ). Total BDI-II scores were not significantly correlated with number of concussions ( $R = .18$ ,  $p = .27$ ), number of concussions with LOC ( $R = .12$ ,  $p = .43$ ), games played ( $R = -.22$ ,  $p = .16$ ), games started ( $R = -.24$ ,  $p = .13$ ), or years playing professionally ( $R = -.28$ ,  $p = .06$ ). When evaluating the Buckley Three Factor Model, only one correlation between depressive symptoms and head-injury exposure approached significance (Buckley affective factor and years playing professionally) but was not significant after correcting for multiple comparisons ( $R = -.30$ ,  $p = .05$ ).

**Conclusions:** Previous studies in retired professional football players suggests that those with a history of recurrent concussions are at greater risk for experiencing depressive episodes later-in-life (Guskiewicz et al., 2007, Kerr et al., 2011). In this small sample of cognitively normal NFL retirees, we did not identify any significant linear relationships between five head-injury exposure variables and depressive symptom clusters later in life. These findings did not suggest a clear dose-response linear relationship between depressive symptoms and head-injury exposure in cognitively normal retirees. Future comprehensive studies that aim to identify risk factors (e.g., psychosocial stressors, chronic pain, etc.) for risk of depressive symptoms among retired NFL players later in life are needed.

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**Keywords:** sports-related neuropsychology, concussion, depression

**A. TERPSTRA, M. CAIRNCROSS, K. YEATES, A. VRANCEANU, J. GREENBERG, C. HUNT, N. D. SILVERBERG. Psychological Mediators of Avoidance and Endurance Behavior After Concussion.**

**Objective:** The avoidance-endurance model (AEM) proposes multiple pathways from acute to chronic pain with distinct cognitive and behavioral components in each pathway. The AEM may also be applicable to persistent symptoms following concussion. The present study tested the

AEM as an explanatory framework for concussion outcomes, by using mediation analyses through the proposed psychological mechanisms. Based on the AEM, we hypothesized that post-concussion symptoms would significantly predict avoidance behavior through catastrophizing, and endurance behavior through thought suppression and self-distraction.

**Participants and Methods:** Eighty-four adults seeking treatment at two outpatient concussion clinics ( $M = 41.8$  years old, 63% female) completed measures of post-concussion symptoms (Rivermead Postconcussion Symptoms Questionnaire), catastrophizing (Pain Catastrophizing Questionnaire adapted for concussion), thought suppression (Thought Suppression Inventory), self-distraction (Five Factor Mindfulness Questionnaire—Acting with Awareness Subscale reverse scored), avoidance behavior (Fear Avoidance Behavior after Traumatic Brain Injury Questionnaire), and endurance behavior (Behavioral Response to Illness Questionnaire—All or Nothing Behavior Subscale) at an average of 12.9 weeks post-concussion. Three mediation analyses were conducted to assess each of the pathways proposed in the AEM.

**Results:** We found a significant indirect effect of post-concussion symptoms on avoidance behavior through catastrophizing [ $ab = 0.113$  (0.036), 95% CI = 0.053, 0.195]. The indirect effects of post-concussion symptoms on endurance behavior through thought suppression [ $ab = 0.011$  (0.012), 90% CI = -0.002, 0.035] and self-distraction [ $ab = 0.003$  (0.009), 90% CI = -0.008, 0.022] were not statistically significant.

**Conclusions:** Results supported the catastrophizing-avoidance pathway in the AEM for concussion, but not the thought suppression-endurance or self-distraction-endurance pathways. The AEM has practical implications for concussion management. Specifically, individuals who exhibit fear-avoidance behavior may be best helped by targeting their catastrophic thinking about concussion symptoms. Further research is needed to establish whether thought suppression and self-distraction are suitable treatment targets for interventions aimed at reducing excessive endurance behavior.

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**Keywords:** concussion, outcome

### **K. FARBER, C. LEVITCH, E. M. MCCONATHEY, M. ZIMMERMAN. The Relationship Between Heading and Depression and Anxiety Symptoms in College Soccer Players.**

**Objective:** Physical contact during soccer play often leads to head impacts. Repetitive head impacts, associated with heading of the ball during soccer games and practice, may not result in overt concussive events but may still have negative effects. Post-concussion syndrome (PCS) is a common medical disturbance following mild Traumatic Brain Injury, and includes symptoms such as cognitive impairment, dizziness, headache, and psychosocial disturbances. The present study explored the relationship between heading and depression and anxiety in college soccer players. We hypothesized that increased heading would be associated with increased severity of depression and anxiety symptoms. The relationship between covariates (age, education, gender, race/ethnicity, concussion history, IQ) and depression and anxiety symptoms was also examined.

**Participants and Methods:** Data from this cross-sectional study was collected from August to November of 2018 from amateur Division 1 varsity and club sport university soccer players ( $N=50$ ; male=25). Participants completed a battery of assessments that included measures of depression (Beck Depression Inventory) and anxiety (Beck Anxiety Inventory) as well as a questionnaire on soccer play activity (e.g., heading, concussion).

Quartiles were used to separate participants into low-heading (quartile 1;  $N=12$ ) and high-heading (quartiles 2-4;  $N=37$ ) groups. An independent sample  $t$ -test was performed to determine differences between groups for symptoms of depression and anxiety. Potential covariates (age, education, gender, race/ethnicity, concussion history, IQ) were also examined in relation to the dependent variable measures. Linear regressions examined the relationship between heading (independent variable) and either depression or anxiety symptoms (dependent variables) with the inclusion of covariates as appropriate.

**Results:** Individuals with higher education had higher levels of anxiety symptoms ( $r=-.28$ ,  $p=.049$ ). Non-white individuals had higher (mean= 9.25,  $SD=2.22$ ) levels of depressive symptoms than white individuals (mean= 3.61,  $SD= 2.93$ ;  $t(47)=3.74$ ,  $p<.001$ ). Athletes with a history of concussion ( $N=18$ ) reported higher levels of depressive symptoms (mean = 5.28,  $SD=2.70$ ) than athletes with no concussion history ( $N=31$ , mean = 3.35,  $SD= 3.43$ ;  $t(47)=-2.04$ ,  $p=.047$ ). There was a significant linear regression model overall for the prediction of depression ( $F(3,45)=7.38$ ,  $p < .001$ ,  $R^2 =.33$ ). Heading was not a significant predictor, although concussion history ( $p=.01$ ) and race/ethnicity ( $p<.001$ ) were. There was also a significant linear regression model for anxiety symptoms ( $F(3,45)=6.75$ ,  $p = .001$ ,  $R^2 =.31$ ). Heading exposure was not a significant predictor, although IQ was ( $p=.005$ ). The depression and anxiety differences between heading groups were nonsignificant.

**Conclusions:** In college soccer players, heading of the ball was not associated with either depression or anxiety symptoms. In contrast, several covariates (e.g., concussion history, gender, education, an estimate of intelligence, and race) did affect depression and anxiety symptoms. Although our study hypotheses were not supported, future research may focus on the interrelationship among these covariates with other measures of PCS, such as cognitive function, headache, and dizziness.

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**Keywords:** depression, anxiety, concussion

**V. C. MERRITT, C. CHANFREAU-COFFINIER, S. F. SORG, L. DELANO-WOOD, V. (MVP). An Epidemiological Analysis of Self-Reported Cognitive and Psychiatric Functioning in Veterans with and without a History of Traumatic Brain Injury—A Million Veteran Program Study.**

**Objective:** The VA Million Veteran Program (MVP) is a nationwide initiative offering Veterans who receive care in the VA Healthcare System the opportunity to participate in research that seeks to better understand the array of factors that influence health and illness. The purpose of this MVP study was to examine (1) self-reported cognitive and psychiatric diagnoses and (2) subjective ratings of cognitive and psychiatric symptoms in military Veterans with and without a remote history of deployment-related traumatic brain injury (TBI).

**Participants and Methods:** Participants were selected from a larger sample of MVP Veterans who (1) completed Baseline and Lifestyle surveys upon enrollment in MVP, (2) screened positive on the VA TBI Clinical Reminder Screen, and (3) were administered the Comprehensive Traumatic Brain Injury Evaluation (CTBIE). Briefly, the CTBIE provides information about any deployment-related TBIs that may have occurred, including mechanism of injury and TBI signs and symptoms. At the conclusion of the CTBIE, the clinician is required to make a determination about whether a Veteran's history is consistent with TBI; Veterans were classified as "CTBIE+" (TBI cases) and "CTBIE-" (controls). Primary outcomes of interest included self-reported

cognitive and psychiatric diagnoses from the Baseline survey and measures of subjective cognitive and psychiatric functioning from the Lifestyle survey (i.e., the Medical Outcomes Study Cognitive Functioning Scale [MOS-Cog-R], Patient Health Questionnaire-4 [PHQ-4], and the PTSD Checklist [PCL]).

**Results:** Approximately 5,000 MVP participants (90% male) were included in the present analyses, of which 3,051 were classified as TBI cases (CTBIE+). Chi-square analyses showed that there was a significant difference between TBI cases and controls with respect to the proportion of Veterans who endorsed cognitive and psychiatric diagnoses ( $p$ 's<.001;  $\phi$ =0.05-0.15). Specifically, TBI cases, relative to controls, endorsed significantly greater rates of memory loss/impairment (38.3% vs. 24.3%); anxiety/panic (50.8% vs. 43.7%); PTSD (76.6% vs. 65.0%); and depression (59.5% vs. 54.9%). Additionally, independent samples t-tests showed that there were group differences with respect to subjective cognitive functioning across all MOS-Cog-R items ( $p$ 's<.001;  $d$ 's=0.10-0.18). Group differences were also observed across measures of psychiatric distress including the PHQ-4 and PCL ( $p$ 's=<.001-.002;  $d$ 's=0.12-0.15), such that CTBIE+ Veterans endorsed more severe dysfunction relative to CTBIE- Veterans. Finally, among the CTBIE+ subgroup, clinicians rated the etiology of patients' current clinical symptoms as follows: 44.1% due to a "combination of deployment-related TBI and behavioral health conditions"; 35.8% due to "behavioral health conditions"; 8.6% due to "TBI residual problems"; 5.9% due to "other condition not related to TBI or behavioral health"; and the final 5.6% classified as "symptom resolution."

**Conclusions:** Among MVP-enrolled Veterans, CTBIE+ Veterans perceive and endorse greater rates of cognitive and psychiatric distress than CTBIE- Veterans. Future directions of this research include examining a third group of Veterans who screened negative on the TBI screener to serve as an additional control group for these analyses. Finally, to better understand the etiology of cognitive and psychiatric distress in Veterans with a history of TBI, analyses are underway in order to evaluate genetic underpinnings of these clinical sequelae.

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**Keywords:** traumatic brain injury, cognitive functioning, neuropsychological outcome

**S. W. LIEBEL, K. L. VAN PELT, G. P. GARCIA, L. L. CZERNIAK, M. A. MCCREA, T. MCALLISTER, S. P. BROGLIO. Sensation-Seeking is Associated with Sport-Related Concussion Risk and Incidence and Sport Contact Level in Collegiate Athletes.**

**Objective:** Sensation-seeking, or the need for novel and exciting experiences, is a personality trait that is thought to be associated with sport-related concussion (SRC). However, how it influences SRC risk and incidence remains unknown.

*Participants and Methods:* In a large multi-site sample of NCAA collegiate athletes collected by the CARE Consortium, we prospectively measured sensation-seeking (with the Brief Sensation Seeking Scale-8), sport contact level, and SRC history and incidence. Study groups included a full study sample of 22,374 baseline evaluations and a sub-sample of 2,037 participants with incident SRC. Independent samples t-test, analysis of covariance, and hierarchical logistic regression were utilized.

**Results:** In the full study sample, ANCOVA results showed a significant difference between high sport contact level and greater sensation-seeking while adjusting for sex ( $p$ <.001,  $R^2$ =.007,  $\eta^2_p$ =.003). Post-hoc tests showed there were significant sensation-seeking mean differences between all sport contact levels (all  $p$ <.05). In the incident SRC sub-sample, there was no

difference in sensation-seeking by sport contact level when adjusting for sex differences ( $p=.777$ ,  $R^2=.001$ ,  $\eta^2_p=.000$ ).

In the full study sample, ANCOVA results showed significant mean differences of sensation-seeking by the number of prior SRC at the time of enrollment after controlling for sex and sport contact level ( $p<.001$ ,  $R^2=.010$ ,  $\eta^2_p=.004$ ). Post-hoc tests showed participants with one ( $p<.001$ ) and two ( $p<.001$ ) prior SRC had higher sensation-seeking than those with zero prior SRC. Participants with two prior SRC had higher sensation-seeking than those with one prior SRC ( $p<.001$ ). Participants with three or more prior SRC did not have different sensation-seeking scores than any other prior SRC level. In the incident SRC sub-sample, there was also a significant mean difference between sensation-seeking scores by the number of prior SRC after controlling for sex and sport contact level, ( $p=.004$ ,  $R^2=.010$ ,  $\eta^2_p=.012$ ). Post-hoc tests showed participants with one ( $p=.028$ ) prior SRC had higher sensation-seeking than those reporting zero prior SRC.

A hierarchical logistic regression model constructed in the full study sample found a one-point increase in sensation-seeking resulted in a 21% greater risk of prior SRC (OR=1.212; 95% CI: 1.154-1.272) after accounting for participant sex and sport contact level. In a separate model among the incident SRC sub-sample, participants had a 28% greater risk for prior SRC with every one-point increase in sensation-seeking (OR=1.278; 95% CI: 1.104-1.480) after accounting for participant sex and sport contact level.

After accounting for participant sex, sport contact level, and the number of years played, a one-point increase in sensation-seeking resulted in a 12% greater risk of incident SRC among the full study sample, (OR=1.119; 95% CI: 1.039-1.204).

**Conclusions:** Our findings show higher sensation-seeking was reported in athletes playing contact sports compared to limited- or non-contact sports. Additionally, concussion history at the time of enrollment was related to higher sensation-seeking scores, which was also an independent risk factor for incident SRC, though effect sizes were small. These findings suggest sensation-seeking may be a potentially useful behavioral and personality factor to consider in SRC management.

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**Keywords:** concussion, personality, transdisciplinary research

### **C. S. WALLER, L. PAWLOW, A. M. POMERANTZ. Loss of Consciousness as a Moderator in the Relationship Between Sleep-Wake Dysfunction and Postconcussion Syndrome.**

**Objective:** A prior study conducted by this team identified posttraumatic amnesia as a moderating factor in the relationship between sleep-wake dysfunction and post-concussion syndrome. This extension of that work seeks to further explore those findings in the context of loss of consciousness at the time of injury.

**Participants and Methods:** A total of 224 participants with a history of traumatic brain injury (TBI) were recruited via online sources to complete several questionnaires remotely for the previous study via advertising targeted toward those who had experienced a closed-head injury. After exclusionary criteria were applied, forty-seven adults self-reporting recent, clinically-confirmed mild-to-moderate TBI answered questions related to their current functioning and

their history of neurological insult via an online data collection system. Data analysis was conducted via hierarchical multiple regression to determine possible interaction effects.

**Results:** An interaction effect was observed. Subsequent simple slopes analysis suggests that the duration of unconsciousness experienced at the time of injury moderates the relationship between sleep-wake dysfunction and post-concussion syndrome. As the time spent unconscious increases, so does the effect of sleep-wake dysfunction on the recovery profile following a TBI.

**Conclusions:** These findings extend previous research by suggesting that the symptoms present at time of injury (i.e. loss of consciousness) may be connected to a sleep-related protracted recovery profile following the neurological insult.

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**Keywords:** concussion, sleep, traumatic brain injury

### **K. RIEGLER, E. T. GUTY, G. A. THOMAS, P. A. ARNETT. Prospective Implications of Insufficient Sleep for College Athletes.**

**Objective:** Insufficient sleep in athletes is associated with increased symptoms at baseline, but no differences in cognitive functioning, when compared to athletes getting sufficient sleep. Additionally, athletes getting insufficient sleep at baseline look similar, in terms of subjective self-report symptoms and objective cognitive performance, to athletes getting sufficient sleep post-concussion (Riegler, Guty, Thomas, & Arnett, 2020). The goal of the current study is to expand on these previous findings by exploring the implications of insufficient sleep at baseline for athletes who later sustain a sport-related concussion (SRC).

**Participants and Methods:** 614 athletes (M=455, F=159) completed a comprehensive neuropsychological evaluation at baseline. Athletes were separated into two groups based on the amount of sleep the night prior to testing. The sleep duration cutoffs for these group were empirically determined by sample mean and standard deviation (M=7.07, SD=1.29). There were 102 insufficient sleepers and 512 sufficient sleepers. As part of our sports concussion program, these athletes were prospectively followed and if they sustained an SRC they were referred for post-concussion testing. Thus, we could also determine which athletes from our baseline sample went on to sustain an SRC (n=61). The Post-Concussion Symptom Scale (PCSS) on the Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) was used to assess overall symptoms. Two neurocognitive composites were created (memory and attention/processing-speed (APS)) based on test indices comprising a hybrid neuropsychological test battery. A Chi-square test of independence was performed to examine the relation between sleep group and likelihood of sustaining an SRC. Independent samples t-tests were conducted to compare groups on neurocognitive test performance and self-reported symptoms.

**Results:** A significantly greater proportion of insufficient sleepers (15.68%) went on to sustain SRC compared to sufficient sleepers (8.79%),  $\chi^2(1, N = 613) = 4.52, p < .03, \phi = .08$ . Compared to insufficient sleepers who did not sustain SRC, insufficient sleepers who sustained SRC reported significantly more total symptoms,  $t(16.33) = -2.20, p = .04, d = .71$ , and performed significantly worse on APS measures,  $t(100) = 3.26, p = .002, d = .96$ , at baseline. Additionally, compared to sufficient sleepers who did sustain SRC, insufficient sleepers who sustained SRC also reported significantly more total symptoms on the PCSS,  $t(16.58) = -2.77, p = .01, d = .94$ , and performed significantly worse on APS measures,  $t(57) = -.28, p = .007, d = .40$ , at baseline. There were no differences between the insufficient sleep group who sustained SRC and either of the other groups on baseline memory composite performance.

**Conclusions:** Athletes with insufficient sleep at baseline are twice as likely as those with sufficient sleep to sustain an SRC. Further, insufficient sleepers who go on to sustain SRC report more total symptoms and perform worse on APS measures at baseline than either sufficient sleepers who also go on to sustain concussion or insufficient sleepers who do not. The combination of insufficient sleep, poor APS, and higher symptom burden seems to be implicated in risk for future concussion.

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**Keywords:** concussion, depression, sports-related neuropsychology

### **E. T. GUTY, G. A. THOMAS, K. RIEGLER, M. BRADSON, P. A. ARNETT. Improving Clinical Interpretation of Performance on a Neuropsychological Concussion Battery by Utilizing Premorbid IQ.**

**Objective:** Neuropsychological testing is often utilized as part of the multi-modal assessment of sports-related concussion (SRC). More recently baseline testing has no longer been considered mandatory for concussion care and instead, normative samples can be used for making determinations regarding an individual's cognitive functioning (McCrory et al., 2017). Previous work has attempted to clarify objective cut-offs to guide clinicians by developing a return-to-play (RTP) algorithm using base rates of impairment determined from normative neuropsychological data (Arnett, Meyer, Merritt, & Guty, 2016). Research also indicates that premorbid IQ impacts rate of impairment across neuropsychological domains (Karr, Garcia-Barrera, Holdnack, & Iverson, 2017). The goal of this study is to determine whether premorbid IQ is a relevant factor in assessing cognitive impairment on a concussion battery and whether it should be incorporated in an RTP algorithm.

**Participants and Methods:** 932 Division I student-athletes (698 males, 234 females) were evaluated at baseline on a concussion battery. Seventeen test indices from both computerized and paper-and-pencil tests were converted into standard scores using normative data, and participants' premorbid IQ was estimated by using the WTAR FSIQ. Individuals were grouped based on the quartiles of the sample into Low (below 100), Mid (100-107), and High (108 or above) IQ groups. A one-way ANOVA determined whether the three groups differed on the number of impaired (below 70) or borderline (below 78) scores across the test indices.

**Results:** The groups differed significantly on number of borderline scores ( $F(2,840) = 36.54, p < .001, h^2 = .08$ ). Individuals in the Low group ( $M = 2.11, SD = .12$ ) had more borderline scores than the Mid group ( $M = 1.08, SD = .08, p < .001, 95\% \text{ CI } [.69, 1.36]$ ) and the High group ( $M = .80, SD = .12, p < .001, 95\% \text{ CI } [.91, 1.71]$ ). The Mid and High groups showed no significant difference in number of borderline scores ( $p = .20$ ).

There was also a significant difference between groups on number of impaired scores ( $F(2,840) = 13.52, p < .001, h^2 = .03$ ). Individuals in the Low group ( $M = .85, SD = .07$ ) had more impaired scores than the Mid group ( $M = .50, SD = .05, p < .001, 95\% \text{ CI } [.15, .56]$ ) and the High group ( $M = .32, SD = .08, p < .001, 95\% \text{ CI } [.27, .77]$ ). The Mid and High groups showed no significant difference in number of impaired scores ( $p = .20$ ). Cutoffs for number of borderline and impaired scores for classifying recovery were also different between the three groups and will be discussed.

**Conclusions:** The results of this study indicate that individuals are likely to have different average rates of borderline and impaired scores based on their premorbid IQ. Such differences translate into different cutoffs needed to classify athletes as recovered or not recovered following

concussion. This work is critical to ensuring that the normative data used to make clinical decisions are accurate, so athletes are neither returned to play/school too early, nor held back too long.

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**Keywords:** assessment, cognitive functioning, normative data

**P. A. ARNETT, V. C. MERRITT, E. T. GUTY, K. RIEGLER, L. GREENBERG, G. THOMAS. Validity of Post-Concussion Only Algorithms in Collegiate Athletes Following Sports-Related Concussion.**

**Objective:** Comparing pre-injury baseline neuropsychological testing with post-concussion testing has become the standard in sports concussion management. However, limitations to this model have led to calls for the development of approaches that only require post-concussion testing. The present study tested evidence-based post-concussion algorithms using a hybrid neuropsychological test battery.

**Participants and Methods:** “Recovered” and “Not Recovered” groups of concussed collegiate athletes were identified using base rate of impairment algorithms (Arnett, Meyer, Merritt, & Guty, 2016). This yielded 145 Recovered and 27 Not Recovered athletes in each of two algorithms (one based on “borderline” scores, i.e., 1.5 SD or more below the mean of athletes at baseline, and one based on “impaired” scores, i.e., 2 SD or more below the mean), and 140 Recovered and 32 Not Recovered athletes based on the combined algorithm. Outcome variables included post-concussion symptom factor scores (ImPACT Post-Concussion Symptom Scale (PCSS)), and indices of cognitive variability (Intra-Individual Standard Deviation (ISD) and Maximum Discrepancy (MD) scores) across the 17 indices.

**Results:** Across algorithms, results consistently showed that, compared with the Recovered group, the Not Recovered group reported significantly greater PCSS symptoms overall and more cognitive variability. To illustrate, for the combined algorithm comparing the groups on the 5 PCSS factors, the multivariate  $F(5, 166) = 4.69, p < .001, \eta_p^2 = .12$ ; for the combined algorithm comparing the groups on the 2 cognitive variability factors, the multivariate  $F(2, 169) = 25.34, p < .001, \eta_p^2 = .23$ . Univariate tests showed that the Recovered group consistently demonstrated significantly ( $p < .05$ ) higher Headache, Sleep, and Cognitive scores on PCSS factor scores; they also showed significantly ( $p < .05$ ) greater ISD and MD cognitive variability scores. Inconsistent with predictions, the groups did not differ significantly on the Affective PCSS factor; results for the Physical factor were mixed. Sex differences were also observed, with more than twice the proportion of females falling in the Not Recovered compared with the Recovered groups; these sex differences did not result in any meaningful changes in the group results when controlled for statistically.

**Conclusion:** Our study provides evidence for the validity of base rate of impairment algorithms, derived from a hybrid neuropsychological battery, for collegiate athletes post-concussion who have not had baseline testing. Applications of these algorithms to the return-to-play decision making process will be discussed.

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**Keywords:** concussion, sports-related neuropsychology, assessment

**M. SULLAN, L. CROCKER, K. R. THOMAS, H. J. ORFF, D. K. DAVEY, S. JURICK, E. W. TWAMLEY, S. NORMAN, D. M. SCHIEHSER, R. AUPPERLE, A. JAK. Sleep Quality in Veterans with Comorbid PTSD and TBI: Impact on Recovery during PTSD Treatment.**

**Objective:** Poor sleep quality is well-established as a common and debilitating problem in Veterans with posttraumatic stress disorder (PTSD) and history of traumatic brain injury (TBI). However, the impact of sleep quality on recovery following different types of interventions is not well understood in Veterans with comorbid PTSD/TBI. This study aimed to better understand if: 1) trauma-focused PTSD treatment improved sleep over time and 2) baseline sleep quality moderated psychological, neurobehavioral, and cognitive treatment outcomes.

**Participants and Methods:** Data were taken from a randomized controlled trial that compared cognitive processing therapy (CPT) to a combined CPT and cognitive rehabilitation (SMART-CPT) treatment in Veterans with PTSD/TBI. One hundred participants with PTSD and history of mild-moderate TBI were included. Participants completed the PTSD Checklist, Specific Event (PCL-S), Neurobehavioral Symptom Inventory (NSI), Pittsburgh Sleep Quality Index (PSQI), Beck Depression Inventory-II (BDI-II), and neuropsychological (NP) testing at baseline, posttreatment (approximately 13 weeks), and 3 months posttreatment. Sleep and fatigue items were removed from the PCL-S, BDI-II, and NSI for analyses. NP measures used for analyses were selected to reflect the cognitive complaint items on the NSI and included: the Wechsler Adult Intelligence Scale, Fourth Edition Digit Span (WAIS-4; concentration), California Verbal Learning Test, 2nd Edition (CVLT-II; forgetfulness), WAIS-4 Processing Speed Index (slowed thinking), and Wisconsin Card Sorting Test-64 (WCST-64; problem-solving/decision-making). Seventeen participants failed 2 out of 3 performance validity measures and were excluded from analyses involving cognitive outcomes. Mixed effects models were used to examine whether: 1) sleep quality significantly improved over the course of treatment and 2) whether baseline sleep scores moderated changes in psychological (PCL-S, BDI-II), neurobehavioral (NSI total and NSI cognitive subscale), or NP outcomes (WAIS-IV Digit Span, CVLT-II, WAIS-IV PSI, WCST-64). Due to concern for practice effects, only 3-way interactions (time x treatment condition x baseline sleep) were examined for cognitive outcomes.

**Results:** Sleep did not significantly improve with treatment. Baseline sleep quality predicted both linear ( $b=.052$ ,  $se=.022$ ,  $p=.019$ ,  $r=.314$ ) and quadratic ( $b=-.005$ ,  $se=.002$ ,  $p=.004$ ,  $r=-.135$ ) changes on the PCL-S such that worse sleep (i.e., higher PSQI scores) was associated with less improvement in PTSD symptoms. Sleep also moderated change in cognitive complaints on the NSI, such that worse sleep at baseline was associated with less improvement in cognitive complaints ( $b=.014$ ,  $se=.006$ ,  $p=.017$ ,  $r=.269$ ), regardless of treatment condition. There was no significant relationship between sleep and change in BDI-II symptom severity or NSI total score. There were no significant time x treatment condition x sleep interactions for any of the cognitive measures.

**Conclusions:** Taken together, these results suggest that more targeted therapies are needed to better address sleep quality in Veterans with PTSD/TBI. Because worse baseline sleep quality limited PTSD symptom response, Veterans with PTSD/TBI and poor sleep may benefit from initial sessions focusing specifically on improving sleep quality prior to starting or during trauma-focused PTSD treatment. Although sleep quality did not significantly impact objective neuropsychological functioning, improvements in sleep may help to alleviate subjective cognitive complaints in this population.

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**Keywords:** mild traumatic brain injury, sleep, post-traumatic stress disorder

**J. EPPIG, H. RAU, H. LIU, M. OTERO, E. PESKIND, K. PAGULAYAN. Latent Neuropsychological Classes in Veterans with a History of Repetitive mTBI: Associations with Risk and Resilience.**

**Objective:** Performance-based neuropsychological studies indicate rapid return to baseline functioning post-mild Traumatic Brain Injury (mTBI). However, many individuals report persistent cognitive difficulties and group-based methodological approaches may mask unique patterns of recovery. Therefore, factor mixture modeling (FMM) was used to identify unique neuropsychological subtypes following mTBI and explore associations with risk and resilience factors before and during deployment.

**Participants and Methods:** 79 OEF/OIF/OND-era Veterans with repeated mTBI completed neuropsychological testing. Confirmatory factor analysis (CFA) was used to derive five cognitive domains in areas often impacted by mTBI: working memory, processing speed, executive functions, verbal memory, and visual memory. Latent class analysis (LCA) was employed on resultant factor scores to identify unique neuropsychological mTBI classes.

**Results:** Fit indices supported a 5-factor CFA and 3-class model consisting of above average (n=28), average (n=25), and below average (n=26) performances across cognitive domains. Classes differed on racial composition, subjective cognitive concerns, perceived stress, social support, and perceived quality of life.

**Conclusions:** FMM supports neuropsychological subtypes post-mTBI with subtle, overall cognitive differences, which may in turn contribute to discrepancies in perceived quality of life. Social support and perceived stress pre-/during deployment, but not current mental health, appear to be important risk and resilience factors that differentiate classes. Future research should explore how class membership in larger samples interacts with risk and resilience factors to impact mTBI outcomes and treatment response.

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**Keywords:** mild traumatic brain injury

**R. E. MIS, T. ANDO, C. BROUGH, L. J. HOFFMAN, T. YAMAGUCHI, I. R. OLSON, T. GIOVANNETTI. Relations Among Executive Functioning, Lifetime Concussion History, and Performance on a Virtual Reality Assessment of Everyday Functioning in Young Adult Athletes.**

**Objective:** In older adults, executive functions (EF) are strongly associated with the ability to complete activities of daily living, with worse EF abilities predictive of future decline in everyday functioning. However, the relation of EF to everyday functioning in younger adults with neurological conditions subtly affecting EF, such as concussion, is less well studied. To address this gap, we examined associations between a computerized measure of everyday task performance and tests of specific EF abilities and processing speed to explicate their link to everyday function in a sample of young adult (collegiate) athletes with and without a lifetime history of concussion.

**Participants and Methods:** 96 young adult athletes with and without a lifetime history of concussion completed the lunch subtask of the Virtual Kitchen Challenge (VKC), a non-

immersive virtual-reality task requiring the manipulation of virtual objects using a touch screen to pack a lunch box with a sandwich, snack, and drink. VKC performance scores reflected completion time and efficiency (i.e., percent of total time spent on the screen, interactions with target objects). Cognitive testing included measures of inhibition (Flanker), shifting (Set-Shifting), and updating (N-back) from the NIH-EXAMINER as well as processing speed (Digit Symbol Modality Test). Correlations between cognitive tests and VKC measures were performed, and t-tests examined the relation between history of concussion and cognitive and VKC performance.

**Results:** Overall, significant correlations indicated better cognitive performance was associated with faster and more efficient VKC performance. Specifically, VKC completion time correlated with processing speed and shifting, number of target interactions with shifting and updating, and percent time onscreen with inhibition, shifting, and updating ( $r's > .2$ ,  $p < .05$  for all). Only flanker performance differed by concussive status, with participants with a history of concussion displaying worse inhibition scores [ $t(91) = 2.0$ ,  $p = .05$ ].

**Conclusions:** Performance on our virtual-reality task of everyday functioning is sensitive to subtle variations in EF occurring in young adults with and without a lifetime history of concussion. Varying VKC outcome measures (i.e., speed v. efficiency) relate to different aspects of EF and/or processing speed, suggesting that a multifactorial approach to everyday functioning is necessary to elucidate the cognitive mechanisms underlying this process. Future studies should examine everyday functioning measures dependent on inhibition to identify performance measures potentially affected by concussion history.

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**Keywords:** computerized neuropsychological testing, concussion, everyday functioning

### **L. T. WHITTINGTON, B. MAKWANA, J. STEWART-WILLIS, Z. PROCTOR-WEBER.** **Number of mTBI Events and Reported Aggression and Symptoms in a Veteran Sample.**

**Objective:** Cognitive impairment, increased aggression, and decreased mood may present following an mTBI, and possibly compound with the occurrence of multiple mTBIs. Limited studies are available regarding the specific association between mTBIs and aggression, including factors that may exacerbate that relationship, including PTSD, which is commonly diagnosed when Veterans transition from military service to civilian life. The present study hypothesized that greater levels of impulsivity, depression, anxiety, aggression, and post-concussive neurobehavioral symptoms would be associated with higher number of reported mTBIs, while lower levels of cognitive flexibility would be associated with higher number of reported mTBIs.

**Participants and Methods:** Participants included 153 male (88%) and female, primarily Caucasian (73%), Veterans, ( $m_{\text{education}} = 13$  years), ages 18-59, who successfully completed neuropsychological assessment at the Bay Pines VAHCS. The study included care-seeking Veterans, who underwent a comprehensive neuropsychological evaluation, six or more months post-injury with documented mTBI in their medical record. Veterans who sustained moderate or severe TBI, have a major neurocognitive disorder, or serious mental illness diagnosis were excluded from this study. Descriptive, followed by Factorial, ANOVAs with Bonferroni correction were conducted. Individuals with only one reported mTBI ( $n = 61$ ) were compared to those reporting a history of more than one and up to four mTBIs ( $n = 92$ ), as well as those with a current diagnosis of PTSD ( $n = 79$ ) and those without ( $n = 74$ ), on reported aggression and

depressive, anxiety and neurobehavioral symptoms, as well as impulsivity and cognitive flexibility.

**Results:** There was a main effect for the presence of PTSD and higher levels of reported aggression  $F(3, 87) = 10.75, p < .01$ , depression  $F(3, 140) = 12.46, p < .01$ , and neurobehavioral symptoms  $F(3, 125) = 10.69, p < .01$ . There was also an interaction effect indicating that the PTSD effect on aggression was greater in the one concussion group than in those reporting multiple concussions. There were no significant main or interaction effects on anxiety, impulsivity, or cognitive flexibility.

**Conclusions:** Findings revealed no significant differences between Veterans with a history of one mTBI and those with multiple mTBIs on levels of impulsivity, depressive and anxiety symptoms, aggression, and post-concussive (PC) neurobehavioral symptoms. It is possible a greater number of concussions may be required to have a meaningful impact on these variables or, perhaps, examining length of time occurring between concussions may offer additional information. Consistent with previous literature, Veterans with a diagnosis of PTSD endorsed greater levels of aggression, depression, and PC neurobehavioral symptoms than those without. Interestingly though, a diagnosis of PTSD was related to greater reports of aggression in those with a history of only one mTBI when compared to those with multiple mTBIs. Findings highlight the importance of treatment targeting PTSD in the mTBI population, specifically following an initial mTBI, as a means to decrease aggression, depression, and PC neurobehavioral symptoms. Impulsivity and cognitive flexibility did not differ between either group, concussion or PTSD, likely due to smaller sample size for these variables, and remains a limitation of this study.

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**Keywords:** mild traumatic brain injury, aggression, post-traumatic stress disorder

#### **D. HUBER, T. GIOVANNETTI, K. HACKETT, R. E. MIS, S. M. SIMONE, M. B. TASSONI. Variability in the Approach to Diagnosis, Prognosis, and Recommendations for Concussion Among Clinical Providers.**

**Objective:** Over the past decade, the number of people diagnosed with concussion has increased dramatically, yet there is considerable confusion regarding the definition and course of concussion in the popular press and public. The goal of this study was to determine whether similar confusion is present among clinicians. We sought to document current clinical practices regarding concussion diagnosis and clinical care.

**Participants and Methods:** Seventy-nine clinicians completed an online survey between October 2019 and May 2020. Of these respondents, 60 clinicians (50 neuropsychologists, 3 neurologists, 3 psychiatrists, 2 orthopedists, and 2 others) reported diagnosing concussion in their daily practice.

**Results:** In response to questions about diagnosing concussion, the diagnostic criteria used by respondents varied widely, with 21.7% reporting using no formal criteria, 26.7% reporting using the American Congress of Rehabilitation Medicine criteria, 20.0% using the Veterans Affairs/Department of Defense criteria, and 11.7% reporting using ICD-10 criteria. Further, clinicians reported relying on a wide range of symptoms when diagnosing concussion, rating loss of consciousness, altered mental state, posttraumatic amnesia, and positive findings on neuroimaging as most important for determining a positive diagnosis. There was similar variability on questions concerning concussion prognosis, with 26.7% of respondents reporting

that they inform clients to expect recovery in less than 1 week, 28.3% suggesting recovery in about 1-2 weeks, 18.3% suggesting recovery in 2-4 weeks, and 13.3% reporting that they inform clients to expect recovery in over 30 days. Ten percent of respondents reported that they did not share the duration for expected recovery with clients. Regarding recommendations for concussion management, most clinicians reported recommending gradual return to activity (88.3%); however, 8.3% of respondents reported recommending resting for several days prior to resuming activity, which has been associated with prolonged symptoms of post-concussion syndrome. In addition, three clinicians reported that their recommendations to clients were based on concussion severity, despite the fact that concussions are, by definition, mild injuries. Moreover, 36.7% of respondents reported informing concussion clients to avoid mental stimulation during recovery, such as bright lights, computer screens, and video games, which has not been shown to be effective in reducing recovery time.

**Conclusions:** In sum, despite the increase in the rate of concussion diagnoses, there is little agreement in the fundamental diagnostic criteria and recommendations for concussion management among clinicians who report diagnosing concussion in their clinical practice. These findings indicate the need for published standards and widely disseminated guidelines for clinicians regarding the diagnosis of concussion, concussion prognosis, and empirically supported interventions.

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**Keywords:** concussion, mild traumatic brain injury, transdisciplinary research

### **G. L. IVERSON, R. VAN PATTEN, D. P. TERRY, C. R. LEVI, A. J. GARDNER. Predictors and Correlates of Depression in Retired Professional Rugby League Players.**

**Objective.** Rugby league is a high-intensity collision sport involving numerous tackles per game and a high rate of concussions. There is concern in the medical and scientific community that a long career participating in contact and collision sports, especially at the professional level, might be associated with later in life mental health problems such as depression. We examined predictors and correlates of depression in retired National Rugby League (NRL) players. We hypothesized that depression would be positively associated with number of prior concussions, years playing professional rugby, and chronic pain. We also hypothesized that depression would be negatively associated with resilience. In a multivariate model, we hypothesized that resilience and chronic pain would be the strongest independent predictors of depression.

**Participants and Methods.** Participants were 143 retired male NRL players in Australia. Four questionnaires were used in this study: the Depression, Anxiety, Stress Scale 21-item (DASS-21) Connor-Davidson Resilience Scale (CD-RISC), Epworth Sleepiness Scale, and the Brief Pain Inventory (BPI). Spearman correlations were used to examine the association between variables because several variables were non-normally distributed. A multiple regression model was conducted to predict the DASS depression score, with age, number of prior concussions, years playing professional rugby, resilience, daytime sleepiness, and life interference due to pain as predictors.

**Results.** The mean age of the sample was 52.6 years (SD=13.8; range=30-89) and their mean years of education completed was 11.9 (SD=2.6; range=7-18). The retired players reported a median of 15.0 total lifetime concussions (M=28.2, SD=36.4, range=0-200). Regarding current psychological distress on the DASS, 29.1% of the retired players reported at least mild depression, 19.2% reported at least mild anxiety, and 27.0% reported at least mild stress. The

breakdown of participants by DASS depression classification ranges was as follows: Broadly Normal=70.9%, Mild=14.9%, Moderate=9.9%, and Severe/Extremely Severe=4.3%. Depression was positively correlated with both anxiety ( $r=.54$ ) and stress scores ( $r=.58$ ). There was no significant correlation between lifetime history of concussions and depression ( $r=.14$ ). There was a small *negative* correlation between years of exposure to professional sports and depression ( $r=-.17$ ). The resilience was negatively correlated with depression ( $r=-.53$ ). Pain severity was not significantly correlated with depression ( $r=.14$ ). There was a small correlation between life interference due to pain and depression ( $r=.20$ ). The multiple regression model explained 35% of the variance in the DASS depression variable, and the only significant predictors were resilience ( $\beta=-0.51$ ,  $t=-6.97$ ,  $p<.001$ ) and life interference due to pain ( $\beta=0.21$ ,  $t=2.83$ ,  $p<.01$ ).

**Conclusions.** This is the first large study of depression in retired professional rugby league players. The proportion of the sample endorsing at least mild depression was 29.1%. Depression was not related to lifetime history of concussions. Moreover, a longer professional career was not associated with increased risk for depression. In contrast, correlates of depression in this sample were anxiety, stress, life interference due to chronic pain, and resilience, with pain interference and resilience as the only predictors of depression in a multivariate model.

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**Keywords:** aging disorders, concussion, depression

**J. N. HERSHAW, L. M. FRENCH, P. YEH, T. A. BRICKELL, J. OLLINGER, S. M. LIPPA, R. T. LANGE. Influence of Repetitive Blast Exposure on White Matter Integrity following Uncomplicated Mild Traumatic Brain Injury.**

**Objective:** Recent studies have found that a high number of lifetime blast exposures are associated with increased rates of neurological complaints and self-reported neurobehavioral symptoms following traumatic brain injury (TBI). However, few studies have examined the influence of lifetime blast exposures on white matter integrity. This study examines the influence of the number of lifetime blast exposures on white matter integrity in a sample of service members and veterans (SMVs) following uncomplicated mild TBI.

**Participants and Methods:** Participants were 129 SMVs who had sustained an uncomplicated mild TBI at least one year prior to assessment (time since injury:  $M=9.3$  years,  $SD=7.6$ ) and 25 non-injured controls with no blast exposure, prospectively enrolled from the Walter Reed National Military Medical Center (Bethesda, MD). Using Diffusion Tensor Imaging (DTI), measures of fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD), and radial diffusivity (RD) were generated across 71 regions of interest (ROIs). Number of lifetime blast exposures in the mild TBI group were categorized into three sub-groups: zero, low (1-10), or high ( $\geq 11$ ) blasts ( $n = 15, 58, \text{ and } 56$ , respectively). The number of atypical ROIs for FA, MD, AD, and RD was computed by totaling the number of ROIs with DTI measures  $\pm 1$ SD from the mean of the control group. In the mild TBI group, the number of atypical ROIs for FA, MD, AD, and RD measures were submitted to univariate ANCOVAs with age as a covariate and number of lifetime blasts as the between-subjects factor (zero, low, and high blasts). The cumulative proportions of atypical ROIs and associated Cohen's H values were also computed across the three blast groups.

**Results:** In the mild TBI group, there were no significant effects for the number of lifetime blasts on the number of atypical ROIs for FA, MD, AD, or RD,  $p > .23$  and  $\eta_p^2 < 0.21$  for all

comparisons. When comparing the cumulative proportion of the number of atypical ROIs across the three blast groups using multiple criteria (e.g.,  $\geq 10$ ,  $\geq 20$ ,  $\geq 30$ , etc), there were no group differences for MD and RD. However, for FA and AD, a greater proportion of the Zero Blast group had a high number of atypical ROIs compared to the High Blast group for a handful of comparisons (e.g.,  $\geq 40$  atypical AD scores: No Blast=46.7%, High Blast=23.5%,  $H=.49$ ). However, these differences were uncommon and not considered clinically meaningful.

**Conclusions:** These results suggest that there was no evidence for cumulative negative effects of repetitive blast exposures over the lifespan on white matter integrity. This analysis did not assess whether repeated blasts has a cumulative effect on the magnitude of within-tract white matter alterations, but it failed to demonstrate that lifetime blast exposure has a cumulative effect on the number of affected neural pathways.

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**Keywords:** neuroimaging: structural connectivity, traumatic brain injury

### **A. M. BRYANT, M. A. MCCREA, L. D. NELSON. Perception of Peripheral Injuries in Patients with Mild Traumatic Brain Injury and Its Relationship to Outcomes.**

**Objective:** Mild traumatic brain injuries (mTBI) in the civilian population rarely occur with isolated injury to the head. Frequently, individuals with mTBI experience concurrent peripheral injuries, which can impact functional outcomes and overall quality of life. However, the perception and relative importance of such peripheral injuries to patients is rarely examined. The Structured Interview of TBI Symptoms (SITS) is a novel interview that allows patients to identify TBI-related and non-TBI related symptoms, and to indicate which set of symptoms are more bothersome. We examined the occurrence of self-reported peripheral symptoms in our sample of mTBI patients. Further, we explored the relationships between perceived most bothersome source of symptoms (i.e., mTBI or peripheral injury) and mTBI symptom endorsement, quality of life, and functional status.

**Participants and Methods:** Level I trauma center patients with mTBI ( $N=74$ ) were recruited within 2 weeks of injury and assessed at 3 months post-TBI. The prevalence of reporting more bothersome mTBI versus peripheral injury symptoms was computed. Groups with worse mTBI (mTBI) or worse peripheral injury (PER) were compared on acute markers injury severity (e.g., acute 3-item Rivermead Post Concussion Symptoms Questionnaire [RPQ-3] score; Injury Severity Score (ISS), Abbreviated Injury Scale for head and neck (AIS-HN) and worst peripheral injury [AIS-P]) and 3-month injury-related symptoms (SITS), quality of life (Quality of Life after Brain Injury [QOLIBRI]; Trauma Quality of Life [T-QOL]), and functional status (Glasgow Outcome Scale Extended [GOSE]; Functional Status Examination [FSE]).

**Results:** Ninety-one percent ( $n=67$ ) of the sample reported additional non-mTBI related injuries. Of these, 46% ( $n=31$ ) reported to be more bothered by their mTBI symptoms (mTBI), whereas 54% ( $n=36$ ) reported their non-TBI injuries were more bothersome (PER). These groups were statistically equivalent in acute markers of mTBI severity (e.g., acute symptom severity, loss of consciousness, posttraumatic amnesia, AIS-HN, but the PER group had more severe AIS-P scores. There were no differences in age, race, education, or estimated premorbid abilities between groups (all  $p$ 's  $> .05$ ). The TBI group had significantly higher RPQ-3 scores ( $p=.015$ ). Pain was the top ranked peripheral symptom across the entire sample, with similar proportions of individuals endorsing pain in the TBI (68%) and PER (72%) groups. Individuals who viewed their TBI symptoms to be more bothersome were more often female (45% vs. 72%) and were

more likely to endorse mTBI symptoms, report lower quality of life, and have lower functional status at 3-month follow-up.

**Conclusions:** About half of level I trauma center patients treated for mTBI may be more concerned with their peripheral injuries than their TBI-related symptoms. Despite similar acute signs of mTBI severity and less severe peripheral injury symptoms, mTBI patients who are more bothered by their mTBI symptoms report more TBI symptoms, lower quality of life, and greater functional impairment compared to individuals who are more concerned with their peripheral injuries. Future research should explore additional factors such as the role of gender and other premorbid risk factors for mTBI symptoms on the relationship between different types of traumatic injuries and outcomes.

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**Keywords:** outcome, assessment, concussion

### **L. J. HOFFMAN, R. E. MIS, T. GIOVANNETTI, I. R. OLSON. Concussion Status, but Not Fronto-Striatal White Matter, Predicts Reward-Based Impulsivity.**

**INTRODUCTION:** Recent studies have documented volumetric changes in striatal architecture following mild TBI (mTBI), suggesting that insult to reward circuitry may underpin increased susceptibility to impulsivity post-TBI. As of late, the link between changes in impulsive behavior following mTBI is less well understood. Moreover, the role of striatal white matter in modulating these changes in impulse-control following concussion is uncharted. In the present study we seek to delineate whether reward-sensitivity and motor impulsivity differ based on concussion status, and whether these forms of disinhibition have dissociable representations in the brain. Furthermore, we seek to replicate and extend the findings of Hampton et al. (2017), predicting that bilateral dorsal striatal (dSTR) connections to the supplementary motor area (SMA) will predict motor impulsivity, while bilateral ventral striatal (vSTR) connections to the vmPFC will predict reward-seeking behavior.

**METHODS:** 90 collegiate athletes underwent a hybrid diffusion imaging (HYDI) scan, and completed delayed discounting and go/no-go tasks (13 excluded for excessive motion or missing data). Reward-based impulsivity (log-k) was assessed in the delayed discounting task by giving subjects a hypothetical choice as to whether they would prefer to forgo an immediate monetary reward in exchange for a greater financial payout at a later date. Motor impulsivity was assessed using the go/no-go task by evaluating subjects' ability to suppress a prepotent response when presented with a stop-signal (stop-signal reaction time/SSRT). Subsequently, bilateral fronto-striatal streamlines were calculated by performing probabilistic tractography. Finally, concussion status was determined with self-report using the OSU-TBI-ID.

**Results:** Four 3-step hierarchical multiple linear regressions were computed - two for the discount-rate (vmPFC) model, and two for the SSRT (SMA) model. At level 1 of the former models log-k was estimated based on control variables - age and streamlines for the left or right dSTR to vmPFC. At level 2 concussion status was added. Finally, at level 3, left or right vSTR to vmPFC streamlines were added. For the motor impulsivity models vSTR to SMA streamlines were entered at level 1, as this was the control tract, while concussion status was included at level 2. From there, streamlines for the tract of interest (dSTR to SMA) were added at level 3. Both the left and right vmPFC models were significant at all levels (right:  $F[4,68]=3.594$ ,  $p<.05$ , adjusted- $R^2=0.126$ ; left:  $F[4,68]=2.726$ ,  $p<.05$ , adjusted- $R^2=0.088$ ), though age and concussion status were the only significant predictors of log-k. For these models, there were significant

changes between levels 1 and 2 only. Neither SMA models were significant at any level, though the right SMA model showed a trending significant change between levels 1 and 2 with concussion status being a trending predictor of SSRT.

**Conclusions:** While concussion status predicts reward-based impulsivity, fronto-striatal connections do not seem to underlie differences in participants' reward sensitivity. Additional DTI analysis of the more distributed reward-network should be examined to disentangle the neurological etiology of this finding. Moreover, SSRT should be further analyzed in relation to the frontal aslant tracts (FAT).

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**Keywords:** concussion, executive functions, neuroimaging: structural connectivity

**M. S. SAKAMOTO, L. DELANO-WOOD, S. F. SORG, D. M. SCHIEHSER, V. C. MERRITT. Greater Neuropsychological Intra-Individual Variability Predicts Unemployment Status in Veterans with a History of Remote Mild TBI.**

**Objective:** Prior work has shown that history of severe traumatic brain injury (TBI) is associated with high rates of unemployment, but less is known about how milder forms of TBI may interfere with working status. Additionally, the relationship between cognitive functioning and employment status in Veterans with mild TBI (mTBI) histories is unclear. Therefore, in a well-characterized sample of Veterans with mTBI histories, we examined the association between employment status and neuropsychological functioning reflected by (a) standard, traditional mean cognitive performance as well as (b) intra-individual variability (IIV) across tests.

**Participants and Methods:** 75 Iraq and Afghanistan-era Veterans (37 employed, 38 unemployed) with a history of remote mTBI completed a clinical interview and a comprehensive neuropsychological assessment. All participants performed adequately on performance validity tests. On average, participants were 32.88 years old ( $SD = 7.11$ ) and were evaluated 66.73 months ( $SD = 33.96$ ) after their most recent mTBI. Primary outcomes of interest included mean cognitive composite test scores and IIV scores on tasks of memory (8 items), attention/processing speed (7 items), and executive functioning (10 items). Both mean performance and IIV scores were calculated using 25 norm-referenced variables for all participants.

**Results:** Independent samples t-tests demonstrated that employed and unemployed groups were equivalent with regard to sociodemographic characteristics as well as neurobehavioral and posttraumatic stress symptoms. While there were no significant group differences across the mean cognitive composite scores representing memory, attention/processing speed, and executive functioning (all  $p$ 's  $> .05$ ), a significant group difference was observed with respect to the IIV-memory score, with unemployed Veterans demonstrating greater variability when compared to employed Veterans ( $t(73) = 2.16, p = .034, d = 0.50$ ). No significant differences were observed for the attention/processing speed ( $p = .933$ ) or executive function ( $p = .188$ ) IIV indices. Additionally, logistic regression models showed that mean cognitive performance was not predictive of employment status; however, IIV indices were significantly predictive of employment status ( $\chi^2(3, N = 75) = 7.88, p = .048$ ), accounting for 13% of the variance in the model (overall classification = 62.7%, employed = 62.2%, and unemployed = 63.2%). Specifically, greater memory-IIV was significantly associated with being unemployed ( $b = -.16, SE = 0.07, p = .020, Exp(B) = 0.85, 95\% CI [0.74, 0.98]$ ).

**Conclusions:** Although mean cognitive performance was not associated with employment status following mTBI, IIV indices were significantly associated with employment status. In particular, memory-IIV was especially important in the prediction of unemployment within our sample of Veterans with mTBI histories. These findings build upon prior work showing that indices reflecting variability in cognitive test performance more sensitively predict poorer outcomes in the context of head trauma. Furthermore, they contribute to the notion that IIV may provide a more nuanced representation of cognitive functioning that is more sensitive to capturing the subtle impairments often evidenced in this population. Future studies should consider the relationship between elevated IIV and functional outcomes to better inform clinical services for this at-risk population.

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**Keywords:** mild traumatic brain injury, neuropsychological assessment, quality of life

**V. C. MERRITT, M. S. SAKAMOTO, S. F. SORG, D. M. SCHIEHSER, L. DELANO-WOOD. Elevated Neuropsychological Intra-Individual Variability Predicts Poorer Health-Related Quality of Life in Military Veterans with a Remote History of Mild Traumatic Brain Injury.**

**Objective:** It has been well documented that Veterans with a history of mild traumatic brain injury (mTBI) demonstrate reduced health-related quality of life (HR-QOL) following injury. A number of factors have been shown to be associated with poorer HR-QOL in this population, particularly comorbid symptoms of posttraumatic stress disorder (PTSD). In contrast, studies evaluating the association between cognitive functioning and HR-QOL have yielded inconsistent findings. The purpose of this study was to examine the association between cognitive functioning and HR-QOL using two methods to assess cognition: (1) mean performance on cognitive composite scores and (2) across-test intra-individual variability (IIV).

**Participants and Methods:** Veterans ( $N=73$ ; 85% male; age:  $M=32.47$ ,  $SD=6.69$ ) with a history of mTBI completed neuropsychological testing, on average, 7 years following their most recent mTBI. In total, 25 variables were selected from the neuropsychological assessment and were converted from raw to norm-referenced standard scores. Three cognitive composite scores were computed to represent mean performance, including memory (8 items), executive functioning (EF; 10 items), and attention/processing speed (A/PS; 7 items). Three IIV indices were also calculated reflecting degree of dispersion across the same cognitive domains: IIV-memory, IIV-EF, and IIV-A/PS. The PTSD Checklist-Military Version (PCL-M) was used to assess current PTSD symptoms and the WHOQOL-BREF was used to assess HR-QOL. For the purpose of this study, the Physical Health domain from the WHOQOL-BREF was used as the primary HR-QOL outcome. Hierarchical multiple linear regressions predicting HR-QOL included PTSD symptoms in the first block and cognitive scores in the second block; mean cognitive performance and IIV indices were evaluated in separate regressions.

**Results:** The hierarchical multiple regression revealed that PTSD symptoms significantly contributed to the model ( $F = 10.32$ ,  $p = .002$ ) and accounted for roughly 13% of the variance in HR-QOL. Although the overall model remained significant when the three mean cognitive composite scores were added ( $F = 3.44$ ,  $p = .013$ ), the change in  $R^2$  was not significant ( $p = .343$ ). In contrast, with PTSD symptoms entered in the first block and the three IIV indices entered in the second block, the overall model was significantly associated with HR-QOL ( $F = 5.36$ ,  $p = .001$ ) and the IIV indices explained an additional 11% of the variance in HR-QOL ( $p =$

.023). Examination of the standardized coefficients showed that the IIV-A/PS index was uniquely associated HR-QOL, such that higher IIV-A/PS scores significantly predicted poorer HR-QOL ( $B = -.30, p = .005$ ).

**Conclusions:** In Veterans with remote mTBI histories, greater cognitive IIV significantly contributes to poorer HR-QOL, even after accounting for PTSD symptom severity. Notably, greater variability across measures of attention/processing speed was especially associated with poorer HR-QOL across the sample. These findings add to a growing body of literature highlighting that, compared to traditional mean cognitive performance scores, measures of IIV represent more robust and sensitive indicators of clinical outcomes following mTBI. Taken together, our results suggest that evaluating IIV indices may help identify Veterans at risk for poor HR-QOL following mTBI, and they may help clinicians tailor treatments to optimize clinical outcomes in this population.

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**Keywords:** quality of life, mild traumatic brain injury, cognitive functioning

### **B. J. CARONE, V. C. MERRITT, S. JURICK, A. JAK. Effects of Major Depressive Disorder and Multiple Mild Traumatic Brain Injuries on Cognitive Functioning and Neurobehavioral Symptoms in Combat-Exposed Veterans.**

**Objective:** Prior research has established that depression can influence both objective cognitive performance and subjective ratings of neurobehavioral symptoms following mild traumatic brain injury (mTBI). However, the relationship between depression and multiple mTBIs has not been readily examined, especially in the context of military-related mTBI. The current study therefore investigated the effects of major depressive disorder (MDD) and multiple mTBIs on objective cognitive functioning and neurobehavioral symptom reporting in a sample of combat-exposed Veterans.

**Participants and Methods:** In this cross-sectional study, 68 combat-exposed Iraq and Afghanistan-era Veterans (91% male; age:  $M = 34.15, SD = 6.48$ ) were divided into four groups based on MDD status (MDD absent [MDD-] vs. MDD present [MDD+]) and mTBI history as follows: MDD- and 0 mTBIs ( $n = 12$ ), MDD+ and 0 mTBIs ( $n = 19$ ), MDD+ and 1-2 mTBIs ( $n = 19$ ), and MDD+ and 3+ mTBIs ( $n = 18$ ). Participants with a history of mTBI were evaluated, on average, approximately eight years following their most recent mTBI. Participants completed a comprehensive neuropsychological assessment as well as the Rivermead Post-Concussion Symptoms Questionnaire (RPQ). Primary outcomes from the neuropsychological assessment included mean cognitive composite scores reflecting memory, executive functioning, and attention/processing speed, and primary outcomes from the RPQ included mood/cognition, general somatic, and visual somatic symptom clusters. As part of the RPQ, participants were also asked questions pertaining to perceived changes in their ability to participate and engage in work-related and social activities; a composite score was computed from these items reflecting participants' perceived change in lifestyle.

**Results:** Multivariate analyses of covariance (MANCOVAs) adjusting for PTSD symptoms revealed no significant differences between groups on all neuropsychological composite scores (all  $p$ 's  $> .05$ ;  $\eta_p^2 = .01$  to  $.04$ ). However, significant group differences were found on all neurobehavioral symptom clusters including mood/cognition ( $p = .001$ ;  $\eta_p^2 = .23$ ), general somatic ( $p = .014$ ;  $\eta_p^2 = .16$ ), and visual somatic ( $p < .001$ ;  $\eta_p^2 = .27$ ) symptoms. Pairwise comparisons generally showed a progressive increase in self-reported neurobehavioral symptoms

across groups, with the MDD- and 0 mTBIs and MDD+ and 0 mTBIs groups endorsing the least severe symptoms, followed by the MDD+ and 1-2 mTBIs group and MDD+ and 3+ mTBIs group each endorsing progressively more severe symptoms. Finally, to evaluate perceived lifestyle change across groups, an analysis of variance (ANOVA) was conducted and revealed a significant effect of group ( $p < .001$ ;  $\eta_p^2 = .26$ ), such that the MDD+ and 3+ mTBI group reported the most severe lifestyle changes; however, when PTSD symptoms were added as a covariate, this finding was notably attenuated ( $p = .051$ ;  $\eta_p^2 = .12$ ).

**Conclusion:** Our findings showed that independent of PTSD symptoms, the combination of MDD and multiple (3+) mTBIs is associated with elevated neurobehavioral symptoms but not objective cognitive performance in combat-exposed Veterans. These findings advance understanding of the long-term consequences of depression and repetitive mTBI in this population and suggest that Veterans with MDD and a history of repetitive mTBI may especially benefit from combined interventions that target mood and neurobehavioral symptoms.

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**Keywords:** depression, traumatic brain injury, neuropsychological outcome

### **A. J. GARDNER, R. VAN PATTEN, D. P. TERRY, C. R. LEVI, G. L. IVERSON. Predictors and Correlates of Perceived Cognitive Impairment in Retired Professional Rugby League Players.**

**Objective.** Rugby League is a full-contact tackle sport. Blows to the head during tackles are common, and the sport has a fairly high rate of concussion. Participation in other full-contact sports such as American football has been considered a risk factor for cognitive, neurological, and psychiatric sequelae later in life. However, little research has addressed the brain health of retired professional rugby league players. We examined predictors and correlates of perceived cognitive decline in retired National Rugby League (NRL) players. We hypothesized that perceived cognitive decline would be positively associated with lifetime history of concussions, duration of contact sport exposure, and current depressive symptoms. We also hypothesized that perceived cognitive decline would be negatively associated with resilience and unrelated to objective cognitive test performance. Finally, we hypothesized that current depressive symptoms would be the strongest predictor of perceived cognitive decline in a multivariate model.

**Participants and Methods.** Participants were 133 retired male NRL players in Australia. All 133 players completed a clinical interview, neuropsychological testing, and self-reported outcome measures. The primary dependent variable was the Informant Questionnaire on Cognitive Decline in the Elderly, self-report version (IQCODE-Self). The cognitive composite score included 12 test scores measuring attention, processing speed, learning and memory, and executive function. The 12 raw scores were converted to age-adjusted T-Scores and averaged to generate the cognitive composite score.

**Results.** The median age of the sample was 55.0 ( $M=53.1$ ,  $SD=13.9$ ;  $IQR=41.0-64.0$ , range=30-89) and the median years of education completed was 12.0 ( $M=11.9$ ,  $SD=2.6$ ;  $IQR=10.0-13.0$ , range=7-18). The retired players reported a median of 15.0 total lifetime concussions ( $M=28.0$ ,  $SD=36.6$ , range=0-200). Their mean IQCODE-Self score was 3.2 ( $SD=0.5$ ; Range=1.3-5.0); 10/133 (7.5%) and 38/133 (28.6%) scored above conservative and liberal cutoffs for perceived cognitive impairment on the IQCODE-Self, respectively. Perceived cognitive decline was positively correlated with depression (independent of age), negatively correlated with duration of professional rugby league exposure, and unrelated to objective cognitive test performance and

lifetime history of concussions. Perceived cognitive impairment was negatively correlated with resilience, but this relationship became non-significant when covarying for depressive symptoms. A multiple regression model, with age, lifetime number of concussions, professional rugby league exposure, depression, resilience, objective cognitive functioning, daytime sleepiness, and pain severity as predictors, explained 17% of the variance in the IQCODE-Self, and depression emerged as the only significant predictor of perceived cognitive decline.

**Conclusions.** This is the first large study of subjectively experienced cognitive decline in retired professional rugby league players. The proportion of the sample determined to be endorsing perceived cognitive decline varied as a function of the cutoff used (7.5% to 28.6%). Similar to studies from the general population and specialty clinics for older adults, no relationship was found between objective cognitive test performance and perceived cognitive decline. Depressive symptoms accounted for more variance in subjective cognitive decline than age, concussion history, years of exposure to professional sport, and select measures of pain, sleep, and resilience. Consequently, subjective reports of cognitive decline in retired rugby players might reflect depression and psychological distress rather than current cognitive impairment.

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**Keywords:** aging disorders, concussion, sports-related neuropsychology

**M. W. REID, Q. XIA, L. H. LU, L. H. PEREZ, C. L. MUNCY, J. E. KENNEDY, J. SHEN-GUNTHER. A Pilot Study of Mild Traumatic Brain Injury and DNA Methylation.**

**Objective:** To explore DNA methylation differences between symptomatic (Sx) and asymptomatic (Asx) mTBI groups. Up to 85% of those who sustain an mTBI recover completely within 3 months. Why some individuals do not is unknown, but an explanation may lie in epigenetics. Evidence suggests that pre-morbid experiences, such as stress and trauma, may cause changes in DNA expression (i.e., epigenetics), resulting in susceptibility to disease and poor health. Methylation, an epigenetic mechanism, can confer susceptibility to poorer health and diminished healing responses via the disruption of transcription, and therefore, gene expression. We hypothesized the Asx group would display lower methylation levels (i.e., less disrupted transcription) than Sx individuals across three well-researched genes related to neuroinflammatory activity, growth, and neuroplasticity: 1) *NR3C1*, which encodes the glucocorticoid receptor, ubiquitously distributed throughout the body and brain. Reduced expression of this gene facilitates exaggerated inflammatory responses. 2) *BDNF*, which encodes a neurotrophin important for neuronal growth, differentiation, and maintenance. 3) *SLC6A4*, which encodes the serotonin transporter, affects the efficiency of serotonergic synaptic transmission. Reduced expression of this gene is associated with decreased gray matter, especially in the context of depression. Prior research supports an association between stress/trauma and increased methylation in each of these genes. This pilot study was intended to discover effect sizes (i.e., Hedge's *g*) for use in the determination of appropriate sample sizes for subsequent studies and possibly provide preliminary evidence in support of our hypothesis.

**Participants and Methods:** Three groups of military service members with a history of combat deployment were compared for methylation differences in 22 CpG nucleotide positions across 3 genes: a currently symptomatic mTBI group (Sx, n=16) >3 months post-injury, an asymptomatic mTBI group (Asx, n=7) that recovered <3 months post-injury, and a healthy control group (HC, n=15) with no history of mTBI. Peripheral blood was collected and total DNA was extracted,

then bisulfite converted. The converted DNA was then used to determine methylation levels of the 22 CpG sites using PyroMark Q48 Autoprep.

**Results:** A significant difference ( $p=.033$ ) was found in the hypothesized direction for one of the 22 CpG sites investigated (*NR3C1* position 5,  $g=1.13$ ). Of the remaining 21 positions, 10 displayed lower methylation levels in the Asx group than the Sx group with  $g$  values ranging from .03 to .69, with a mean of .21. Interestingly, all but 5 of the 22 positions displayed lower methylation levels in the Asx group than the HC group, with  $g$  values ranging from .06 to 1.33 (mean = .43). While only half of the CpG sites explored showed a pattern of methylation in the hypothesized direction, it is noteworthy to mention that each site on *NR3C1* showed this pattern, save one, with most of them displaying medium to large effect sizes (.35 – 1.13).

**Conclusions:** Lower methylation levels in genes necessary for neuroinflammatory activity, growth, and neuroplasticity may facilitate recovery from mTBI. Though causality can not be inferred under the current design, our hypothesis is that pre-injury methylation levels are protective and potentially resist alterations due to injury.

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**Keywords:** mild traumatic brain injury, genetics, neurotransmitter systems

**D. K. DAVEY, L. CROCKER, M. SULLAN, S. JURICK, D. M. SCHIEHSER, S. NORMAN, H. J. ORFF, E. W. TWAMLEY, A. JAK. Independent Contributions of Sleep Disturbances, Fatigue, and Pain to Cognitive Functioning in Iraq/Afghanistan Veterans with Comorbid PTSD and History of TBI.**

**Objective:** Sleep disturbances, fatigue, and pain are highly prevalent among Iraq/Afghanistan Veterans with comorbid posttraumatic stress disorder (PTSD) and history of traumatic brain injury (TBI) and have each been associated with cognitive dysfunction. However, most studies have not examined these somatic variables in a single model to allow for the analysis of their independent contributions to cognitive functioning in a population where many of these symptoms often co-occur. Consequently, our goal was to examine the independent contributions of self-reported sleep disturbances, fatigue, and pain to cognitive dysfunction while controlling for psychiatric distress and neurobehavioral symptoms in a sample of Iraq/Afghanistan Veterans with comorbid PTSD and history of TBI.

**Participants and Methods:** Eighty Iraq/Afghanistan Veterans with PTSD and a history of remote mild-to-moderate TBI completed a comprehensive assessment, including neuropsychological testing and self-report measures of sleep disturbances (Pittsburgh Sleep Quality Index), fatigue (PROMIS Short Form Fatigue 7a), pain (PROMIS Pain Scale), neurobehavioral symptoms (Neurobehavioral Symptom Inventory), and symptoms of depression (Beck Depression Inventory, 2) and PTSD (PTSD Checklist – Specific Event). All included participants passed 2 out of 3 embedded and stand-alone performance validity measures. Normed scores of neuropsychological tests in the domains of attention, processing speed, learning and memory, and executive functioning were examined as dependent variables in multiple regression models to explore the independent contributions of sleep disturbances, fatigue, and pain to cognitive functioning, while controlling for psychiatric distress and neurobehavioral symptoms.

**Results:** Correlations among sleep, pain, and fatigue were small to moderate ( $r$ 's = .28-.44). Sleep disturbances were significantly associated with worse performance on the Wechsler Adult Intelligence Scale-IV (WAIS-IV) Processing Speed Index ( $\beta = -.30$ ,  $t(74) = -2.26$ ,  $p =$

.027), even after controlling for pain, fatigue, psychiatric distress, and neurobehavioral symptoms. Unexpectedly, sleep disturbances were associated with better performance on measures of learning and memory, including the California Verbal Learning Test-II List A 1-5 Total ( $\beta = .28$ ,  $t(74) = 2.14$ ,  $p = .036$ ), Short Delay Free Recall ( $\beta = .32$ ,  $t(74) = 2.50$ ,  $p = .015$ ), and Long Delay Free Recall ( $\beta = .29$ ,  $t(74) = 2.23$ ,  $p = .029$ ). Fatigue ( $\beta = -.29$ ,  $t(74) = -2.15$ ,  $p = .035$ ) and pain ( $\beta = -.28$ ,  $t(74) = -2.06$ ,  $p = .043$ ) were associated with worse performance on WAIS-IV Digit Span, a test of attention and working memory. Sleep, fatigue, and pain were not associated with executive functioning.

**Conclusions:** Sleep disturbances were uniquely associated with better learning and memory and worse processing speed, whereas fatigue and pain were uniquely associated with worse attention and working memory, even after controlling for psychiatric distress and neurobehavioral symptoms. These findings suggest that somatic symptoms have distinct associations with various cognitive domains and may have implications for future treatments designed to address specific somatic symptoms to improve attention/working memory and processing speed. It is possible that poor sleepers exerted extra effort on memory measures to compensate for perceived difficulties, but the unexpected finding regarding sleep and learning and memory warrants further exploration and replication with objective measures of sleep.

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**Keywords:** post-traumatic stress disorder, sleep, traumatic brain injury

**M. L. WERHANE, H. RAU, D. SHEPPARD, K. HOERSTER, A. G. SCHINDLER, E. PESKIND, K. PAGULAYAN. Clinical Characteristics Associated with Reduced Physical Activity in Veterans with a History of Mild Traumatic Brain Injury.**

**Objective:** Engaging in regular physical activity has well-established health benefits and has been linked to improved cognitive outcomes in the context of neurotrauma and aging, and can treat symptoms of common psychiatric conditions like depression and PTSD. As such, increased physical activity is commonly recommended following mild traumatic brain injury (mTBI). There exists, however, little research on the clinical characteristics associated with physical activity in this population, which is an important next step for improving clinical care and health outcomes. To address this gap, the present study examined clinical factors associated with physical activity in a sample of OEF/OIF/OND Veterans with a history of mTBI, with and without cooccurring posttraumatic stress disorder (PTSD). **Participants and Methods:** Forty-eight predominantly White (78%) Veterans aged 26-61 years ( $M=38.6$ ,  $SD=8.85$ ) with a self-reported history of blast-related mTBI. All participants completed questionnaires related to posttraumatic stress symptoms (PTSD Checklist-Military Version [PCL-M]), depressive symptoms (Patient Health Questionnaire-9 [PHQ-9]), apathy (Frontal Systems Behavior Scale [FrSBe], Apathy subscale), sleep quality (Pittsburg Sleep Quality Index [PSQI]), fatigue (Barrow Neurological Institute [BNI] Fatigue Scale), and headache and body pain (Defense & Veterans Pain Rating Scale). Physical activity was measured in total metabolic equivalent (MET) minutes per week derived from the International Physical Activity Questionnaire—Long Form (IPAQ-LF). Bivariate correlations with physical activity were calculated for each clinical variable. Because PTSD commonly co-occurs with mTBI, has overlapping symptomology, and has been associated with physical inactivity in non-mTBI samples, we used simple linear regression and mediation analysis to explore how clinical factors potentially impacted the relationship between PTSD symptom severity and physical activity. **Results:** Lower physical activity was

significantly associated with higher PTSD symptom severity ( $r=-.32$ ,  $p=.028$ ), depressive symptomatology ( $r=-.45$ ,  $p=.001$ ), apathy ( $r=-.32$ ,  $p=.031$ ), and fatigue ( $r=-.39$ ,  $p=.005$ ). No significant associations were observed between physical activity and demographic characteristics, number of mTBIs, sleep quality, or pain (all  $ps>.05$ ). Veterans with a history of mTBI who endorsed clinically-significant levels of PTSD symptoms ( $PCL-M \geq 50$ ;  $n=27$ ) reported greater depressive ( $\eta^2=0.30$ ;  $p<.001$ ) and apathy symptoms ( $\eta^2=0.08$ ;  $p=.062$ ; statistical trend), as well as poorer sleep quality ( $\eta^2=0.18$ ;  $p=.003$ ) and greater fatigue ( $\eta^2=0.12$ ;  $p=.004$ ) relative to those who endorsed subclinical levels of PTSD symptoms ( $n=21$ ). Mediation analyses revealed that the relationship between PTSD symptoms and physical activity was fully mediated by depressive symptoms (indirect effect [IDE]:  $p=.032$ ). A similar mediation pattern was observed for apathy (IDE:  $p=.068$ ) and fatigue symptoms (IDE:  $p=.060$ ), although indirect effects were not statistically significant. **Conclusions:** Psychiatric symptoms and fatigue – but not pain, sleep quality, demographic factors, or frequency of mTBIs – were associated with reduced physical activity in Veterans with a self-reported history of blast-related mTBI. Although preliminary, findings suggest that depressed mood may be particularly important to assess when considering physical activity in Veterans with a history of mTBI, and may even play an explanatory role for PTSD-associated reductions in physical activity within mTBI samples. Results also add to a growing literature highlighting the importance of assessing and promoting health behaviors, such as physical activity, in Veterans with a history of mTBI.

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**Keywords:** mild traumatic brain injury, post-traumatic stress disorder

### **E. MARSTON, D. MARRA, J. ` . HOELZLE. Performance Validity Testing and Outcomes on Neuropsychological Measures in Military Mild Traumatic Brain Injury: A Meta-Analysis.**

**Objective:** Multiple factors, such as the presence of psychiatric comorbidities, detrimentally impact the neuropsychological profile of Veterans who have sustained a mild traumatic brain injury (mTBI). Poor effort is also a notable confound to assessing cognitive performance within military Veterans. For example, prior research has documented that 50% of Veterans with a history of mTBI performed poorly on at least one performance validity test (PVT) and failure on PVTs is associated with increased symptom reporting, decreased cognitive functioning, and greater disability rates. Yet, the utilization and implementation of PVTs in mTBI research has not been systematically evaluated. The current meta-analysis examines observed differences in studies evaluating cognitive performance in Veterans with mTBI when participants are or are not excluded based on PVT performances.

**Participants and Methods:** An initial search of online databases (PsychINFO, Medline, and PUBMED) identified relevant mTBI studies. A secondary search narrowing criteria to Veteran populations identified 61 articles, 18 of which met inclusion criteria (i.e., documented mTBI, non-injured control group, assessment of cognitive functioning).  $k=12$  articles utilized PVTs to exclude participants based on PVT performance and  $k=6$  articles did not use PVTs to exclude participants. Effect sizes (Hedges  $g$ ) were calculated to compare neuropsychological performance based on time since injury (recent  $<3.8$  years; remote  $\geq 3.8$  years) and inclusion of PVTs.

**Results:** Overall, studies excluding participants based on PVT performance exhibited a small effect size ( $k=12$ ;  $g=0.27$ ; 95% CI = .16-.38). In contrast, research that did not incorporate

PVT exhibited a moderate effect size ( $k = 6$ ;  $g = 0.52$ , 95% CI = .34-.69). Effect sizes for more recent studies (i.e., < 3.8 years status post injury) that utilized PVTs to exclude sub-optimal effort ( $k = 6$ ;  $g = 0.28$ ; 95% CI = .44-.87) were smaller than studies that did not include PVTs ( $k = 3$ ;  $g = 0.66$ ; 95% CI = .13-.43). In contrast, there were no systematic differences in observed effect sizes for remote studies (i.e.,  $\geq 3.8$  years) that utilized PVTs ( $k = 6$ ,  $g = 0.25$ , 95% CI = .08-.43) compared to studies that did not utilize PVTs ( $k = 3$ ,  $g = 0.23$ , 95% CI = -.07-.53).

**Conclusions:** These results highlight predictable and systematic differences in observed cognitive dysfunction post-mTBI based on the utilization of PVTs to exclude participants who are likely exhibiting insufficient effort. Overall, observed effect sizes were larger, indicating worse neurocognitive performance, in the studies where PVTs were not utilized to quantify task engagement. This difference was clearly highlighted in the studies where evaluations were conducted more acutely (i.e., < 3.8 years). However, this observed difference appears to diminish in the most post-acute studies. These findings further highlight the important relationship between PVT performance and outcome on neuropsychological measures in military Veterans who sustained an mTBI.

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**Keywords:** mild traumatic brain injury, effort, assessment

**J. CLARK, Z. MAHMOOD, A. JAK, M. HUCKANS, M. O'NEIL, R. WILLIAMS, A. TURNER, K. PAGULAYAN, D. STORZBACH, E. W. TWAMLEY. Age and Psychiatric Symptoms do not Moderate Relationship Between Neuropsychological Performance and Functional Capacity Following Mild Traumatic Brain Injury in Veterans.**

**Objective:** Approximately 20% of Iraq/Afghanistan Veterans sustained a traumatic brain injury (TBI) during deployment, the majority of which were mild in severity (mTBI). Many of these individuals experience persistent post-concussive symptoms, including endorsement of cognitive difficulties, and functional impairment long after they are expected to resolve. Prevalent co-occurring psychiatric symptoms (e.g., posttraumatic stress disorder [PTSD] and depressive symptoms) may contribute to worse functional outcomes and enduring symptoms. Identifying modifiable factors related to functional outcomes in this population can inform potential treatment strategies. Growing evidence supports a relationship between greater neuropsychological deficits and worse functional outcomes in individuals with a history of mTBI. These prior investigations have been limited by small sample size, heterogenous TBI profiles, inconsistent appreciation of the role of psychiatric symptomatology and age, and subjective assessment of functional performance. As such, we aimed to: 1) examine the relationship between neuropsychological functioning and objective, performance-based functional capacity in a larger, more geographically representative sample of Veterans with a history of mTBI, and 2) investigate psychiatric symptom severity (i.e., PTSD and depressive symptom severity) and age as individual moderators of the relationship between neuropsychological functioning and overall functional capacity. Furthermore, we explored the relationship between empirically derived neuropsychological domains and functional capacity.

**Participants and Methods:** One hundred nineteen Iraq/Afghanistan Veterans with a history of mTBI and self-reported cognitive difficulties, recruited from 3 VA medical centers, completed neuropsychological, performance-based functional capacity (UCSD Performance-based Skills Assessment-Brief), and PTSD and depressive symptom severity assessments. A global deficit

score (GDS) for the neuropsychological measures was calculated based on attention, processing speed, executive functioning, and verbal memory performance.

**Results:** Approximately 65.5% of the sample exhibited mild neuropsychological impairment as determined by a GDS score  $\geq 50$ . Bivariate analyses indicated that worse neuropsychological performance (i.e., higher GDS) was associated with worse communication ( $r=-.26$ ;  $p=.004$ ) and overall functional capacity ( $r=-.30$ ;  $p=.001$  on the UPSA-B). Greater PTSD symptom severity was associated with worse communication ( $r=-.18$ ;  $p=.047$ ) and worse overall functional capacity ( $r=-.22$ ;  $p=.019$ ). Depressive symptom severity was not associated with functional capacity. Multiple linear regressions demonstrated that GDS and PTSD symptom severity explained 9% of the variance in communication [ $F(2,115)=5.38$ ,  $p=.006$ ,  $R^2=0.09$ ,  $\eta^2=0.07$ ] and 10% of the variance in overall functional capacity [ $F(2,115)=6.01$ ,  $p=.003$ ,  $R^2=0.10$ ,  $\eta^2=0.08$ ]. GDS emerged as the only significant predictor in both regressions. Age, PTSD, and depressive symptom severity did not moderate the relationship between GDS and overall functional capacity. Performance in the verbal learning and memory domain emerged as the strongest neuropsychological predictor of communication and overall functional capacity.

**Conclusions:** Worse neuropsychological functioning was moderately associated with worse performance-based functional capacity, even when accounting for PTSD symptom severity. Verbal learning and memory was the neuropsychological domain with the strongest association with functional capacity. Future research should examine whether improvement in verbal learning and memory results in later improvement in functional capacity.

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**Keywords:** cognitive functioning, activities of daily living

### **E. POLEJAEVA, M. J. SULLAN, K. L. HANSON BONDI, A. JAK. Association Between Symptoms of Depression and Anxiety with Performance on Measures of Executive Functioning in a Clinical Sample of Veterans with a History of Traumatic Brain Injury.**

**Objective:** Prior studies have found that approximately 30% of individuals who have sustained a traumatic brain injury (TBI) reported symptoms of depression within the first 6 to 12 months post-injury. Depression has been shown to significantly impact executive function and is often comorbid with anxiety; however, the specific relationship between symptoms of depression, anxiety, and executive functioning in clinical samples of Veterans with a history of TBI is less well-understood. Therefore, we sought to examine the relationship between symptoms of depression and anxiety with performance on tasks of executive functioning in a clinical sample of Veterans with history of TBI.

**Participants & Methods:** Veterans with history of mild to severe TBI (predominantly mild TBI) referred to the TBI Cognitive Rehabilitation Clinic within the San Diego Veterans Affairs Medical Center ( $n=306$ ) completed a comprehensive neuropsychological (NP) assessment to help inform diagnosis and treatment recommendations. For the purposes of this study, we used Beck Depression Inventory (BDI) and Beck Anxiety Inventory (BAI) total scores, and age-corrected subtest scores from the Delis-Kaplan Executive Function System (D-KEFS): Trails Letter-Number (LN) Switching, Color Word (CW) Inhibition Switching, and Verbal Fluency (VF) Switching Accuracy. Hierarchical multiple regression models were used to analyze the relationship between mood measures and executive functioning after controlling for education, race/ethnicity, and longest duration of loss of consciousness (LOC) and post-traumatic amnesia

(PTA). Additionally, we controlled for failure of two out of three measures of performance validity.

**Results:** Using Trails LN Switching as the dependent variable (DV), block 1 predicted 13% of the total variance ( $f(4,299)=11.26$ ,  $p<.001$ ), and block 2 predicted 19% of the overall variance ( $f(8,295)=8.57$ ,  $p<.001$ ). More symptoms of depression were associated with lower scores in Trails LN Switching ( $\beta=-.23$ ,  $p=.002$ ), but there was not a significant relationship between Trails and anxiety symptoms. With CW Inhibition Switching as the DV, block 1 explained 4.4% of the variance ( $f(4,194)=2.23$ ,  $p=0.67$ ) and block 2 accounted for 9.2% of the variance ( $f(8,190)=2.40$ ,  $p=.017$ ). Higher depression ratings were associated with lower scores on CW Inhibition Switching ( $\beta=-.216$ ,  $p=.032$ ), but there was again not a significant relationship for anxiety symptoms. Lastly, using VF Switching Accuracy as the DV, block 1 accounted for 8% of the total variance ( $f(4,301)=6.57$ ,  $p<.001$ ) and block 2 predicted 11.4% of the total variance ( $f(8,297)=4.78$ ,  $p<.001$ ). Greater symptoms of anxiety were associated with worse VF Switching Accuracy ( $\beta=-.195$ ,  $p=.013$ ), but symptoms of depression were not significantly related to this variable. Neither LOC nor PTA duration were significantly associated with performance on any of these tasks of executive functioning.

**Conclusions:** These results suggest that symptoms of depression and anxiety may contribute to poorer executive functioning within clinical samples of Veterans with a history of TBI. Thus, addressing symptoms of depression and anxiety may result in improved executive functioning in this population. Further work may investigate whether treatment of symptoms of depression and anxiety prior to, or in concordance with, cognitive rehabilitation results in improved executive functioning compared to administration of psychotherapy or cognitive rehabilitation independently.

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**Keywords:** traumatic brain injury, executive functions, depression

### **N. S. DAILEY, A. C. RAIKES, A. ALKOZEI, J. VANUK, W. D. KILLGORE. A Shared Biomarker of Cognitive Ability and Sleep Disruptions in Mild Traumatic Brain Injury.**

**Objective:** Attentional deficits and sleep disruptions are among the most prevalent cognitive and physical symptoms associated with mild traumatic brain injury (mTBI). Emerging research suggests a link between structural changes in the brain resulting from mTBI and symptom presentation, with prefrontal regions particularly susceptible to brain injury. However, brain-behavior relationships following mTBI remain poorly understood, and some individuals recover rapidly while others show lingering post-concussion deficits. While it is known that cognitive performance continues to recover for some time after an injury, the underlying mechanisms are uncertain. The present study aimed to characterize cortical thickness in sub-acute and chronic mTBI populations relative to healthy controls, and identify associations between brain structure, cognitive ability, and physical symptoms. We hypothesized lower cortical thickness in prefrontal brain regions following mTBI would be associated with worse attention and higher levels of daytime sleepiness.

**Participants and Methods:** Fifty-eight adults participated ( $M_{age}=23.58$ ;  $SD=5.31$ ), including 19 healthy controls (HCs), 22 sub-acute mTBI patients (up to 3-months post-injury), and 17 chronic mTBI patients (6-12 months post-injury). Sustained attention was measured using the Psychomotor Vigilance Task (PVT). Outcome measures of interest included reaction time (RT), in milliseconds, and false starts. Daytime sleepiness was assessed using the Epworth Sleepiness

Scale (ESS), where scores of 10 or greater indicate excessive daytime sleepiness. Cortical thickness was derived from high-resolution T1-weighted anatomical images. The standard pipeline was used to process MR images in FreeSurfer (v.6.0; *recon-all*). Whole-brain vertex-wise estimations of cortical thickness were calculated and entered into a GLM to identify between-group differences in cortical thickness, controlling for age, sex, and mean cortical thickness. To assess brain-behavior relations, partial correlations were calculated between cortical thickness, RT, false starts, and daytime sleepiness using the same covariates (age, sex, and mean cortical thickness).

**Results:** Three regions in the left hemisphere, including the inferior parietal lobule ( $p = .01$ ), precuneus ( $p = .03$ ), and pars triangularis ( $p = .04$ ) showed significantly lower cortical thickness in sub-acute, compared to chronic mTBI patients (cluster-forming threshold  $p < .01$ ; cluster-wise threshold  $p < .05$ ; two-tailed; FWE-corrected). Cortical thickness did not differ significantly between HC and patients with mTBI. There were significant negative associations between cortical thickness in the inferior parietal lobule and false starts ( $r = -0.40$ ,  $p = .05$ ), as well as daytime sleepiness ( $r = -0.67$ ,  $p = .002$ ) only in sub-acute mTBI patients.

**Conclusions:** These findings provide direct evidence for structural characteristics associated with cognitive and physical symptoms in patients with mTBI. Cortical thickness within frontal and parietal lobes was reduced following mTBI and further associated with attention deficits and daytime sleepiness. These associations were only present in the sub-acute timeframe, suggesting structural damage to the attention network may be a shared biomarker affecting cognition and sleep in the early stages following mTBI. Furthermore, these findings highlight the dynamic aspect of mTBI recovery and support the use of continued symptom evaluation throughout the recovery trajectory.

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**Keywords:** neuroimaging: structural, cognitive functioning, sleep

**K. A. HOLIDAY, L. T. EYLER, S. F. SORG, L. DELANO-WOOD, D. M. SCHIEHSER.**  
**Cognitive Fatigue is Associated with Increased Neural Activation During Response Inhibition in Veterans with mild TBI.**

**Objective:** Although cognitive sequelae are generally expected to resolve several weeks following a mild traumatic brain injury (mTBI), a “miserable minority” of individuals continue to report post-concussive symptoms, such as cognitive fatigue (CF) and executive difficulties (e.g., response inhibition), in the chronic phase of injury. While CF is thought to negatively impact cognitive performance, the literature is mixed, as some studies have shown that CF is associated with poorer response inhibition in mTBI, while others have not observed such findings. Given suggestions that cortico-striatal brain regions such as the anterior cingulate cortex (ACC) and caudate may be preferentially affected in mTBI and CF, we examined whether mTBI Veterans with and without clinical levels of CF differ in response inhibition and/or brain activation in these regions during a response inhibition task.

**Participants and Methods:** Forty-seven Veterans with mTBI with and without clinical levels of cognitive fatigue (TBI-CF=27; TBI-lowCF=20) participated in a response inhibition (go/no-go) task while undergoing event-related functional MRI. Groups were categorized based on an established clinical cutoff score of 18.5 on the CF subscale of the Modified Fatigue Impact Scale (MFIS; Schiehser et al., 2014). Task performance was measured by  $d'$ , or discriminability

accuracy, calculated by subtracting the z-score for the false alarm rate from the z-score of the hit rate. The ACC and bilateral caudate regions of interest were selected *a priori* using Neurosynth. Changes from baseline in the blood oxygen-level dependent signal were calculated at each voxel. Analyses of covariance (ANCOVAs), adjusting for important demographic variables (e.g., age, sex, years of education, and ethnicity) that demonstrated a significant relationship with the outcome variable, compared behavior ( $d'$ ) and brain activation between groups. Finally, across the mTBI sample, correlations between the MFIS-CF subscale and behavioral performance were calculated.

**Results:** Compared to the TBI-lowCF group, the TBI-CF group performed significantly worse on the go-no task ( $p = .007$ ;  $h_p^2 = .152$ ) and exhibited significantly greater activation in the ACC ( $p = .001$ ;  $h_p^2 = .214$ ) and caudate ( $p = .005$ ;  $h_p^2 = .162$ ). Across the entire mTBI group, higher MFIS-CF was associated with significantly decreased response inhibition ( $p = .008$ ,  $r = -.382$ ) as well as increased ACC ( $p = .001$ ,  $r = .456$ ) and bilateral caudate activation ( $p = .024$ ,  $r = .330$ ).

**Conclusions:** Compared to Veterans with mTBI and low CF, those with clinical levels of CF exhibited increased ACC and bilateral caudate activation, and this increased activation was associated with worse response inhibition. These findings suggest that clinically-significant CF following mTBI is associated with inefficient engagement of additional brain response needed to successfully complete challenging executive tasks. Our findings improve knowledge of the neurobiological basis of behavioral inhibition and suggest that CF may be directly linked to impulsive responding, which can profoundly interfere with everyday functioning and disrupt quality of life in those with mTBI histories. Given that CF may be a risk factor for brain and behavioral deficits in response inhibition, additional research is needed in order to better elucidate these putative relationships.

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**Keywords:** fatigue, neuroimaging: functional, mild traumatic brain injury

**E. OZTURK, S. F. SORG, A. L. CLARK, V. C. MERRITT, M. S. SAKAMOTO, M. W. BONDI, K. L. HANSON BONDI, D. M. SCHIEHSER, L. DELANO-WOOD. Elevated Somatic-Sensory Postconcussive Symptoms Predict Reduced Orbitofrontal and Temporal Cortical Volumes in Blast-Related Mild TBI.**

**Objective:** We and others have shown that the most common constellation of enduring complaints in mild traumatic brain injury (mTBI) comprise both vestibular (i.e., dizziness, imbalance, and incoordination) and sensory changes (i.e., loss of taste/smell, hearing loss, and vision problems), which together are observed in roughly 55-80% of individuals with a history of mTBI. However, to our knowledge no studies have examined neurostructural correlates of these common postconcussive symptoms (PCS) in the context of blast-related mTBI. Given the known susceptibility of the orbitofrontal and temporal cortices to TBI, we examined links between these regions' volumes and vestibular-sensory PCS symptoms in a sample of Veterans with a history of mTBI. Secondary analyses investigated possible links between regional volumes and loss of consciousness (LOC) reported across the sample.

**Methods:** 51 Veterans with a history of blast-related mTBI underwent 3T MRI neuroimaging and a clinical interview to obtain detailed TBI history and injury details. The sample also completed the Neurobehavioral Symptom Inventory (NSI) and Posttraumatic Stress Disorder (PTSD) Checklist. Regional brain volumes were indexed using FreeSurfer-derived cortical and subcortical segmentations of temporal and orbitofrontal regions of interest (ROIs). Hierarchical

linear regressions examined the relationship between somatic-sensory NSI subscores and ROI volumes, adjusting for age, education, intracranial volume (ICV), and PTSD symptom severity.

**Results:** Hierarchical regression analyses, adjusting for the covariates described above, demonstrated that higher NSI somatic-sensory subscores were significantly associated with lower total gray matter volume ( $t = -3.23, p = 0.002$ ) across the sample. Specific ROI volumes that appeared to drive this relationship were left ( $t = -2.90, p = 0.006$ ) and right lateral orbitofrontal cortex ( $t = -1.94, p = 0.037$ ); left ( $t = -2.15, p = 0.037$ ) and right superior temporal cortex ( $t = -3.15, p = 0.003$ ); left insula ( $t = -2.27, p = 0.028$ ), and right amygdala ( $t = -2.05, p = 0.046$ ). Exploratory correlational analyses showed that LOC duration for the most significant blast-related mTBI was significantly associated with reduced volume of total gray matter ( $r = 0.38, p = .005$ ), right amygdala ( $r = -0.44, p = .002$ ), bilateral orbitofrontal cortex ( $r = -0.34, -0.44, p$ 's  $< 0.01$ ), and bilateral insula cortex ( $r$ 's =  $-0.27, -0.29, p$ 's  $< 0.05$ ).

**Conclusions:** Elevated somatic-sensory postconcussive symptomatology is associated with lower total gray matter as well as regional volumes across several TBI-susceptible ROIs. Remarkably, these areas have been shown to be predilection sites in human and animal TBI models. Furthermore, longer LOC duration—a marker of injury severity—was strongly related to lower volume of several ROIs examined, suggesting neuroanatomical links to troublesome vestibular-somatic symptoms that may diminish positive clinical outcomes and quality of life. Future work is needed to (1) determine whether observed relationships are unique to blast-related TBI and (2) further elucidate the association between brain morphology, LOC, and postconcussive symptoms in individuals with mTBI histories.

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**Keywords:** neuroimaging; structural, traumatic brain injury

**S. T. CABLE, J. O'NEILL, J. G. SPRINGER, M. COX, L. FERRILL, E. SWANSON-KIMANI, D. C. SCHWEBEL, O. J. CLAY, J. JOHNSTON, K. MCCOLLOUGH, M. T. ELLERBUSCH, J. O. ORTEGA, L. E. DREER. Who will they talk to? Adolescent perspectives and comfort levels communicating about concussion symptoms and needs following injury.**

**Objective:** To examine adolescent communication comfort levels and barriers to communication with individuals in the systems of care (e.g., family, medical, school, athletic, friends) about their concussion and related symptoms following injury.

**Participants and Methods:** Participants were 73 adolescents (mean age = 14.4, SD = 1.8) of which 61.6% were male and 67.1% were White. All were recruited from specialty sports medicine clinics. In this mixed-methods study, participants rated their communication comfort with individuals in each system of care on a 4-point scale: 1 (*not at all*), 2 (*a little*), 3 (*somewhat*), and 4 (*very*). Reasons for comfort ratings less than *very* were obtained through semi-structured interviews and distilled into key themes through qualitative content analysis. Associations between communication comfort ratings and demographic factors, injury characteristics, medical history, emotional functioning, and recovery outcomes were evaluated.

**Results:** The majority of participants reported feeling *very comfortable* communicating about their concussions with the family and medical systems of care. Seventy-eight percent were *somewhat* or *very comfortable* communicating with their friends. Communication comfort with the athletic system of care was higher than expected, with *very comfortable* was the most frequent rating for athletic trainers (74.0%), coaches (64.2%), and teammates (61.2%). Around

half of participants were *very comfortable* communicating with school nurses (50.0%) and guidance counselors (44.3%). The most frequent rating for teachers was *somewhat comfortable* (46.6%), and *a little comfortable* was most frequently provided for principals (31.5%). Common themes that emerged as communication barriers across multiple systems of care included poor quality of relationships, perceptions that others would not understand or take the concussion seriously, desires to maintain privacy, and concerns about being viewed or treated negatively. A notable theme unique to the school system of care was the view that school personnel do not have a role in concussion management. No clear patterns of significant associations between communication comfort ratings and demographic, medical, emotional, injury, or recovery factors were found across the systems of care.

**Conclusions:** The current findings suggest that adolescents are generally comfortable talking about their concussion with many individuals in their broad system of care, but many are not fully comfortable discussing their concussion and related symptoms with school personnel. Thus, it should not be assumed adolescents are always voicing their academic or school concerns when needed. Ongoing communication is critical with school personnel as these individuals often assist in concussion management and return to learn protocols. Failure of an adolescent to disclose symptoms or communicate clearly with school personnel about their symptoms, tolerance of cognitive activities, academic accommodations, and emotional functioning may hinder recovery. More broadly, the barriers to communication elicited in this study provide insights into the reasons adolescents may not communicate equally across systems of care regarding their concussions. The findings have implications for concussion education programs with patients, particularly with regards to efforts to enhance concussion communication, as well as the need to improve sensitivity and openness to communication among school personnel and other individuals in adolescent concussion patients' systems of care.

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**Keywords:** concussion, mild traumatic brain injury, adolescence

**V. PLOURDE, N. D. SILVERBERG, M. CAIRNCROSS, S. VIRANI, B. L. BROOKS.**  
**Expectations of Symptom Duration are Associated with Emotional Stress in Children and Adolescents with Protracted Concussion Recovery.**

High emotional stress levels are often reported in children and adolescents with persisting post-concussive symptoms. Multiple factors have been studied as correlates of psychological distress, including being female and having higher levels of post-concussive symptoms. However, perceptions specifically about recovery duration/timeline (ex: "my symptoms will last a long time") have not yet been investigated as a predictor of higher levels of emotional stress in this age group.

**Objective:** To evaluate perceptions about the duration of post-concussive symptoms and its association with emotional distress in children and adolescents with a slower post-concussive recovery.

**Participants and Methods:** Participants ( $N=49$ , 69% girls, 11-17 years old,  $M=15.8$  years,  $SD=1.8$ ) were recruited as part of a concussion clinic, where they were seen by a neuropsychologist on average 7.7 months after injury ( $SD=2.5$ ). Measures included the Illness Perception Questionnaire Revised (IPQ-R; perceived duration of symptoms only) to evaluate recovery expectations, the Health and Behavior Inventory (HBI) to evaluate current post-concussive symptoms (cognitive and somatic symptoms), the emotional distress subscale of the

Strengths and Difficulties Questionnaire (SDQ), and the emotional functioning subscale of the Pediatric Quality of Life Questionnaire (PedsQL).

**Results:** Regression analyses (linear models with all covariates entered at once) suggested that higher self-reported scores on the duration perceptions of symptoms were significantly associated with higher emotional stress on both SDQ and PedsQL subscales whereas female sex was associated with emotional distress measured by the SDQ only. Emotional distress was not associated with perceptions reported by parents, post-concussive symptoms (self- and parent reports), age, number of concussions, or time since injury.

**Conclusions:** This study suggests that more pessimistic expectations for recovery length could be a stronger correlate of emotional stress than current post-concussive symptom severity. Negative perceptions of symptom duration are a potential modifiable factor that could be targeted with psychological interventions.

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**Keywords:** child brain injury, concussion, emotional processes

### **M. CAIRNCROSS, B. L. BROOKS, S. VIRANI, N. D. SILVERBERG. Fear Avoidance Behavior in Youth with Poor Recovery from Concussion: Measurement Properties and Correlates of a New Scale.**

**Objective:** After a concussion, many people avoid activities or situations that provoke or worsen their symptoms. Excessive fear avoidance behavior in adults is associated with poor clinical outcomes from concussion. The newly developed Fear Avoidance Behavior after Traumatic Brain Injury Questionnaire (FAB-TBI) has good psychometric properties in adults. No such measure exists for pediatric concussion. The present study aimed to develop pediatric self- and informant-report versions of the FAB-TBI (PFAB-TBI). We examined the basic measurement properties of the PFAB-TBI (i.e. association between self- and informant-report, internal consistency, individual item analysis) and how scores on the PFAB-TBI relate to core clinical outcomes, such as post-concussion symptoms, emotional distress, and quality of life.

**Participants and Methods:** Children (N=51) who were approximately 7.6 months (SD=7.0) post-injury and their primary caregiver (N=51) were recruited from a hospital-based concussion clinic. The children were on average 15.5 years-old (SD=2.1). The majority were female (70.6%), white (86.3%), and were most commonly injured in sport (52.9%) or as a result of motor vehicle collision (15.7%) or fall from a height (15.7%). The child and caregiver completed self- and informant-report measures of fear avoidance (PFAB-TBI), post-concussion symptoms (Health Behavior Inventory), emotional distress (Emotional Symptoms Scale - Strengths and Difficulties Questionnaire), and quality of life (Pediatric Quality of Life Inventory Version 4.0).

**Results:** Self- and informant-report PFAB-TBI total scores were moderately correlated ( $r = 0.51$ ,  $p < 0.001$ ). Neither the self or informant PFAB-TBI had floor or ceiling effects and both had strong internal consistency (Cronbach's  $\alpha = 0.87$  and  $0.89$ , respectively). PFAB-TBI self-report scores was positively correlated with somatic symptoms ( $r = 0.37$ ), emotional distress ( $r = 0.39$ ), and negatively correlated with quality of life ( $r = -0.57$ ). The PFAB-TBI informant-report was positively correlated with somatic symptoms ( $r = 0.52$ ) and emotional distress ( $r = 0.50$ ).

**Conclusions:** The PFAB-TBI has desirable basic measurement properties and we found the expected correlations with important clinical outcomes. This measure can be used to better understand how fear avoidance behavior impacts recovery and disability following pediatric concussion.

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**Keywords:** concussion, assessment

**G. STAPLES, A. BENJAMINOV, K. GETTIG, K. JONES. The Importance of Multi-Modal Assessment: Evaluating the Relationship Between Symptom Ratings and Neuropsychological Test Performance in Pediatric mTBI.**

**Objective:** Pediatric mild TBI (mTBI) results in a variety of symptoms manifested in physical, cognitive, emotional, and sleep-related domains. The CDC recommends using a combination of tools to assess recovery in pediatric mTBI, including validated symptom rating scales and cognitive testing (Lumba-Brown, et al., 2018). The *Postconcussion Symptom Inventory (PCSI)* is a validated self-report symptom rating scale with four subscales (physical, cognitive, emotional, fatigue) and a total score (Sady et al., 2014). Little is known about the relationship between symptom rating scales and performance on commonly used neuropsychological tests in pediatric mTBI. This study investigates the relationship between the *PCSI* and performance on neuropsychological tests in youth with mTBI.

**Participants and Methods:** Participants included 165 youth with mTBI (63% male), ages 8 to 19 years ( $M = 13.98$ ,  $SD = 2.49$ ), evaluated in an interdisciplinary, hospital-based mTBI clinic, for whom *PCSI* and performance-based neuropsychological test data were available. As part of routine clinical care, the *PCSI* and a brief battery of neuropsychological tests assessing performance validity (*MSVT*), cognitive response speed (*KTEA-3 Math Fluency*, *Silent Reading Fluency*, *Object Naming Facility*), fine motor speed (*Grooved Pegboard*), brief attention (*WAIS-IV/WISC-V Digit Span Forward*), working memory (*WAIS-IV/WISC-V Digit Span Backward*), and verbal memory (*WRAML2 Verbal Learning*) were administered.

**Results:** Bivariate correlations were used to analyze the relationship between *PCSI* scores and performance on neuropsychological tests. *PCSI-Total* scores were negatively correlated with working memory ( $r = -0.18$ ,  $p = .019$ ), rapid naming ( $r = -0.24$ ,  $p = .014$ ), math fluency ( $r = -0.31$ ,  $p < .01$ ), and delayed verbal memory recognition ( $r = -0.28$ ,  $p = .019$ ). *PCSI-Cognitive* scores were correlated with the same performance-based measures as *PCSI-Total* scores (all  $p < .03$ ). Performance validity scores (*MSVT Delayed Recognition*) were significantly correlated with *PCSI-Emotional* ( $r = -0.26$ ) and *PCSI-Fatigue* ( $r = -0.27$ ) scores (both  $p < .05$ ). Math fluency was significantly correlated with all *PCSI* scores. There were no significant relationships between fine motor speed, brief attention, and reading fluency and *PCSI* scores. Further, patients with pre-injury anxiety symptoms reported greater mTBI symptoms (*PCSI-Total*  $M = 35.97$ ) than those without pre-injury anxiety symptoms (*PCSI-Total*  $M = 17.52$ ,  $p < .001$ ). However, no significant differences in performance on neuropsychological measures were noted between the two groups.

**Conclusions:** The *PCSI-Total* and *PCSI-Cognitive* scores are more strongly correlated with performance on neuropsychological measures than the *PCSI-Physical*, *PCSI-Emotional*, and *PCSI-Fatigue* scores. Math fluency was the only performance-based measure that was correlated with all *PCSI* scores, suggesting it may be particularly sensitive to effects of mTBI symptoms. Consistent with the literature, youth with pre-injury anxiety reported greater mTBI symptoms than those without. These findings support the need for multi-modal assessment following mTBI including validated symptom rating scales and performance-based neuropsychological measures. Implications include benefits of early specialist care after mTBI and using neuropsychological screenings as intervention, particularly in youth with anxiety.

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**Keywords:** mild traumatic brain injury, cognitive screening, pediatric neuropsychology

**G. J. GOODWIN, S. MOORE, N. A. HOPKINS, J. MAIETTA, H. C. KUWABARA, T. F. KINSORA, S. R. ROSS, D. ALLEN. Post-Concussion Symptom Scores Among Athletes with Neurodevelopmental History.**

**Objective:** Recent research suggests that athletes who have neurodevelopmental disorders and sustain sport-related concussion have greater symptom severity and longer recovery time than their neurotypical peers. However, the pattern of effects is inconsistent across studies; some report no post-concussion symptom differences while others report associations between premorbid neurodevelopmental symptoms and increased risk for more post-concussion symptoms. It is critical to elucidate whether neurodevelopmental history is associated with post-concussion symptoms in order to help identify athletes at risk for complicated recovery and inform patient-specific prevention and treatment efforts. This study examined post-concussive symptom profiles among high school athletes with a history of attention deficit hyperactivity disorder (ADHD), learning disorder (LD), and comorbid ADHD/LD to determine whether athletes with neurodevelopmental disorders differed from neurotypical athletes on the ImPACT Post-Concussion Symptom Scale (PCSS). Given baseline symptom differences reported in other studies, we anticipated that athletes with comorbid ADHD/LD would have the highest symptom severity post-concussion compared to the other groups.

**Participants and Methods:** Participants were selected from a larger longitudinal database of high school athletes who were administered Version 2.1 of the ImPACT after sustaining a head injury during athletic play. Athletes were excluded from this study if they reported a history of neurological pathology (e.g., epilepsy, meningitis, migraines, neurosurgery) or treatment for substance abuse or psychiatric illness. The final sample included 310 high school athletes ages 13-18 (controls=155, ADHD=98; LD=32; ADHD/LD=25). The PCSS consists of 22 commonly reported symptoms; participants indicated whether they endorsed each symptom and rated the extent of symptom severity on a seven-point Likert scale (0="Not experiencing this symptom", 6="Worst I have ever experienced"). PCSS scores were aggregated into four symptom domains: cognitive-sensory, sleep-arousal, vestibular-somatic, and affective (Kontos et al., 2012). Scores within the four domains were averaged, with higher scores reflecting higher symptom severity. To examine whether there were group differences in symptom domains, we conducted a mixed-model ANOVA with symptom domain as within-subject factor and neurodevelopmental history (neurotypical, ADHD, LD, and ADHD/LD) as a between-subject factor. Given that the symptom scores were not normally distributed, a permutation based non-parametric mixed ANOVA was computed.

**Results:** The mixed ANOVA revealed a nonsignificant Domain x Group interaction, suggesting that athletes did not differ in their level of post-concussive symptoms.

**Conclusions:** Results of this study suggest that neurotypical and neurodevelopmental athletes report similar levels of symptoms following sport-related concussion. This finding is similar to studies with smaller sample sizes, and studies with larger samples are needed to determine whether these results are due to a lack of statistical power. In addition, prospective studies are needed to examine the extent to which symptom profiles change from baseline to post-injury in neurodevelopmental groups and whether these changes are useful for determining injury severity, return-to-play status, and improving patient-centered care.

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**Keywords:** concussion, child development disorders, computerized neuropsychological testing

**D. T. PULSIPHER, A. FLECKENSTEIN, E. M. KRAPP, L. D. STANFORD. Latent Profile Analysis of Neuropsychological Performance in Youth and Young Adults with Multiple Concussions.**

**Objective:** Findings vary considerably regarding the cognitive effects of multiple concussions. We previously reported that significantly worse neuropsychological scores in youth/young adults with multiple concussions were associated with performance validity test (PVT) failure or the presence of specific psychiatric (e.g., depression, adjustment disorder) or neurodevelopmental comorbidities (e.g., ADHD, learning disability) and not number of concussions after accounting for confounding medical factors. The purpose of this study was to validate our prior findings implementing latent profile analysis (LPA). LPA is a deductive, person-centered approach used to identify subgroups that creates generalizable models and is more robust than cluster analysis. We hypothesized that the best fit model would contain two profiles with one profile primarily comprised of youth/young adults with comorbidities or PVT failure and one profile comprised of the remainder of the subjects who passed a PVT or did not have a comorbidity.

**Participants and Methods:** 351 youth/young adults (ages 8-21; lifetime concussions: 1 [n=177], 2 [n=90], or 3+ [n=86]) completed a brief multi-domain neuropsychological evaluation. LPA was conducted in Mplus using only neuropsychological scores. After identifying the best fitting model, profiles were compared on sociodemographic variables, number of concussions, time since most recent concussion, PVT performance, and comorbidity presence.

**Results:** LPA models with two, three, and four profiles were tested, and a two-profile model (P1, n=176; P2, n=175) was the strongest solution according to Akaike, Bayesian, and sample-size adjusted Bayesian information criteria; fit indices Vuong-Lo-Mendell-Rubin and Lo-Mendell-Rubin adjusted likelihood ratio tests ( $p$ 's < 0.00001); and the classification uncertainty entropy value (0.802). The two profiles did not significantly differ by age, sex, race, time since most recent concussion, or concussion number ( $p$ 's=0.13-0.91). The two profiles significantly differed by comorbidity presence ( $p$ =0.004), PVT performance ( $p$ =0.01), and parental education levels ( $p$ 's  $\leq$  0.012). Despite these differences, profiles were not overwhelmingly defined by comorbidity presence or PVT failure. 58% of P1 had a comorbidity or failed a PVT while this was true of 35% in P2.

**Conclusions:** Consistent with our prior findings using different statistical analyses, our current results also show that number of concussions is not strongly or significantly related to neuropsychological performance. While our prior findings showed PVT failure or comorbidity presence explained low neuropsychological scores, present findings are partially consistent. Although PVT failure and comorbidity presence frequency significantly differed between the two latent profiles, there was not one profile primarily comprised of those who failed a PVT or had a comorbidity as we had hypothesized. Findings continue to support the importance of not making causal attributions about functioning to the direct effects of multiple concussions. However, results also indicate greater caution in attributing neuropsychological deficits solely to PVT performance and/or comorbidity presence. Additional non-injury elements contribute to neuropsychological performance such as partially heritable factors (e.g., parental cognitive functioning) and more acute, modifiable factors (e.g., impact of sleep).

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**Keywords:** concussion, child brain injury, pediatric neuropsychology

**L. N. MAIETTA, J. MAIETTA, G. J. GOODWIN, H. C. KUWABARA, T. F. KINSORA, S. R. ROSS, D. ALLEN. Effects of helmet use on concussion rates across sport categories.**

**Objective:** Research on concussions and their long-term impacts are currently focal points in many sports, from school-based athletics to professional leagues. It is thought that helmets decrease concussions, so they are used in many collision and contact sports where risk of concussion is increased. Previous research has demonstrated that helmet use is an effective method for preventing severe injury outcomes in sport but evidence supporting the effectiveness of helmet use to decrease concussion is mixed, and at least one recent study of soccer players indicated that helmet use did not decrease the incidence of concussion. Also, while there is an abundance of research investigating concussion rates in specific collisions sports (e.g., football vs. rugby), less information is available regarding whether helmet use decreases concussion rates across all sport categories (i.e., collision, contact, and limited contact). The current study investigates whether helmet use impacts the relationship between sport type and concussion rates in high school athletes.

**Participants and Methods:** Participants included 38,059 high school athletes aged 13-19 (mean age=15.1,  $SD=1.2$ ; mean education=9.1;  $SD=1.4$ ; 43.2% female) selected from a larger database who completed baseline ImpACT testing from 2008-2016. Exclusionary criteria included: history of neurodevelopmental disorder, migraines, epilepsy, brain surgery, meningitis, psychiatric, and/or alcohol/substance use treatment history. Athletes with missing data for concussion history or sport type were also excluded. Sports were categorized into four groups based on previous literature: collision, contact, limited-contact, and non-contact. Sports were further divided by helmeted and non-helmeted. Non-contact sports were not included in analyses because none were helmeted.

**Results:** Differences in frequency of self-reported concussion history (positive or negative) were examined using chi-square analyses that indicated significant differences for helmeted and non-helmeted sport categories. Post-hoc analyses (with Bonferroni correction) indicated that helmeted contact and collision sports had significantly higher rates of concussion than non-helmeted contact and non-helmeted limited contact sports. Additionally, helmeted contact sports had significantly greater frequency of concussion than non-helmeted contact sports. Follow-up one-way ANOVA (with number of concussions ranked due to non-normality) with helmet use and sport category as between-subjects variables indicated a significant main effect for helmet use. The main effect for sport category and the helmet use by sport category interaction effect were not significant. Post hoc analyses comparing helmet use by each sport category indicated medium effect sizes.

**Conclusions:** Results revealed that athletes from helmeted contact and collision sports were on average twice as likely than non-helmeted athletes to report a history of concussion. Additionally, athletes who wore helmets reported more concussions than their non-helmeted peers. The results are consistent with prior studies that do not support the effectiveness of helmets in reducing concussion, although the reason for this is unclear. Some studies suggest helmet effectiveness is reduced when helmets are not properly fitted while others implicate helmet technology as a factor. This study was limited by small numbers of athletes in the non-helmeted collision category and helmeted limited contact category which limits generalizability

of the findings. Future research should examine mechanisms (including behavioral interventions) underlying these differences.

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**Keywords:** concussion, sports-related neuropsychology

**A. SNYDER, C. SHERIDAN, M. PATEL, F. KOSASIH, M. KIRCHBERG, C. CARRARA, J. FISCHER, K. BICKART, T. BABIKIAN, M. CHOE, C. GIZA, R. ASARNOW. Breathing After Concussion: The influence of cardiorespiratory functioning on cognitive performance.**

**Objective:** Patients with persistent post-concussion symptoms (PPCS) exhibit signs of dysregulated autonomic functioning at baseline and in response to stress. Breathing dysfunction can be a sign of abnormalities in central autonomic control and is also associated with symptoms that overlap with PPCS such as headache, vestibular problems, cognitive difficulties, and mood symptoms. Medical and psychiatric conditions with similar symptomatology to PPCS (e.g., chronic pain, anxiety disorders, postural orthostatic tachycardia) demonstrate alterations in end-tidal CO<sub>2</sub> (EtCO<sub>2</sub>), which is the maximal concentration of carbon dioxide in exhaled breath. However, little is known about breathing patterns in patients with PPCS and how they might affect response to stress. Therefore, the purpose of this study was to evaluate the relationship of cardiorespiratory variables (EtCO<sub>2</sub>, respiration rate [RR], oxygen saturation [SaO<sub>2</sub>], and pulse rate [PR]) to performance on a cognitive-emotional stressor in young patients with PPCS.

**Participants and Methods:** A prospective cross-sectional study design was used to study 24 participants between the ages of 13 to 25. Participants were divided into two groups: 1) patients with PPCS (2-16 months post-injury) (n= 12), and 2) age-matched, non-injured controls (n= 12). Baseline cardiorespiratory assessment was conducted for 5 minutes in a seated position via capnometer and pulse oximeter. A modified version of the Paced Auditory Serial Addition Test (PASAT) was used as the cognitive-emotional stressor and performance was evaluated by total correct and error type (i.e., commission and omission) across 5 trials.

**Results:** Overall, the PPCS patients performed significantly worse on the PASAT compared to the control group. This difference was solely driven by the significantly higher number of omission errors committed (PPCS:  $M = 102.25$ ,  $SD = 46.47$ ; Control:  $M = 47.67$ ,  $SD = 34.30$ ;  $p < .05$ ), compared with similar rates of incorrect responses between groups. For both groups, baseline RR and PR were significantly correlated with PASAT performance such that higher values were moderately associated with greater number of omission errors (RR:  $R = .51$ ,  $p = .03$ ; PR:  $R = .45$ ,  $p = .03$ ).

**Conclusions:** Compared to controls, PPCS patients taking the PASAT were much more likely to demonstrate a response pattern that may be associated with freezing and/or feeling overwhelmed. For both groups, higher respiration rate and pulse rate at rest predicted this pattern, suggesting an important influence of autonomic arousal on cognitive performance. As such, interventions that target autonomic arousal like controlled breathing may be especially helpful for patients with PPCS who exhibit cognitive and/or emotional symptoms.

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**Keywords:** brain injury, chronic stress, sports-related neuropsychology

**S. GUO, M. G. MARBIL, A. L. WARE, W. CRAIG, R. ZEMEK, M. BEAUCHAMP, Q. DOAN, H. TAYLOR, D. M. COHEN, L. K. MIHALOV, E. D. BIGLER, A. BACEVICE, B. L. BROOKS, K. YEATES. Intellectual Functioning is Not Impaired Following Pediatric Mild Traumatic Brain Injury.**

**Objective:** Pediatric mild traumatic brain injury (TBI), including concussion, is a global public health concern affecting millions of children annually. Most children experience post-concussive symptoms but outcomes from pediatric mild TBI are highly variable between children. Some studies have indicated that intellectual functioning may be impaired following mild TBI in children. In the current study, we investigated whether intellectual functioning is affected by mild TBI in the post-acute period ( $\sim$ 2 weeks post-injury) and at a 3-month post-injury period in children. A comparison group of children with mild orthopedic injury (OI) not involving the head was included to distinguish the effects of mild TBI from effects related to suffering a traumatic injury and to control for pre-morbid demographics.

**Participants and Methods:** Data were drawn from two independent studies of pediatric mild TBI that involved prospective, concurrent cohort designs with longitudinal follow-up. Children between the ages of 8 and 16.99 years were recruited within 24 hours of injury in the Emergency Departments (ED) of two children's hospitals in Ohio, USA as part of the Mild Injury Outcomes Study (MIOS;  $N=214$ ; mild TBI:  $n=141$ , OI:  $n=73$ ) and in five children's hospitals across Canada as part of the Advancing Concussion Assessment in Pediatrics (A-CAP) study ( $N=967$ ; mild TBI:  $n=633$ , OI:  $n=334$ ). Intellectual functioning was assessed at a post-acute assessment ( $\sim$ 2 weeks post-injury) in the MIOS study, and at a 3-month post-injury assessment in the A-CAP study. Socioeconomic status (SES) was estimated by averaging sample Z-scores for years of maternal education, median family income for census tract, and the Duncan Socioeconomic Index for the MIOS study, and by parental education for the A-CAP study. For both studies, Full-Scale IQ (FSIQ) was estimated using the two-subtest version of the Wechsler Abbreviated Scale of Intelligence-Second Edition (WASI-II). Univariate general linear models were used to examine group differences in FSIQ, covarying for sex and SES.

**Results:** Groups did not significantly differ in age or sex across studies but did in SES in the MIOS study ( $p=.006$ ). Children who completed the WASI-II assessment were demographically similar to those who did not. Groups did not differ significantly in FSIQ at the post-acute assessment,  $F(1, 211)<1.00$ ,  $p=.238$  (mild TBI:  $M=98.71$ ,  $SD=15.05$ ; OI:  $M=97.89$ ,  $SD=15.54$ ). Groups differed significantly in FSIQ at the 3-month assessment,  $F(1, 718)=5.24$ ,  $p=.003$ ,  $d=0.183$  (mild TBI:  $M=106.16$ ,  $SD=13.82$ ; OI:  $M=108.60$ ,  $SD=12.98$ ). However, the effect size was negligible to small.

**Conclusions:** Groups differed statistically in FSIQ at 3 months, however, the group difference was not clinically meaningful (negligible to small effect size) and fell within the standard error of measurement of the WASI-II. The average FSIQ for both groups was within the average range. Our results indicate that intellectual functioning is not meaningfully impacted following mild TBI in children as compared to OI. These results were as expected, despite some assertions to the contrary and parental concerns, and support the current literature on cognitive outcomes after pediatric mild TBI.

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**Keywords:** mild traumatic brain injury, intellectual functioning, pediatric neuropsychology

**J. SLEMP, M. MCARDLE, S. SHIN, Y. KEREN, K. RUSSELL, R. BASILE. Exploring Gender Differences in Symptom Severity Following Concussion.**

**Objective:** Prior research has demonstrated that female gender is a risk factor for prolonged recovery after a concussion among pediatric and young adult populations (Covassin et al., 2016; Davis et al., 2017). Further, there is evidence that females may experience different types of symptoms, such as greater somatic symptoms (Covassin et al., 2007; Kay et al., 2018). The objective of this study was to build on prior research by investigating gender differences in symptom patterns and total symptom severity experienced following a concussion. Differences were retrospectively reported for three time points: before the injury was sustained, immediately after the injury occurred, and currently.

**Participants and Methods:** A retrospective analysis was conducted on children and adolescents ( $n = 126$ ), ages 4 through 21, who presented to the Outpatient Neuropsychology Service at Staten Island University Hospital an average of 12.73 days after a concussion. The sample was 57.1% male and 42.9% female. Symptoms experienced at baseline, immediately after sustaining a concussion, and currently (defined as within three days of visiting the outpatient clinic) were measured using the Post-Concussion Symptom Inventory (PCSI). One-way ANOVAs were utilized to observe gender differences in overall symptom severity and for individual symptoms at each time point.

**Results:** No significant gender differences in overall symptom severity were observed at baseline or immediately after injury ( $F(1,124) = 3.14, p = .08$ ;  $F(1,124) = 3.62, p = .06$ ). However, at baseline, females reported higher severity for dizziness, photophobia, and tiredness. Immediately after the injury, females reported higher severity for headache, drowsiness, and tiredness. At time of their appointment, roughly 12 days after injury, females reported greater overall symptom severity ( $F(1,124) = 4.84, p = .03$ ). When asked to reflect on symptoms within the past three days females reported greater symptom severity for headache, dizziness, increased sleeping, photophobia, and nervousness.

**Conclusions:** Overall, the patterns observed in this study are largely consistent with prior findings. Additional studies are necessary to explore why these observed gender differences exist. For example, future research should explore baseline differences in more depth and take into account potential interaction effects of pre-existing mental health conditions. Additionally, it should explore the role of hormones in recovery and/or gender differences in brain functioning after injury.

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**Keywords:** concussion, pediatric neuropsychology, mild traumatic brain injury

**M. MCARDLE, J. SLEMP, S. SHIN, Y. KEREN, K. RUSSELL, R. BASILE. Neurocognitive Trends in Concussion Patients Based on Gender and Loss of Consciousness.**

**Objective:** Prior research utilizing CNS Vital Signs has indicated that loss of consciousness (LOC) following head trauma, when compared to those without LOC, is not associated with significant differences in performance across all cognitive domains (Lanting, Iverson, & Lange, 2012).

Additionally, previous research has found that in healthy controls, males perform significantly faster on the right-handed finger tapping test than females (CNS Vital Signs;  $p = .006$ ; Iverson, Brooks, & Rennison, 2014). This study sought to further investigate the effects of gender and

loss of consciousness on performance across multiple domains of functioning in children and adolescents following a concussion.

**Participants and Methods:** A retrospective analysis was conducted on children and adolescents ( $n=102$ ), ages 7 to 20, who presented to the Staten Island University Hospital-Outpatient Neuropsychology Department following a concussion. The sample consisted of 55.9% males ( $n=57$ ) and 44.1% females ( $n=45$ ). Cognitive functioning was measured using the CNS Vital Signs computerized test, including the domains of attention, psychomotor speed, reaction time, processing speed, executive function, and verbal and visual memory. One-way ANOVA analyses were utilized to observe differences across domains related to gender and LOC.

**Results:** LOC was not associated with any significant differences in performance. However, significant differences in performance were observed respective to gender. Males performed faster on motor speed ( $p=.003$ ) and finger tapping ( $p=.008$ ), and displayed a higher hit rate on a task of immediate visual memory ( $p=.036$ ).

**Conclusions:** Overall, the findings of this study are consistent with prior research demonstrating no significant differences in cognitive performance associated with LOC. Additionally, the significant gender differences in motor speed, finger tapping, and immediate visual memory are consistent with prior research. Future research should explore potential underlying factors associated with these gender differences in cognitive performance, particularly in the aftermath of a concussion.

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**Keywords:** concussion, pediatric neuropsychology, cognitive screening

#### **D. GOMES, R. BASILE, M. ZIMMERMAN, K. RUSSELL. Reporting Patterns of Subjective and Objective Neuropsychological Symptoms in Adolescents with Sports-Related Concussions.**

**Objective:** Sports-related concussions are recognized as a significant health risk, especially for children and adolescents. Neurocognitive functioning has been shown to be negatively impacted by concussions. Due to the diffuse and multifaceted nature of concussions, both subjective and objective measures of reporting are used for accurate and timely diagnosis. This study aims to assess high school athletes' patterns of reporting of neurocognitive symptoms, as compared to objective, computer-based neuropsychological measures.

**Participants and Methods:** High school athletes with suspected sports-related concussions ( $N=56$ ; mean age=15.2, age range: 13-18 years; male=62.5%) presented for a neuropsychological evaluation at Staten Island University Hospital. Athletes completed the Post-Concussion Symptom Inventory (PCSI) and were administered a neuropsychological battery including CNS Vital Signs (CNSVS). CNSVS is a computerized test that measures memory, attention, speed, reaction time, cognitive flexibility, and executive function. The PCSI is a self-report measure assessing subjective presence and severity of concussion symptoms at three time periods (before the injury, immediately after the injury, in the past three days). PCSI symptom totals at each time period range from 0–120.

**Results:** Participants reported highest symptom load immediately after injury (mean=44.40), as compared to before the injury (mean=5.69), and in the past three days (mean=29.73), [ $F(1, 54)=118.61, p<.05$ ]]. There was a small relationship between athletes who demonstrated memory loss for events before the injury and PCSI symptom totals ( $r(55)=.27, p<.05$ ). Simple linear regressions were conducted to predict CNSVS scores based on PCSI scores in the domains of

attention/concentration, memory, and executive function. A significant predictive relationship was found between executive function CNSVS scores and the PCSI item assessing for deficits in executive function [ $F(1, 53)=12.56, p<.05, R^2 = .19$ ], indicating that with every one-unit increase in PCSI symptom scores, CNSVS executive function standard scores decreased by 5.66 points. A significant predictive relationship was found between visual memory CNSVS scores and the PCSI item assessing for deficits in memory [ $F(1, 52)=4.31, p<.05, R^2 = .08$ ], indicating that with every one-unit increase in PCSI symptom scores, CNSVS executive function standard scores decreased by 2.42 points. Additionally, a significant predictive relationship equation was found between complex attention CNSVS scores and the PCSI item assessing for deficits in attention/concentration [ $F(1, 52)=11.74, p<.05, R^2 = .18$ ], indicating that with every one-unit increase in PCSI symptom scores, CNSVS complex attention scores decreased by 6.80 points.

**Conclusions:** Similar to previously reported symptom profiles of adolescents with sports-related concussions, athletes reported most severe symptomology immediately after the injury. Subjective reporting of concussion symptomology accurately reflects scores in objective, computerized neuropsychological test data within the domains of executive function, visual memory, and attention. Results provide further validity for the use of subjective measures; objective measures may help provide additional details regarding symptom severity in clinical settings.

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**Keywords:** sports-related neuropsychology, concussion, adolescence

### **T. TARKENTON, C. H. SILVER, S. MILLER, N. DIDEHBANI, S. BURKHART, H. BATJER, K. BELL, M. CULLUM. Post-Injury Symptomatology Following Concussion Versus Orthopedic Injury.**

**Objective:** Few investigations have examined whether post-concussion symptoms are related to the neurophysiologic consequences of brain injury itself or associated with psychological reactions related to injury per se. This study aimed to assess post-injury presentation and psychological symptoms in concussed adolescents compared to well-matched orthopedic injury [OI] controls.

**Participants and Methods:** Participants age 12-18 who sustained a concussion ( $n=25$ ) were matched with OI controls ( $n=25$ ) by sex, age, ethnicity, mechanism of injury, and days since injury. Measures administered at initial clinic visit (within 14 days of injury) included a four-factor symptom checklist (physical, emotional, cognitive, sleep), pain scale, GAD-7, PHQ-8, and PTSD Checklist for DSM-5 (PCL-5). Chi-square and independent t-tests were used to compare individual and total symptom scores between injury groups. Logistic regression was used to determine significant factors associated to injury group.

**Results:** Compared to OI controls, concussed adolescents endorsed a significantly higher level of physical, cognitive, and sleep symptoms following injury (all  $ps<.001$ ), although level of pain, emotional functioning, and posttraumatic stress symptoms were comparable between the injury groups. Similarly, logistic regression demonstrated concussion was more associated with higher endorsement of physical, cognitive, and sleep symptoms. Pain level and emotional symptoms did not significantly predict group membership.

**Conclusions:** Using a well-matched physical injury control group, this study demonstrated post-concussion symptoms are specific to the physical consequences of a head injury, despite

similarities in pain level and psychological sequelae with general injury. Findings underscore the importance of tailored interventions to treat post-concussion symptomatology in adolescents.

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**Keywords:** brain injury, concussion, sports-related neuropsychology

**K. A. TARNAI, B. MARCOPULOS. Return to School 1 Year After Traumatic Brain Injury: A Study Using the Traumatic Brain Injury Model Systems National Database.**

**Objective:** For many individuals, recovery from moderate to severe brain injuries involves returning to a level of pre-injury productivity, defined primarily in the context of educational or employment involvement, but may also include volunteer and/or homemaker pursuits. Previous research has focused extensively on factors predicting return to employment, where students are inconsistently categorized with those in competitive employment. Research dedicated to return to school for students in secondary and tertiary education is largely qualitative; very few studies have utilized predictive modeling on a student sample. Qualitative studies have focused on the use/efficacy of disability services, which appear to be endorsed more frequently by high school students, as well as perceptions regarding students' return. The purpose of this study was to adapt a framework traditionally applied in models of return to work to create and evaluate a model of return to school one-year post-injury.

**Participants and Methods:** This study used a sample of 196 students within the Traumatic Brain Injury Model Systems National Database. Predictors focused primarily on indices of injury severity and functional capabilities and included days of post-traumatic amnesia (PTA), inpatient length of stay (LOS), rehabilitation discharge Disability Rating Scale (DRS) scores, and educational level. The sample was primarily male (67%), White (60.2%), and single (95.9%). Approximately half (51%) of individuals were high school students, followed by undergraduate students (32.1%), Associate's students (14.8%), and graduate students (2%). The outcome was binary and dummy-coded such that 0=did not return and 1= returned.

**Results:** The overall return to school rate was 63.78%. Logistic regression results indicated that lower scores on the DRS and being in high school pre-injury resulted in the highest probabilities of returning to school one-year post-injury. College students were less likely to return to school within a year following injury. The proposed model fit significantly better than an intercept-only model, and Tjur's  $R^2$  and McFadden's  $R^2$  indicated adequate model-data fit. A chi-square test of independence suggested that there was no statistically significant relation between employment (employed vs. unemployed) at follow-up and degree conferral (degree conferred vs. not conferred). Failure to obtain a degree did not negatively impact employment status at follow-up; however, obtaining a degree prior to transitioning to the job force was not significantly advantageous.

**Conclusions:** Results suggest that for some, productivity post-injury was possible outside of the school setting, and for others, returning to school did not indicate long-term productivity. Moreover, contrary to return to work studies, this study found that high school students had a better outcome compared to college students. These results highlight that productivity defined within a school versus a work setting may be somewhat distinct concepts. Because findings from this study suggest that the return to school rate among college students is lower than that of high school students, this study also substantiates the claim that college students, in particular, may benefit from increased outreach and awareness of disability services, which may heighten rates

of return to school in the future. Suggestions by which to improve future models include the addition of cognitive, neuropsychological, or psychological well-being variables.

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**Keywords:** traumatic brain injury, outcome, academic skills

### **L. J. RADIGAN, L. J. RAPPORT, R. A. HANKS. Influence of Insurance Type on Disability and Emotional Outcomes Following TBI.**

**Objective:** Access to quality healthcare can affect patient outcomes. Differences among insurance payor sources influence the type and amount of care received. In Michigan for individuals with no-fault automobile insurance, accident victims receive comprehensive care, regardless of ability to pay. The present study examined the extent to which patients' insurance type affects outcomes following traumatic brain injury (TBI).

**Participants and Methods:** A retrospective cohort study was conducted using data from the Southeastern Michigan Traumatic Brain Injury System (SEMTBIS). Participants included 794 adults (80% men, mean age at injury = 39.9 years) who used auto no-fault, Medicare/Medicaid, or commercial insurance to pay for their TBI rehabilitation. Injury severity characteristics as well as disability and emotional distress outcomes were assessed at 1, 2, and 5 years post injury. Disability was assessed via the Disability Rating Scale (DRS) and Glasgow Outcome Scale (GOS) total scores. Patients were classified as having emotional distress if they scored in the moderate range or higher on either the Patient Health Questionnaire-9 (PHQ-9) or General Anxiety Disorder-7 (GAD-7). Data were not available for all patients on all measures at all timepoints; sample sizes are included for each analysis.

**Results:** Initial indicators of injury severity (i.e., days in post-traumatic amnesia and DRS at discharge) did not vary significantly between the groups. At 1 year post injury, there were significant differences in DRS between all three groups, ( $n = 521$ ),  $H(2) = 7.44$ ,  $p = .024$ , with Medicare/Medicaid > auto no-fault > commercial insurance. Patients with commercial insurance were more likely to be classified as having made a "good recovery" on the GOS than patients with auto no-fault or Medicare/Medicaid, ( $n = 296$ ),  $H(2) = 9.24$ ,  $p = .010$ . Additionally, patients with commercial insurance were less likely to experience emotional distress than patients with no-fault insurance or patients with Medicare/Medicaid,  $X^2 (n = 110) = 6.66$ ,  $p = .036$ ,  $\phi = .25$ . By 2 years post injury, only significant differences in DRS remained ( $n = 481$ )  $H(2) = 17.30$ ,  $p < .001$ , with Medicare/Medicaid > no-fault > commercial insurance. At 5 years post injury, Medicare/Medicaid continued to show worse DRS than both no-fault and commercial insurance ( $n = 432$ )  $H(2) = 18.49$ ,  $p < .001$ .

**Conclusions:** Despite severity of injuries being generally similar at baseline, the type of insurance payor for rehabilitation was associated with substantial differences in recovery. The most substantial differences were seen in the early recovery period, in which patients with commercial insurance typically did better than patients with Medicare/Medicaid and auto no-fault. The presence of early discrepancies may highlight important differences in access to care. Further research is needed to understand the mechanisms of this initial discrepancy so that changes can be made to ensure equity of care and outcomes among patients with TBI.

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**Keywords:** traumatic brain injury

**S. M. VERVOORDT, P. A. ARNETT, C. ENGELAND, F. G. HILLARY. Examining Depression as a Marker for Decline in Older Adults with a History of Moderate to Severe Traumatic Brain Injury: Genetic Risk, Cognitive Deficits, and Hippocampal Volumetric Changes.**

**Objective:** To examine psychological outcomes, cognitive ability, genetic risk, and hippocampal differences in an older sample of adults with a history of traumatic brain injury (TBI) with a specific focus on the impact of depressive symptomatology.

**Participants and Methods:** In this study preregistered with the Open Science Framework, 121 participants aged 51-92 with a history of moderate to severe or complicated mild TBI were included. All participants underwent buccal swabs for genetic testing, a comprehensive neuropsychological battery, surveys, and 46 participants underwent an MRI scan.

**Results:** APOE e4 carrier status significantly predicted clinically significant depressive symptomatology on the Geriatric Depression Scale (GDS) with an odds ratio of 3.63 ( $p = .01$ ), and carriers presented with a higher mean GDS score ( $p = .05$ ). GDS was not predictive of scores on measures of executive function ( $p = .71$ ), delayed recall ( $p = .40$ ), or retention ( $p = .68$ ). Although GDS score was initially associated with poorer semantic memory scores ( $p = .04$ ), this significance dropped out in a linear model that included age and cognitive reserve. Higher GDS scores were associated with decreased hippocampal volume as a ratio of whole brain volume ( $p = .04$ ) but were not associated with hippocampal asymmetry ( $p = .84$ ) in models that included GDS score, time post injury, and the interaction between these two variables.

**Conclusions:** APOE carrier status is predictive of depression in a sample of older individuals with a history of TBI a mean of 10 years post injury. Depression is also associated with decreased hippocampal volume, but it did not predict hippocampal asymmetry or cognitive deficits in the domains of executive function, delayed recall, retention, or semantic memory. Earlier research has demonstrated that e4 carrier status and decreased hippocampal volume are markers of Alzheimer's Disease (AD) (Ward et al., 2012; Wolf et al., 2001), and both depression and TBI have additionally been shown to serve as risk factors for the onset of this dementia (Diniz et al., 2013; Gottlieb, 2000). However, depression did not have a demonstrable impact on either hippocampal symmetry or on the cognitive outcomes examined, which are more classic indicators of AD. These results indicate that the effects of e4 and hippocampal volume on depressive symptomatology post-TBI may not be directly related to AD onset.

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**Keywords:** depression, aging disorders, head injury (closed)

**S. M. VERVOORDT, F. G. HILLARY. All Breadth and Little Depth: A Critical Review of Depression in Moderate to Severe Traumatic Brain Injury.**

**Objective:** To review the literature that examines depression in moderate to severe traumatic brain injury.

**Participants and Methods:** This critical review examined 555 unique abstracts across PubMed and PsycInfo that examined depression within an mTBI context for adult injury. To meet for inclusion, studies had to (1) examine only adult injury within human populations, (2) examine only traumatic brain injury or otherwise analyze traumatic brain injury as a unique group, (3) include a majority moderate to severe injury in the sample, and (4) include depression or mood as a predictor or outcome variable.

**Results:** Of these 555, 142 studies published between 1994-2020 met inclusion criteria, and 55 studies framed depression as a primary outcome or predictor variable of interest. Within these 142 studies, various post-injury outcomes were examined in the context of depression, from quality of life and community participation (N=25) to treatment (N=21). The literature demonstrates an inconsistent and widespread net for depression research in this population, including studies of pain (N=3), epilepsy (N=2), anosmia (N=2), sexuality (N=2), headache (N=1), and a number of other foci. However, despite this relative breadth, only 9 of the 142 included papers examined neuropsychological (cognitive) outcomes related to depression, only 11 studies examined the relationship between depression and biological factors, and only 1 of these studies integrated both cognitive and biological factors. Additionally, the majority of studies looked at participants an average of one-year post-injury (N=51), while 11 studies looked at participants an average of >10 years post-injury at the latest study time-point.

**Conclusions:** Despite the fact that depression has been a point of study for nearly 30 years in msTBI, a focused literature has yet to emerge. Given the clear impact that depression has been shown to have on general outcomes (Satz et al., 1998) and the fact that it is a common sequela post-msTBI (Seel et al., 2010), the findings of this review demonstrate a clear need for more studies with clear goals to identify the cognitive and biological mechanisms for depression after msTBI. There is an additional need to examine depressive symptoms and low mood many years post-injury, especially at time points greater than 10 years post-injury and into senescence.

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**Keywords:** depression, head injury (closed)

## **B. LAMBEZ, E. VAKIL. The effectiveness of External vs. Internal Memory Remediation Strategies as a function of injury severity in individuals with traumatic brain injury: Systematic Review and Meta-analysis.**

**Introduction:** Traumatic Brain Injury (TBI) is a steadily rising health concern associated with significant risk of emotional, behavioral and cognitive impairments. Several comparative and comprehensive reviews on the effects of cognitive interventions in individuals with TBI have been conducted, but usually with a qualitative rather than quantitative approach.

**Objective:** In this meta-analysis we examined the memory remediating effects of Internal and External interventions, injury severity and the interaction of both factors for patients with TBI.

**Methods:** Data were extracted from studies published between 1980 and 2020 using objective memory measures, and multiple meta-analyses were conducted to compare effectiveness across these interventions. Publication bias was assessed as well as quality of evidence, using the Cochrane risk of bias tool for randomized control trials studies. Our final meta-analysis included 17 studies with interventions classified into three categories: Internal, External and mixed.

**Results:** Mixed interventions demonstrated the highest average effect-size. An evaluation of injury severity yielded two categories: mild-moderate and moderate-severe. Analyses demonstrated a homogenous medium effect-size of improvement across injury severity, with moderate-severe demonstrating the largest average effect-size. Further evaluation of injury severity interaction with intervention type displayed a mediating effect for both factors, demonstrating the largest effect-size for mixed interventions in moderate-severe patients.

**Conclusion:** This study highlights the effectiveness of memory remediation interventions on memory impairment following TBI. It further supports and expands existing intervention standards and guidelines.

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**Keywords:** traumatic brain injury, memory training, cognitive functioning

**J. PATRONICK, B. G. KUROWSKI, V. PILIPENKO, L. J. MARTIN, A. G. JEGGA, A. TREBLE-BARNA. Review of Genetic Factors Associated with Recovery after Traumatic Brain Injury: A 4-year Update.**

**Introduction:** Traumatic brain injury (TBI) is one of the leading causes of morbidity and mortality worldwide; however, there is a paucity of information available for prognosis, management, and treatment of the medical, cognitive, and behavioral sequelae of TBI. Pinpointing the genetic contributions related to recovery is vital to understanding the physiological mechanisms associated with response to injury and predicting recovery. Kurowski et al (2016) performed a review of the literature and identified 33 unique genes associated with clinical and functional outcomes following TBI.

**Objective:** To provide an updated review of the literature on genetic variants associated with clinical outcomes in studies published between September 2016 and May 2020.

**Methods:** We performed review of the literature in PubMed to generate a list of genetic loci found to be associated with clinical outcomes from TBI. We used the following search terms: ("brain injury" OR "brain injuries" OR "concussion" OR "brain concussion" OR "head injuries" OR "head injury") AND ("genetic" OR "genetics" OR "gene" OR "genes" OR "polymorphism" OR "DNA" OR "genetic polymorphism" OR "genetic variation" OR "genetic variability" OR "genotype"). Articles were considered eligible if they were human clinical studies published in English between September 2016 and May 2020. After identifying the new genes, we grouped outcomes into Survival/Global functioning, Cognitive, Behavioral/Emotional, and Medical Sequelae.

**Results:** The PubMed search terms resulted in 763 articles for comparison against inclusion criteria; after review of titles and abstracts, 704 articles were excluded. After review of full manuscripts, 29 were excluded and the final number of studies included was 39. Fifteen unique genes were identified as having a significant association with clinical outcomes: ITGAV, ITGB8, ABCG2, ABCC8, S100B, IGF1, SLC1A3, SLC6A3, DRD2, PPP3CC, PER3, SLC1A1, UGT1A6, SLC17A7, and SLC18A2. A subset of these newly identified genes (ITGAV, ITGB8, ABCC8, S100B) is involved in initial response to injury (e.g. cell adhesion, migration, signaling, cell death). These genes were primarily associated with Survival/Global functioning and risk for Medical Sequelae, such as cerebral hemorrhage and decompressive hemicraniectomy. Additionally, several genes implicated in glutamate uptake and regulation (SLC1A3, SLC1A1, UGT1A6) were associated with post-traumatic seizure risk and time to first seizure. Finally, several dopamine-related genes (SLC6A3, DRD2, SLC18A2) were associated with long-term Cognitive and Behavioral/Emotional outcomes.

**Conclusions:** These updated results highlight the complexity of genetic variability in TBI recovery, and the need for a better understanding of the biological processes implicated following injury. This updated gene list can be used in future studies employing systems biology methodology to identify biologic pathways over-represented in the literature, leading to a better understanding of genetic influences and the development of precision treatments. Due to the new and evolving nature of the field, future updates to this review are necessary.

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**Keywords:** traumatic brain injury, genetics, outcome

**H. QUANG, S. MCDONALD, P. HUYNH-LE, T. NGUYEN, N. LE, N. LAM-NGUYEN.**  
**Influence of Family Functioning, Overprotectiveness and Self-Efficacy in Apathy after Traumatic Brain Injury.**

**Objective:** The reduction of motivation and goal-directed behaviour, termed apathy, is one of the most frequently reported behavioural syndromes following traumatic brain injury (TBI). While there is no doubt about the organic basis of apathy, the influence of individual and family psychosocial factors on how apathy manifests have rarely been addressed. This study aimed to investigate the impact of family functioning, family overprotective behaviour and patient self-efficacy on apathy in people sustaining TBI.

**Participants and Methods:** One hundred and eleven participants (61 individuals with moderate to severe TBI and 50 healthy subjects, matched for age, education and gender) and their informants took part in the study. All participants lived in Vietnam. To assess apathy and apathy symptoms in executive, emotional and initiation dimensions, self-rated and informant-rated forms of the Dimensional Apathy Scale (DAS) were completed. The Family Assessment Device - General Functioning was used to characterise overall health of family function while the Overprotecting Scale for Adults - Short form was used for the assessment of overprotectiveness as perceived by the target individual within the family (person with TBI or control). The Overprotection Subscale of Questionnaire for Resources and Stress in Family was used to assess self-rated overprotective behaviour by informants. The General Self-Efficacy Scale was applied as a measure of participants' self-efficacy. Multiple regression models were employed to examine whether family factors and self-efficacy significantly predicted apathy in executive, emotional and initiation dimensions.

**Results:** Overall, apathy was rated higher on both the self- and informant-rated DAS in the TBI group compared to the control group. Informants of the person with TBI rated all three dimensions of apathy higher than informants of health control participants. In contrast, self-rated apathy in the TBI group was only higher for initiation apathy. This result indicates insight impairments of apathy symptoms occurring after TBI and the greater reliability of the informant-rated measure. Regarding family factors, people with TBI had greater overprotectiveness (as both perceived by self and the informant) from their families and had lower self-efficacy relative to controls. Family functioning did not differ between the two groups.

Across participants, informant-rated overprotectiveness and family functioning along with the individual's self-efficacy and the presence of head injury significantly predicted informant-rated apathy symptoms. The influence of overprotectiveness perceived by participants was not observed in any included models.

**Discussion:** This study suggests that psychosocial factors are associated with the extent to which apathy is manifest after TBI. It also confirms other reports that people with TBI may have lack of insight regarding their own apathy levels. Therefore, clinical profiles of patients should be based on information obtained from their carers or close relatives. Understanding of family environment, overprotective behaviour and patients' self-efficacy would be important for establishing comprehensive management plans and interventions of apathy.

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**Keywords:** motivation, head injury (closed), frontal lobes

**S. FATOORECHI, P. Y. LITVIN, D. W. LOPEZ-HERNANDEZ, R. RUGH-FRASER, S. MANGASSARIAN, A. BUENO, K. E. SMITH, W. OLMOS, S. SARAVIA, N. GRAUB, A. ARZUYAN, H. RAD, E. WAITE, E. LOPEZ, M. RICO, D. BUDDING, P. M. VESPA, D. A. HOVDA, D. L. MCARTHUR, D. PLURAD, J. FUSTER, E. WOO, D. J. HARDY, M. J. WRIGHT.** **Assessing Memory Workload in Latinx Participants With Traumatic Brain Injury.**

**Objective:** We assessed perceived workload (via the NASA Task Load Index; NASA-TLX) on the California Verbal Learning Test, Second Edition (CVLT-II), Brief Spatial Memory Test, Revised (BVMT-R), and overall composite memory score (CMS) in Latinx and non-Latinx Caucasian participants with and without traumatic brain injury (TBI).

**Participants and Methods:** The sample consisted of 34 participants with TBI (12 Latinx & 22 Caucasian) and 44 healthy comparison participants (HC; 20 Latinx & 24 Caucasians). Demographically corrected CVLT-II and BVMT-R scores were combined to compute the CMS. All participants passed performance validity testing.

**Results:** ANOVAs revealed that the HC group outperformed TBI group on demographically adjusted memory scores,  $ps < .01$ ,  $\eta ps^2 = .11-14$ . An interaction emerged indicating that Caucasians HC outperformed Latinx HC on the BVMT-R,  $p = .046$ ,  $\eta p^2 = .05$ . ANCOVAs, controlling for age, were used to evaluate group difference on the NASA-TLX. On the CVLT-II, participants with TBI reported higher levels of frustration and overall subjective workload compared to the HC participants,  $p = .001$ ,  $\eta p^2 = .13$ . While no main effects were found, we found an interaction on the CVLT-II performance ratings, were Latinx participants with TBI reported higher performance ratings compared to Caucasians with TBI, while Caucasians HC reported higher performance ratings compared to Latinx HC,  $p = .039$ ,  $\eta p^2 = .06$ . Next, on the BVMT-R, participants with TBI reported higher physical demand, temporal demand, effort, frustration, and overall subjective workload ratings compared to HC participants,  $ps < .05$ ,  $\eta ps^2 = .06-.21$ . We also found an interaction on the BVMT-R, Caucasian participants with TBI reported higher mental demand, physical demand, and temporal demand ratings compared to Latinx participants with TBI and Latinx HC participants over Caucasian HC participants,  $ps < .05$ ,  $\eta ps^2 = .06-.09$ . Finally, on the CMS, the TBI group reported higher physical demand, temporal demand, and frustration, and overall subjective workload ratings compared to the HC group,  $ps < .05$ ,  $\eta ps^2 = .07-.19$ . Additionally, we found an interaction on the CMS, Caucasian participants with TBI reported higher physical demand ratings compared to Latinx participants with TBI and Latinx HC participants over Caucasians HC participants,  $p = .024$ ,  $\eta p^2 = .07$ . Finally, we found another interaction on the CMS, Latinx participants with TBI reported higher performance ratings compared to Caucasians participants with TBI and Caucasian HC participants over Latinx HC participants,  $p = .021$ ,  $\eta p^2 = .07$ .

**Conclusions:** As expected, we found individuals with TBI demonstrated memory deficits compared to HC participants. Furthermore, persons with TBI reported greater perceived workload across memory tests compared to HC participants. Also, Caucasians with TBI reported higher perceived workload across memory tests compared to Latinx with TBI.

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**Keywords:** traumatic brain injury, diversity

**A. O. LOPEZ, D. A. LOPEZ PALACIOS, Z. N. PEART, L. Y. NO, S. SAVAGE, A. QUINTANA, D. GIBSON. Effect of Anxiety on Verbal Fluency in a Traumatic Brain Injury Sample.**

**Objective:** To determine whether anxiety affects performance on a verbal fluency task in brain injured individuals.

**Participants and Methods:** The data for this study was derived from the National Alzheimer's Coordinating Center's Uniform Data Set containing neuropsychological information for patients who have sustained a Traumatic Brain Injury (TBI) ( $n=227$ ) who completed the Neuropsychiatric Inventory-Questionnaire (NPI-Q) and the Phonemic Test – F words and L words. The Phonemic Test requires the examinee to name as many words that begin with the letter given in one minute across two trials (letter F followed by letter L). The sample was divided into two groups. One which endorsed feelings of anxiety in the last month ( $n=62$ ; mean age=67,  $SD=11.44$ ; 52% female) and a second group which denied feelings of anxiety within the last month ( $n=165$ ; mean age=70,  $SD=9.91$ ; 54% male).

**Results:** The results of an ANCOVA revealed that those who reported feelings of anxiety performed more poorly on the verbal fluency task than those who did not report it [ $F(1,224)=10.21, p<.01$ ]. Age was used as a covariate given that a significant difference was found for this demographic between the two groups [ $t(1,267)=2.09, p=.038$ ].

**Conclusion:** Previous research has found that anxiety can affect neural activation during verbal fluency tasks. Brain activation has been shown to differ significantly during complex tasks between individuals who report high anxiety and those who report low anxiety. Specifically, greater activation has been found in the frontal gyri and cerebellum in those with low anxiety (Gawda & Szepietowska, 2016). Individuals who experience brain injuries are already prone to experiencing deficits in verbal fluency. Further, research in the past has found damages to the Anterior Thalamic Radiation (ATR), Inferior Fronto-occipital Fasciculus (IFOF), Uncinate Fasciculus (UF), Superior Longitudinal Fasciculus (SLF), and Frontal Aslant Tract (FAT) tracts to be significantly correlated with deficits in semantic and phonological fluency (Li et al., 2017). The current results indicate that individuals who experienced feelings of anxiety perform more poorly on verbal fluency tasks than those who did not. Based on the previous findings, it can be suggested that anxiety, particularly in individuals who have suffered a brain injury, can have a negative impact on verbal fluency scores. Thus, these results highlight the importance of including psychological treatment for feelings of anxiety as part of the rehabilitation process for individuals who have sustained brain injuries. Future research should aim to include more robust measures of anxiety as these were not available for this study.

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**Keywords:** traumatic brain injury

**N. GRAUB, D. W. LOPEZ-HERNANDEZ, A. BUENO, W. OLMOS, E. LOPEZ, S. FATOORECHI, J. KNIGHT, R. CERVANTES, A. J. BAEZ, I. MUNOZ, A. BICHLMEIER, S. SARAVIA, E. TORRES, R. RUGH-FRASER, D. BUDDING, P. M. VESPA, D. A. HOVDA, K. V. HERNANDEZ, D. L. MCARTHUR, D. PLURAD, J. FUSTER, E. WOO, D. J. HARDY, P. Y. LITVIN, M. J. WRIGHT. The Relationship Between Bilingualism and Traumatic Brain Injury on Verbal Fluency Across Performance Intervals.**

**Objective:** Research shows that traumatic brain injury (TBI) survivors demonstrate verbal fluency deficits compared to healthy comparisons (HC). Additionally, bilingualism has been found to impact cognition. We examined the influence of TBI and bilingualism on verbal fluency performance and across four 15-second performance intervals.

**Participants and Methods:** The sample consisted of 30 acute TBI (ATBI; 16 monolinguals; 14 bilinguals), 30 chronic TBI (CTBI; 13 monolinguals; 17 bilinguals), and 46 HC (20 monolinguals; 26 bilinguals) participants. ATBI participants were tested 6 months post-injury and CTBI participants were tested 12 months or more post-injury. Demographically corrected T-scores were used to evaluate verbal fluency performance and interval scores. All participants passed performance validity testing. A series of 3x2 ANCOVAs, covarying for gender, were utilized.

**Results:** ANCOVAs revealed that HC participants outperformed the ATBI group on verbal fluency performance,  $p=.000$ ,  $h_p^2=.17$ . Next, during the first 15-second interval, HC participants outperformed both TBI groups,  $p=.000$ ,  $h_p^2=.21$ . Additionally, HC participants outperformed only the ATBI group on the second and fourth 15-second interval  $ps<.05$ ,  $h_{ps}^2=.06-.08$ . A main effect was also found for language with monolinguals outperforming bilinguals on the first 15-second performance interval,  $p=.036$ ,  $h_p^2=.04$ . No interactions emerged.

**Conclusions:** As expected, the HC participants outperformed the ATBI on verbal fluency performance and several 15-second performance intervals, but HC participants only outperformed the CTBI group only on the first 15-second performance interval. Furthermore, monolinguals demonstrated better verbal fluency performance during the first 15-seconds relative to bilinguals. Our finding highlights that even 12 months post-injury, TBI survivors may struggle to perform as well as HC on verbal fluency tasks, especially in the first several seconds. Also, bilingualism appears to adversely impact verbal fluency performance, but only initially, during the first several seconds.

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**Keywords:** traumatic brain injury, bilingualism, fluency

**F. ZAKARIAN, D. W. LOPEZ-HERNANDEZ, R. RUGH-FRASER, P. Y. LITVIN, A. BUENO, S. SARAVIA, S. FATOORECHI, A. BICHLMEIER, S. MANGASSARIAN, O. UGURU, B. CUI, E. TORRES, A. ARZUYAN, K. E. SMITH, D. BUDDING, P. M. VESPA, D. A. HOVDA, D. L. MCARTHUR, D. PLURAD, J. FUSTER, D. J. HARDY, E. WOO, M. J. WRIGHT.** The Effect of Moderate Alcohol Consumption on Verbal Fluency Performance in Traumatic Brain Injury Survivors.

**Objective:** We examined the effects of moderate weekly alcohol consumption on verbal fluency performances in TBI survivors and healthy comparison (HC) adults.

**Participants and Methods:** The sample ( $N=92$ ) consisted of 41 HC (26 abstinent; 15 reported 1-2 drinks weekly), 31 acute TBI (ATBI; 17 abstinent; 14 reported 1-2 drinks weekly), and 20 chronic TBI (CTBI; 8 abstinent; 12 reported 1-2 drinks weekly) participants. Participants completed the Verbal Fluency subtest of the Delis-Kaplan Executive Function System (D-KEFS), which is comprised of letter fluency (LF), category fluency (CF), and category switching (CS) conditions.

**Results:** ANCOVAs, controlling for gender, revealed a main effect for group on the LF,  $p=.002$ ,  $h_p^2=.13$ , and CS,  $p=.019$ ,  $h_p^2=.09$ , with HC outperforming the ATBI group. Main effects emerged for group on CF,  $p=.000$ ,  $h_p^2=.17$ , with HC outperforming both TBI groups. No main effects

were found between alcohol use groups. An interaction emerged between groups and alcohol consumption on LF, with CTBI performing better with abstinence, while HC performed better with moderate alcohol consumption,  $p=.020$ ,  $h_p^2=.09$ .

**Conclusions:** Overall, ATBI survivors performed worse on all fluency tasks relative to HC. Our data further suggests that during the chronic stages of TBI recovery, moderate alcohol consumption can adversely impact letter fluency performances, while, in healthy adults, moderate alcohol use does not adversely impact these performances. Our findings suggest that alcohol consumption may negatively impact verbal fluency performances.

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**Keywords:** traumatic brain injury, alcohol, verbal abilities

**E. TORRES, D. W. LOPEZ-HERNANDEZ, P. Y. LITVIN, T. L. VICTOR, S. MANGASSARIAN, S. FATOORECHI, R. RUGH-FRASER, J. KNIGHT, A. J. BAEZ, E. LOPEZ, H. RAD, M. RICO, O. UGURU, D. BUDDING, P. M. VESPA, D. A. HOVDA, D. L. MCARTHUR, D. PLURAD, J. FUSTER, E. WOO, D. J. HARDY, K. B. BOONE, M. J. WRIGHT. Perceived Workload on the Dot Counting Test and Rey 15-Item Recall and Recognition Test in Bilingual and Monolingual Traumatic Brain Injury Survivors and Healthy Comparison Adults.**

**Objective:** Perceived workload (via the NASA Task Load Index) ratings were examined on the Dot Counting Test (DCT) and Rey-15 plus recognition (RMT) in bilingual and monolingual traumatic brain injury survivors and healthy comparison (HC) participants. The DCT and RMT are performance validity tests. As such, these tests may appear difficult to examinees, but very little effort is required to complete and pass these measures.

**Participants and Methods:** The sample was comprised of 30 participants with TBI (13 monolinguals & 17 bilinguals) and 54 HC (24 monolinguals & 30 bilinguals). TBI participants were tested 12 months or more post-injury. All participants passed performance validity testing. ANCOVAs, controlling for age, were conducted to determine the effect of TBI and language on the perceived workload on the DCT and RMT.

**Results:** No group differences were found on actual DCT and RMT performance,  $ps < .05$ . On the DCT, bilinguals indicated greater perceived cognitive effort relative to monolinguals,  $p = .034$ ,  $n_p^2 = .06$ . No main effects were found for the RMT, although two interactions emerged. First, an interaction was found on perceived performance, where bilingual participants with TBI reported better perceived performance relative to monolingual participants with TBI. Interestingly, in the HC group, monolinguals reported better perceived performance relative to bilinguals,  $p = .047$ ,  $n_p^2 = .05$ . Next, an interaction was found on perceived frustration, where monolingual participants with TBI reported higher levels of frustration on the RMT relative to bilingual participants with TBI and, bilingual HC reported higher levels of frustration relative to monolinguals,  $p = .009$ ,  $n_p^2 = .08$ .

**Conclusions:** Overall, we found that bilinguals showed greater perceived effort than monolinguals on the DCT task. On the RMT, bilingual participants with TBI tended to indicate better perceived performance and lower frustration than their monolingual counterpart. However, the inverse was true in healthy comparisons. Our data suggests that despite similar actual performances on common performance validity tests, bilingualism interacts with TBI to impact perception of effort on performance validity testing. Further work is needed to understand what

stimulus properties of performance validity tests give rise to different levels of perceived effort in examinees.

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**Keywords:** neuropsychological assessment

**W. OLMOS, R. CERVANTES, D. W. LOPEZ-HERNANDEZ, P. Y. LITVIN, S. SARAVIA, R. RUGH-FRASER, A. BUENO, K. E. SMITH, F. ZAKARIAN, E. TORRES, A. BICHLMEIER, K. V. HERNANDEZ, A. J. BAEZ, I. MUNOZ, H. RAD, A. ARZUYAN, E. WAITE, D. J. HARDY, P. M. VESPA, D. PLURAD, D. A. HOVDA, J. FUSTER, D. BUDDING, E. WOO, M. J. WRIGHT. Anxiety and Depression Symptomatology on Memory Performance in Traumatic Brain Injury Survivors.**

**Objective:** Memory, anxious, and depressive symptoms have been associated with traumatic brain (TBI). We evaluated the relationship between TBI and symptoms of anxiety and depression on memory in order to determine any interactive effects of TBI and mood symptoms on memory function.

**Participants and Methods:** The sample included 56 healthy comparison participants (HC; 50% with abnormal symptoms of anxiety and 13% with abnormal symptoms of depression), 42 participants with acute TBI (ATBI; 24% with abnormal symptoms of anxiety and 24% with abnormal symptoms of depression) and 31 participants with chronic TBI (CTBI; 48% with abnormal symptoms of anxiety and 16% with abnormal symptoms of depression). We utilized the Hospital Anxiety and Depression Scale (HADS), the California Verbal Learning Test, Second Edition (CVLT-II), and the Brief Spatial Memory Test, Revised (BVMT-R) in this study.

**Results:** ANOVAs revealed the HP outperformed both TBI groups on the CVLT-II,  $p < .05$ ,  $\eta p^2 = .13$ . Next, we found that the participants with clinically significant depressive symptoms showed worse performances on the BVMT-R,  $p = .004$ ,  $\eta p^2 = .07$ . Finally, interactions emerged on the BVMT-R,  $p = .040$ ,  $\eta p^2 = .05$ , with ATBI participants who had abnormal symptoms of anxiety outperforming the ATBI participants with minimal symptoms of anxiety, CTBI performing similarly on the BVMT-R regardless of level of anxiety, and HC participants with minimal anxiety outperforming HC participants with high levels of anxiety.

**Conclusions:** As predicted, the HP group outperformed both TBI groups on the CVLT-II, but not the BVMT-R. Furthermore, we found that symptoms of depression adversely impacted non-verbal memory performance across all groups. Our findings further suggest that a lack of anxiety in the acute stages of TBI is associated with worse performances.

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**Keywords:** traumatic brain injury, anxiety, depression

**E. WEBER, N. YI, H. KLECHA, L. D'ANGELO, N. CHIARAVALLOTI. Time Monitoring Independently Predicts Time-Based Prospective Memory in Individuals with TBI.**

**Objective:** Time-based prospective memory (TBPM) tasks are common in everyday life and important for optimal daily functioning. Although impairments in TBPM are known to be prevalent in individuals with traumatic brain injury (TBI), relatively little is known about the mechanisms underlying these deficits, which could ultimately provide avenues for rehabilitation.

The present study sought to explore the role of time monitoring in TBPM and examine its cognitive underpinnings in TBI.

**Participants and Methods:** Participants included 34 adults with chronic moderate-to-severe TBI who were at least one year removed from their injury (median [IQR] = 8.9 [11.4]). Participants completed the Memory for Intentions Test (MIST), which is a 30 minute task that assesses time- and event-based PM with varying cue-intention delay length (2 versus 15 min) in the context of an ongoing task. While completing the MIST, the examiner simultaneously logged instances when the participant checked a clock, which was located outside of their peripheral view; this was totaled to create a MIST time monitoring score. Additionally, participants completed a comprehensive neuropsychological battery, from which sample-based z-scores were generated for domains of processing speed, executive functions, attention and working memory, verbal fluency, and new learning and memory.

**Results:** Pearson's  $r$  correlations revealed that time monitoring was strongly correlated with MIST Time-Based total (MIST TB;  $r=0.654$ ,  $p<0.001$ ), with comparable correlations between the 2- and 15-min delay MIST TB scores ( $r=0.589$  and  $0.572$ , respectively; both  $ps<0.001$ ); frequent monitoring was associated with better TBPM performance. Although time monitoring was significantly correlated with indicators of MIST retrospective memory impairments (i.e., MIST recognition score, no response errors;  $r=0.43$ ,  $p=0.001$ ).

To examine the cognitive underpinnings of time monitoring, Pearson's  $r$  correlations were conducted between time monitoring and neuropsychological domain z-scores. Time monitoring was significantly correlated with all domains ( $rs>0.4$ ,  $p<0.05$ ). The same pattern was found for secondary ANCOVAs predicting MIST 2-min TB (time monitoring  $p=0.027$ ) and MIST 15-min TB (time monitoring  $p=0.043$ ), although the latter also revealed attention/working memory as an additional independent predictor ( $p=0.036$ ).

**Conclusions:** Results suggest that the ability to monitor for the passage of time plays an important and independent role in the performance of TBPM tasks. Although time monitoring was significantly correlated with many domains of cognition, it was most strongly aligned with performance on executively-driven tasks (i.e., switching, planning, inhibition, verbal fluency), consistent with McDaniel & Einstein's Multiprocess Theory of PM (2000). Future studies should thus seek to improve TBPM performance vis-à-vis interventions targeting time monitoring.

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**Keywords:** traumatic brain injury, memory: prospective, self-monitoring

### **R. L. SNYDER, M. J. WALSH, K. S. CHIOU. Metacognitive Evaluation of Inhibitory Processes After Traumatic Brain Injury.**

**Objective:** The present study aimed to explore how metacognitive evaluations of inhibitory processes are affected by traumatic brain injury (TBI). Metacognition refers to the ability to monitor and assess one's own performance while engaged in a cognitive task. Previous findings suggest that individuals with TBI demonstrate impairments when making metacognitive judgments. However, studies in TBI to date have focused on metacognitive evaluations of memory performance. It remains unclear whether metacognitive functioning after injury generalizes to all domains; that is, if accurate metacognitive judgments of one cognitive domain translate to another domain. Therefore, the purpose of this study was to depart from the conventional examination of metamemory and to document post-injury metacognitive evaluations of inhibition.

**Participants and Methods:** Participants included adults with a history of TBI ( $n=6$ ) and a control group of adults without a history of reported traumatic brain injury ( $n=6$ ). All participants completed two runs of the Erikson flanker task, which involved identifying the direction of a target arrow that was “flanked” with distractor arrows on each side. Each response of the flanker task was followed by a retrospective confidence judgment whereby participants reported their confidence in the accuracy of their performance. Metacognitive accuracy was calculated by taking the difference between confidence ratings and task accuracy. Independent samples t-tests were used to determine group differences in mean accuracy of the flanker task, metacognitive judgments and accuracy, as well as mean reaction times of flanker items and confidence judgments.

**Results:** The results of the t-test showed no significant difference in flanker task response accuracy between groups ( $t(6) = -0.5994, p=0.5708$ ). Individuals with TBI were slower to respond on the flanker task, but this finding was not statistically significant ( $t(6) = -1.7025, p=0.1396$ ). In terms of metacognitive responses, adults with TBI reported higher confidence in the accuracy of their flanker task performance compared to the healthy control group ( $t(5) = -2.7403, p=0.0408$ ). Adults with TBI also demonstrated less discrepancy between their subjective confidence ratings and actual performance, compared to healthy controls ( $t(5) = -2.6806, p=0.0438$ ). Finally, reaction times of the retrospective confidence judgments did not differ significantly between groups ( $t(8) = 1.001, p=0.3460$ ).

**Conclusions:** Adults with TBI performed similarly to healthy peers on a task of inhibition. Furthermore, metacognitive processing of inhibitory processes was relatively spared in this sample of adults with TBI. This result contrasts earlier findings in the literature documenting post-injury metacognitive deficits of other cognitive domains (e.g., metamemory). This may suggest that metacognition is not unitary, and that metacognitive processes may vary depending upon the domain. Future studies should confirm this through direct, within-subjects comparison of metacognitive accuracy across multiple different domains.

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**Keywords:** traumatic brain injury, brain injury, metacognition

### **J. FEIGER, J. SNELL, K. S. CHIOU. Baseline Predictors of Adjustment Functioning After Post-Acute Rehabilitation for Traumatic Brain Injury.**

**Objective:** Individuals with traumatic brain injury (TBI) may experience continued difficulty with daily functioning even after completion of post-acute rehabilitation programming. Knowledge of factors that predict functioning at discharge may be useful to guide targeted, and thus more effective, programming. While both neuropsychological functioning and depression are associated with functional outcome after TBI, their utility in predicting persistent impairments in adjustment functioning at discharge from rehabilitation is not well understood. This study examined cognitive performance during post-acute recovery from TBI as a latent construct predictor of adjustment functioning (AF) impairment at discharge from a residential rehabilitation program. Depression was investigated as a mechanism of this relationship using a structural equation modeling (SEM) approach.

**Participants and Methods:** A retrospective record review was conducted of adults who received rehabilitation services for a TBI at a residential post-acute rehabilitation facility. Data were extracted for individuals who completed a full battery of neuropsychological tests and assessment of depression using the BDI-II or the BDI- Fast Screen soon after arrival to the

facility (final  $n=172$  [137 male, 37 female]). Level of functional adjustment was measured at admission and discharge using the Mayo-Portland Adaptability Inventory (MPAI-4) adjustment subscale. Neuropsychological measures assessing a representative spectrum of cognitive domains were selected from the larger neuropsychological battery as indicators of a latent variable cognitive functioning (CF). A full mediation model was tested with an indirect path from the CF latent variable to AF at discharge via depression. A path from AF at admission to AF at discharge was included as an autoregressive control for baseline AF.

**Results:** The SEM analysis estimated a mediation model with adequate global fit ( $\chi^2(11) = 12.47, p = .33$ ; CFI = .99; TLI = .99; RMSEA = .03; SRMR = .04). When controlling for depression and AF at admission, CF was negatively associated with AF at discharge ( $B = -.21, SE = .10, p = .03$ ) such that poorer CF at admission was associated with greater functional impairment at discharge. Depression was positively associated with AF at admission when controlling for CF ( $B = .04, SE = .02, p = .02$ ), but did not predict AF at discharge ( $B = -.32, SE = .61, p = .61$ ). Depression did not mediate the relationship between CF and AF at discharge (95% CI [-.01, .08]). CF was not related to depression ( $B = -.02, SE = .02, p = .35$ ).

**Conclusions:** Results of this study support a direct predictive association between cognitive functioning and adjustment functioning upon completion of a residential rehabilitation program. Specifically, while controlling for baseline AF, lower overall CF predicted greater impairments in AF after rehabilitation above and beyond the effects of depression. Results of this study did not support the hypothesis of depression as a mechanism connecting CF to AF outcomes. Cognitive functioning status upon beginning a post-acute rehabilitation program is an important prognostic factor for the effectiveness of rehabilitation in addressing functional impairments.

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**Keywords:** traumatic brain injury, cognitive functioning, adaptive functioning

### **H. KLECHA, E. WEBER, J. MORECRAFT, K. S. CHIOU. Improving Intraindividual Variability in TBI Using Mindfulness: Preliminary Findings from a Pilot Study.**

**Objective:** Individuals with TBI often experience pervasive cognitive, physical, and/or emotional functioning impairments. However, these impairments may appear inconsistent within a given person. Intraindividual variability (IIV) is defined as the within-person, short-term fluctuation in performance that is hypothesized to be a marker of global impairment and derived from higher-order attention abilities. This pilot study examined the effects of a mindfulness mediation intervention theorized to improve attention on IIV in individuals with TBI.

**Participants and Methods:** Fifteen individuals with moderate-to-severe TBI, with a mean age of 45.5 (SD=10.7) and education of 14.0 (SD=1.76), completed a double-blind, placebo-controlled randomized clinical trial. Participants were administered the Sustained Attention to Response Task (SART) as part of a comprehensive neuropsychological battery at baseline and follow-up. The SART coefficient of variability (CV) is a measure of variability independent of mean differences; and was used as an indicator of IIV. After baseline testing, participants were randomly assigned to either the mindfulness treatment group ( $n=8$ ) or the active placebo control group ( $n=7$ ). Conditions were matched on intervention modality (standardized auditory material), session duration (50 minutes), frequency (10 sessions over approximately 5 weeks), and interventionist engagement. Groups were matched on study condition parameters and relevant demographics (all  $ps>0.10$ ). Uptake of the mindfulness intervention was assessed using the Five Facet Mindfulness Questionnaire Short form (FFMQ), and everyday cognitive performance was

assessed using the Memory Functioning Questionnaire (MFQ). A series of repeated-measures ANOVA were conducted to explore questions of treatment efficacy; post-hoc follow-up analyses conducted in the treatment group were used to examine effects by treatment response (i.e., Responders vs. Non-Responders, generated via median split on FFMQ). Spearman's rho correlations were conducted to examine IIV improvement in relation to self-reported functioning. **Results:** A repeated-measures ANOVA revealed a significant interaction between Group and FFMQ Total ( $p=0.011$ ; partial-eta-squared =0.405), such that individuals in the Mindfulness Group reported higher use of mindfulness strategies at post-intervention than baseline ( $p=0.041$ ), whereas there was no change in the Control Group ( $p=0.135$ ). Although a repeated-measures ANOVA did not yield a statistically significant interaction between Group and SART CV z-score ( $p=0.179$ ), the interaction term was associated with a large effect size (partial eta-squared =0.134). There were no statistically significant effects of group or time (all  $p>0.10$ ; partial-eta-squared values  $<0.005$ ). Paired sample t-tests between Responders and Non-Responders in the Treatment Group demonstrated a large clinical effect among Mindfulness Responders but not Non-Responders (Hedge's  $g=0.96$ ;  $ps>0.10$ ). Spearman's rho correlations revealed a significant relationship between SART CV z-score and MFQ Total, such that greater positive change in IIV was associated with improved self-reported cognitive functioning ( $\rho=0.738$ ;  $p=0.037$ ).

**Conclusions:** Although this study was a pilot RCT study with a limited sample size, preliminary results suggest that mindfulness meditation may have the potential to reduce IIV in individuals with TBI, and increase the use of strategies which may in turn yield better everyday cognitive functioning. Future studies using larger sample sizes should seek to confirm mindfulness as an effective intervention strategy for improving higher order attention abilities, and to determine the long-standing effects.

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**Keywords:** cognitive control, cognitive rehabilitation, traumatic brain injury

### **K. S. CHIOU, G. AMADON, H. KLECHA, E. WEBER. Improvements in Reaction Times of Metacognitive Confidence Judgment with Repeated Exposure After Moderate to Severe TBI.**

**Objective:** Metacognition is a facet of self-awareness that refers to one's online ability to monitor their own performance in the moment of completing a cognitive task. Importantly, positive associations between metacognitive performance and functional independence found in numerous clinical samples implicate its role in facilitating successful everyday functioning. Metacognitive functioning has been shown to be impaired after traumatic brain injury (TBI), as individuals with TBI demonstrate more inaccuracies and take a longer time to report metacognitive judgments than healthy peers. While post-injury metacognitive deficits have been documented, it remains unclear whether functioning in this domain can improve with practice. The purpose of this study was to determine the capacity for change in metacognitive performance after moderate to severe TBI.

**Participants and Methods:** 13 adults with moderate to severe TBI were recruited from the community. All participants completed a visual working memory paradigm that involved the recognition of a target shape and location. After each recognition item, participants reported a metacognitive judgment of their confidence in answering the item correctly. Participants were exposed to 3 separate trials of the paradigm. Each trial consisted of 16 recognition items, each immediately followed by a metacognitive judgment. Trials were counter-balanced between

participants. Task performance, metacognitive ratings, and reaction times were recorded. Metacognitive accuracy was determined by calculating the area under the receiver operating characteristic curve using task performance and metacognitive ratings. Repeated measures t-tests were employed to determine differences in recognition performance, metacognitive accuracy, and their reaction times between the first and third trials of the paradigm.

**Results:** Results of repeated measures t-tests indicate notable trends of better working memory performance ( $p=0.056$ ,  $d=0.59$ ), higher confidence ratings ( $p=0.059$ ,  $d=0.58$ ), and greater metacognitive accuracy ( $p=0.056$ ,  $d=0.59$ ) during the third exposure to the paradigm compared to the initial exposure. Mean reaction times of the working memory item responses from the final exposure were longer than on the first exposure, but this difference was not statistically significant ( $p=0.28$ ). However, the reaction times of the metacognitive confidence judgments were significantly shorter during the final exposure compared to the initial exposure of the paradigm ( $p=0.006$ ).

**Conclusions:** The results of this study suggest that metacognitive performance following moderate to severe TBI is malleable over time. Specifically, adults with TBI are able to make faster confidence judgments with repeated exposure to the task. While not statistically significant, reaction times of recognition performance became slower as the trials progressed. The slowed processing of the task could have enhanced the individual's memory of completing the task item, and thus facilitated a faster decision of confidence. These findings hold promise for the development of future interventions that can be used to improve metacognitive functioning after TBI.

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**Keywords:** metacognition, awareness, traumatic brain injury

### **H. KLECHA, H. M. GENOVA, N. CHIARAVALLI, J. DELUCA, P. HOLTZHEIMER, S. MALLOY, G. R. WYLIE. Cognitive fatigue in TBI: Do State and Trait Measures of Fatigue Assess the same Underlying Construct?**

**Objective:** Cognitive fatigue is a common and disabling symptom following a traumatic brain injury (TBI). Literature on cognitive fatigue has distinguished between two types of fatigue: "state" fatigue refers to the acute experience of fatigue, whereas "trait" fatigue refers to the susceptibility to fatigue over an extended period. In other clinical populations, state and trait measures of fatigue have been shown to correlate poorly with each other, though trait fatigue correlates well with depression. Here, we examine the relationship between state and trait fatigue in individuals with TBI, hypothesizing that if they measure the same underlying construct, they should correlate with one another.

**Participants and Methods:** Twenty-one participants with chronic moderate-severe TBI were recruited, with a mean age of 43.9 (SD=13.0) and an education of 14.8 (SD=2.1). Cognitive fatigue was induced by participants performing eight blocks of the N-back working memory task (four 0-back and four 2-back blocks) during fMRI acquisition. State fatigue was assessed with the visual analog scale of fatigue (VAS-F), which was presented at the beginning and end of each block. Trait fatigue was assessed using the Modified Fatigue Impact Scale (MFIS) and the Fatigue Severity Scale (FSS). The Chicago Multiscale Depression Inventory (CMDI) was also given as a measure of depression.

**Results:** To determine whether state and trait fatigue correlated with each other the VAS-F scores for each task (0-back, 2-back) were compared to both the FSS and the MFIS. No

correlation was found between state and trait fatigue (Pearson's  $r=0.06$ ,  $r=0.1$ ,  $r=0.2$ , and  $r=-0.04$  respectively). However, the two measures of trait fatigue, MFIS and FSS, correlated well with one another ( $r=0.72$ ,  $p=0.01$ ). Additionally, trait fatigue correlated with depression scores: there was a significant correlation between the CMDI and FSS ( $r=0.4$ ,  $p<0.05$ ). No significant correlation was found between CMDI and VAS-F. VAS-F scores were analyzed using a 2X4 repeated measures ANOVA to determine if scores were comparable across tasks. The factors were Task (0-back vs. 2-back) and Run (runs 1-4). The only significant effect was that of Run ( $F(3,60)=4.74$ ,  $p<0.005$ ), and resulted from subjects reporting progressively higher VAS-F scores across the runs (i.e. a marked increase in state fatigue as the runs progressed). To determine the extent of the correlation between VAS-F scores and N-Back performance two linear, mixed effect analyses were done looking at response time (RT) and accuracy. Only the main effects of task and run were significant ( $F(1,100.9)=45.64$ ,  $p<0.0001$  and  $F(1,99.1)=4.18$ ,  $p<0.01$ , respectively).

**Conclusions:** These findings show that measures of state and trait fatigue do not correlate with one another in individuals with TBI. This suggests that trait and state fatigue do not measure the same construct in TBI. Future studies should take this into consideration, and aim to carefully define the type of fatigue when assessing fatigue in individuals with TBI. Future work should also look to the develop more nuanced tools to assess the different types of fatigue, and differentiate between fatigue, depression and other potentially co-occurring factors.

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**Keywords:** fatigue, depression, traumatic brain injury

### **G. SANDERS, L. J. RAPPORT, S. MILLIS, R. A. HANKS. Growth Curve Trajectories of Processing Speed After Moderate or Severe Traumatic Brain Injury.**

**Objective:** Processing speed is highly sensitive to brain insult and is often considered a proxy for general cognitive status because of its robust association with functional outcomes and disability. Prior research has generally reported that cognitive recovery after traumatic brain injury (TBI) is steepest up to the second year post injury and subsequently plateaus. However, most longitudinal research into this phenomenon has utilized cross-sectional designs. It is critical to understand the long-term trajectory of cognitive recovery to maximize rehabilitation and resource planning. Cognitive reserve theory postulates that individuals with greater reserve are at lower risk for cognitive dysfunction after sustaining neurologic injuries as compared to individuals with less reserve. The present study examined the trajectory of processing speed recovery and the extent to which trajectory differed as a function of cognitive reserve, as assessed by premorbid education.

**Participants and Methods:** 267 participants with moderate or severe TBI completed the written portion of the Symbol Digit Modalities Test (SDMT) during hospitalization and at least two other occasions over a 20-year span. Most of the sample identified as Black (72%) men (81%) with an average age of 36.5 ( $SD = 13.4$ ) years and high school (HS) or greater (63%) education. Three series of growth curve models (GCMs) examined longitudinal change in SDMT performance within a multilevel modeling framework. The first series examined the linear effect of time beginning with a baseline model without random effects, a model specifying a random intercept, and then specification of a random intercept and slope. The second analysis examined piecewise GCM with time segmented at year 2. The third series investigated the interaction between time and education (coded as less than HS or HS or greater), controlling for age and

duration of posttraumatic amnesia. Models were estimated with maximum likelihood and comparisons were made using common fit indices. All analyses were conducted in *R*.

**Results:** The GCM fit the data significantly better than the baseline and random intercept models across all analyses, indicating substantial variability in SDMT intercept and slope across participants. The piecewise GCM demonstrated better fit compared to the linear model, suggesting a difference in performance across the time segments. Results showed significant variability in SDMT performance among participants in the first 2 years after injury, but little individual variability beyond. There was a significant interaction of education for the first but not the second time segment. This result indicated that rate of recovery in the first time segment was greater for participants with a HS or greater education than those with less than HS education, but in the second time segment the slope was comparable between the education groups.

**Conclusions:** Findings demonstrate that recovery of processing speed varies considerably across patients within the first couple years post injury and little thereafter. Persons of older age and worse injury severity were associated with a flatter trajectory across time. Consistent with cognitive reserve theory, persons with greater education exhibited steeper recovery of processing speed. Reserve associated with education may facilitate cognitive recovery after injury.

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**Keywords:** traumatic brain injury, information processing speed, cognitive rehabilitation

**E. C. GROSSNER, E. K. BRENNER, R. A. BERNIER, E. T. GUTY, F. G. HILLARY. Age and Time Post Injury Moderate the Relationship Between Metacognition and Executive Functioning After Traumatic Brain Injury.**

**Objective:** There is evidence that normal aging exacerbates neuropathological processes and cognition following traumatic brain injury (TBI) (Moretti et al., 2012). Metacognition, or the ability to reflect on one's own cognitive processes, is a domain commonly disrupted in both normal aging and TBI. Metacognitive deficit has been documented in samples of healthy older adults and in adults with neurodegenerative disorders (Rosen et al., 2014), with this deficit associated with a decline in executive functioning (EF) (Souchay & Isingrini, 2004). Similarly, TBI frequently results in frontal injury, leading to similar cognitive dysfunctions in EF and metacognition. Lastly, poorer cognitive functioning overall is associated with time post injury (TPI), as well as older age (Senathi-Raja, Ponsford, & Schönberger, 2010). We aim to investigate the role of aging and TPI on the relationship between metacognition and executive functioning in both a TBI and healthy control (HC) group.

**Participants and Methods:** Participants included 175 individuals with moderate-severe TBI (N=126) and HCs (N=49) ages 18-84 [TBI M(SD)=57.58(13.68); HC M(SD)=52.92(16.16)]. Participants received a neuropsychological battery, including tests of EF, working memory (WM), and an objective metacognitive task. An EF/WM composite was created using Trails B and Digit Span Backward. Metacognitive ability was derived from an abstract reasoning task with retrospective confidence judgments using signal detection theory to measure both task accuracy and confidence level. TPI was measured in months.

**Results:** Among individuals with TBI, EF/WM was associated with metacognition,  $r=0.38$ ,  $p<0.001$ , and age,  $r=-0.19$ ,  $p=0.037$ , but metacognition and age were not significantly correlated,  $r=-0.11$ ,  $p=0.213$ . In the HC group, EF/WM was also associated with metacognition,  $r=0.36$ ,  $p=0.013$ , but not with age,  $r=0.23$ ,  $p=0.116$ , and metacognition was not associated with age,  $r=-0.11$ ,  $p=0.491$ . There was a significant interaction between age and metacognition on EF/WM in

the TBI group,  $\beta=-0.45$ ,  $p=0.005$ , as well as in the HC group,  $\beta=-0.41$ ,  $p=0.048$ . In the TBI group, at low age, there was an interpretable relationship between metacognition and EF/WM,  $\beta=-0.65$ ,  $p=0.073$ , but the relationship was not significant at high age,  $\beta=-0.25$ ,  $p=0.268$ . In the HC group, there was not a significant relationship between metacognition and EF/WM at high ( $\beta=-0.17$ ,  $p=0.588$ ) or low ( $\beta=-0.65$ ,  $p=0.229$ ) age. There was a significant interaction between TPI and metacognition on EF/WM,  $\beta=0.53$ ,  $p=0.008$ . There was a significant relationship between metacognition and EF/WM at high TPI,  $\beta=0.29$ ,  $p=0.002$ , and low TPI,  $\beta=0.77$ ,  $p<0.001$ .

**Conclusions:** In both groups, metacognition was not associated with age, but there was a significant interaction between age and metacognition on EF/WM. Within individuals with TBI, there was a stronger relationship between metacognition and EF/WM at younger age than older age. This demonstrates that the relationship between metacognition and EF/WM becomes weaker with older age, perhaps indicating that these skills are being differentially impacted by the aging process after TBI. Additionally, TPI was a moderator of the relationship between metacognition and EF/WM at both longer and shorter intervals of time post injury, with a stronger relationship after shorter TPI. Together, both age and TPI are important factors in understanding metacognition and cognitive functioning following TBI.

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**Keywords:** metacognition, executive functions, aging (normal)

**K. E. SMITH, D. W. LOPEZ-HERNANDEZ, P. Y. LITVIN, S. FATOORECHI, S. MANGASSARIAN, T. L. VICTOR, A. BUENO, R. RUGH-FRASER, E. LOPEZ, M. SCHMITTER-EDGEcombe, F. ZAKARIAN, H. RAD, E. WAITE, K. V. HERNANDEZ, D. BUDDING, P. M. VESPA, D. A. HOVDA, D. L. MCARTHUR, D. PLURAD, J. FUSTER, E. WOO, K. B. BOONE, D. J. HARDY, M. J. WRIGHT. Assessing Fluency Workload in Latinx Traumatic Brain Injury Survivors .**

**Objective:** We evaluated perceived workload (via the NASA Task Load Index; NASA-TLX) on the Delis-Kaplan Executive Function System verbal fluency (VF) and design fluency (DF), and overall composite fluency score (CFS) in Latinx and non-Latinx Caucasian participants with and without traumatic brain injury (TBI).

**Participants and Methods:** The sample consisted of 34 participants with traumatic brain injury (TBI; 12 Latinx & 22 Caucasian) and 45 healthy comparison participants (HC; 22 Latinx & 23 Caucasians). Demographically corrected VF and DF scores were combined to compute the CFS. All participants passed performance validity testing.

**Results:** ANCOVAs, controlling for age, were used to evaluate NASA-TLX group differences. For VF, TBI participants reported higher levels of temporal demand, better performance, and overall subjective workload compared to the HC participants,  $ps<.05$ ,  $\eta p^2=.06-.08$ . We also found that Latinx participants reported better performance compared to Caucasian participants on the VF,  $p=.010$ ,  $\eta p^2=.08$ . On the DF, TBI participants reported higher levels of temporal demand compared to HC participants,  $p=.032$ ,  $\eta p^2=.06$ . Also, on the DF, Latinx participants reported better performance compared to Caucasian participants,  $p=.000$ ,  $\eta p^2=.18$ . Finally, on the DF task an interaction emerged where Caucasian participants with TBI reported higher physical demand ratings compared to Latinx participants with TBI, while Latinx HC participants reported higher physical demand ratings compared to Caucasian participants,  $p=.034$ ,  $\eta p^2=.06$ . On the CFS, we found the TBI participants reported higher levels of temporal demand, better

performance, and overall subjective workload compared to the HC participants,  $ps < .05$ ,  $\eta ps^2 = .06-.07$ . Finally, we found a main effect between ethnic groups on the CFS, where the Latinx participants reported better performance compared to Caucasian participants,  $p = .001$ ,  $\eta p^2 = .14$ . ANOVAs revealed the HC group outperformed the TBI group on VF, DF, and CFS demographically adjusted T-scores,  $ps < .05$ ,  $\eta ps^2 = .11-.23$ . Additionally, we found Latinx participants underperformed compared to Caucasians on the DF task,  $p = .039$ ,  $\eta p^2 = .06$ .

**Conclusions:** As predicted, we found individuals with TBI demonstrated fluency deficits compared to HC participants. Furthermore, persons with TBI reported greater perceived workload across fluency tests compared to HC participants. Finally, Latinx participants rated higher perceived workload across fluency tests compared to Caucasian participants. Our data suggests participants perceived their performance difficult in a way that is consistent with their VF and DF performance.

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**Keywords:** traumatic brain injury, verbal abilities

## **R. ZACHAR-TIRADO, Z. CHEN, J. DONDERS. Clinical Utility of the Patient Health Questionnaire–Adolescent in Adolescents with Traumatic Brain Injury.**

**Objective:** To determine the clinical utility of the Patient Health Questionnaire–Adolescent (PHQ-A) in screening for depressive disorders in adolescents following traumatic brain injury (TBI).

**Participants and Methods:** Adolescents ( $n = 101$ ) with mild to moderate-severe TBI who were referred for an outpatient neuropsychological evaluation at a regional rehabilitation facility within 1 to 12 months postinjury. Persons who failed performance validity tests were excluded, as were potential participants with serious premorbid neurological (e.g., hydrocephalus) or developmental (e.g., autism spectrum) disorders, or prior psychiatric conditions that required hospitalization (e.g., schizoaffective disorder). The main outcome measures were the Patient Health Questionnaire-Adolescent (PHQ-A), the PHQ-A\_2 (2-item version), and the Processing Speed Index (PSI) from the Wechsler scales of intelligence.

**Results:** When the PHQ-A cut-off for potentially clinically significant symptoms was set as  $> 4$ , both premorbid depressive disorder and PHQ-A scores predicted a postinjury diagnosis of depressive disorder, with a combined sensitivity of 0.91 and specificity of 0.59. PHQ-A\_2 did not reach acceptable levels of sensitivity in predicting suicidal thoughts. PHQ-A scores did not add significantly to the prediction of PSI results after accounting for TBI severity.

**Conclusions:** PHQ-A has clinical utility as a screening instrument for depressive disorders in outpatient adolescents with TBI when the cutoff for clinically significant concern is set at more than 4 (as opposed to the cutoff score of more than 9 used with adult populations) and when premorbid psychiatric history is also taken into account. Relying on the PHQ-A\_2 has the risk of potentially missing some cases with suicidal thoughts. Current level of depressive symptoms, as assessed by the full PHQ-A, do not appear to affect performance on cognitive measures that are known to be sensitive to severity of TBI in adolescents who pass performance validity tests.

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**Keywords:** adolescence, depression, traumatic brain injury

**J. LENGENFELDER, H. M. GENOVA, J. LEDDY, J. MORECRAFT, A. ALEXANDER, N. CHIARAVALLOTI. Theory of Mind in Pediatric Traumatic Brain Injury: The Jack and Jill Task.**

**Objective:** Understanding the intentions and mental states of others is an aspect of theory of mind (ToM). This work evaluates ToM in pediatric traumatic brain injury (pTBI) using the Jack and Jill Task. This task examines the understanding of intentional thinking by evaluating the awareness of what others know and their ability to predict how others will act.

**Participants and Methods:** 22 children with TBI, (age:  $M=11.82$ ,  $SD=3.66$ ) and 22 typically developing children (TDC; age:  $M=10.95$ ,  $SD=3.12$ ) completed the Jack and Jill Task. The task consists of 32 random trials consisting of a frame of 3 cartoons, each of which is comprised of a character (Jack, Jill), 2 hats (red, blue) and a ball. In Frame 1, Jack holds a ball above one of the 2 hats, which is witnessed by Jill. In Frame 2, Jack drops the ball into either the same hat in Frame 1 (unswitched) or the different color hat (switched). Frame 2 was either not seen by Jill (unwitnessed) or seen by Jill (witnessed). Participants are asked to respond to questions regarding which hat Jill will think ball is in (Frame 3).

**Results:** Results indicated a significant difference between children with TBI and TDC for the percent accuracy for the task (pTBI 75%, TDC 90%;  $F[1,44]=8.70, p=.005$ ). Reaction time to respond did not differ between the groups for the overall time ( $F[1,44]=1.29, p=.263$ ), for correct responses only ( $F[1,44]=0.95, p=.336$ ), or for incorrect responses only ( $F[1,44]=2.50, p=.621$ ). Performance on Jack and Jill was correlated with parental evaluations of social responsiveness (SRS;  $r=-.567$ ,  $p=.000$ ) and social communication traits (SCDC;  $r=-.394$ ,  $p=.010$ ).

**Conclusions:** The results suggest that children with TBI differ from TDC on a ToM task assessing intentional thinking. Children with TBI had greater difficulty evaluating what they believed Jill knew and how she would respond based on that knowledge. This aspect of social communication is not directly expressed in words, but relies on an understanding of intent and understanding. These findings imply that deficits in understanding indirect speech, such as intentional thinking, can have implications for a child's social success.

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**Keywords:** theory of mind, traumatic brain injury, child brain injury

**K. M. GREER, D. COBIA, A. SNYDER, S. JARVIS, C. JUNGE, M. READING, C. SQUIRES, E. D. BIGLER, H. TAYLOR, K. VANNATTA, C. GERHARDT, K. H. RUBIN, K. YEATES. Examination of Executive Functioning in Frontostriatal Circuitry in Pediatric TBI: A SOBIK Study.**

**Objective:** Childhood traumatic brain injury (TBI) is one of the most common causes of acquired disability and has significant implications for executive functions (EF), such as impaired attention, planning, and initiation, that are predictive of everyday functioning. One of the more prominent clinical features of TBI includes behavioral impulsivity, which may suggest disruption of frontal lobe function. Evidence has suggested attentional features of executive functioning require behavioral flexibility that are also dependent on frontostriatal circuitry. The purpose of this study was to evaluate surface-based integrity of a specific frontostriatal circuit in pediatric TBI and its role in attention and EF. Regions of interest included: the dorsolateral prefrontal cortex (DLPFC), caudate nucleus, globus pallidus, and the medial dorsal nucleus of the thalamus. We hypothesized that greater neuroanatomic abnormalities in this DLPFC circuit would be observed in the TBI group relative to an orthopedic injury (OI) comparison group, and

that abnormalities in basal ganglia structures would be associated with greater impairment in attention and EF.

**Participants and Methods:** T1-weighted magnetic resonance images were obtained in a sample of children ages 8-12 with complicated mild, moderate, or severe TBI (n=32) and a group of comparison children with OI (n=30). The caudate (CD), globus pallidus (GP), and medial dorsal (MD) nucleus of the thalamus were characterized using high-dimensional brain mapping, and DLPFC cortical thickness using the FreeSurfer toolkit, to determine frontal-subcortical circuit integrity. Aspects of attention and EF were assessed using select subtests from the Test of Everyday Attention for Children (TEA-Ch). Repeated-measures ANOVA models tested group differences in cortical thickness and mean deformation of the MD, vertex-wise statistical surface maps and MANOVA models evaluated differences in subcortical surface shape, and correlation models evaluated relationships with a global measure of attention and EF.

**Results:** Statistical surface maps revealed significant inward deformation on ventral-medial aspects of the CD in TBI relative to OI but null results in the GP. Main effects for group were found in both cortical thickness of the DLPFC ( $F_{1,60} = 4.16, p = 0.046$ ) and MD mean deformation ( $F_{1,60} = 1.56, p = 0.037$ ). No significant relationships were found between attention and measures of brain integrity in the TBI group.

**Conclusions:** The overall aim of the study was to examine whether structural integrity of dorsolateral prefrontal circuitry in a sample of pediatric TBI related to performance on measures of attention and EF. Findings revealed abnormalities in various aspects of the DLPFC circuit in pediatric TBI, which may reflect broader pathophysiological mechanisms. In particular, localized volume loss in ventral CD may represent injury from the mechanical impact of CSF movement in lateral ventricles due to rapid deceleration of the head in TBI. A similar mechanism may also explain abnormalities in MD integrity given it forms part of the 3<sup>rd</sup> ventricle wall. In sum, select components of DLPFC circuitry appear vulnerable in pediatric TBI, but do not relate to performance on measures of attention.

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**Keywords:** brain injury

## **H. VANLANDINGHAM, C. GONZALEZ, R. ELLISON, A. LINDSEY, A. AARONSON, S. KLETZEL, A. GUERNON, M. STIKA, A. HERROLD, T. BENDER PAPE. Pairing Neurostimulation and Cognitive Intervention: A Theoretical Framework for Treatment of Co-Occurring TBI and PTSD.**

**Objective:** Rehabilitation of cognitive and psychosocial deficits resulting from traumatic brain injury (TBI) along with commonly co-occurring post-traumatic stress disorder (PTSD) continues to be an area of concern in healthcare. Cognitive intervention research has not advanced at the same pace as other areas of medicine and there is increased need for procedures that will yield consistent gains indicative of recovery of function towards baseline. Intermittent theta burst stimulation (iTBS), a form of repetitive transcranial magnetic stimulation (rTMS), has potential as an instrument that can be tailored to aid cognitive processes and support functional gains. The use of iTBS enables direct stimulation of the neural system and paired with behavioral interventions it is likely to enhance rehabilitation of skills hindered by neurological trauma. We hypothesize that iTBS performed in conjunction with behavioral interventions (e.g., cognitive rehabilitation) is likely to result in additive success facilitating cognitive restoration and adaptation. The purpose of this poster is to provide a theoretical review based on intervention

research to illustrate how the technical and physiological aspects of iTBS can enhance other forms of neurorehabilitation for individuals with TBI. Future findings have the potential to be translated to other complex neuropsychiatric conditions.

**Participants and Methods:** Data from studies of rTMS/iTBS were used to develop a theoretical framework derived, in part, from multimodal approaches utilized in the treatment of depression, disorders of consciousness, and cognitive deficits secondary to TBI. Studies examining the use of rTMS/iTBS as a tool to enhance cognitive processes in healthy neurotypical individuals were also reviewed. Several neuroimaging methods were frequently used in these studies including structural and functional magnetic resonance imaging. Outcomes measures include symptom scales, cognitive performance tests, and physiological measures.

**Results:** Studies of rTMS/iTBS have shown that neurostimulation is capable of altering neural networks, increasing cerebral blood flow and promoting functional connectivity in a manner that may benefit special populations such as persons with a history of TBI. Targeting regions such as the DLPFC with iTBS/rTMS has the potential to engender a neural network that is malleable and subsequently capable of adaptive functional changes.

**Conclusions:** Rehabilitation of cognitive-psychosocial deficits experienced by persons with TBI and commonly co-occurring PTSD requires interventions sufficient to induce a shift in neural processing that will be evidenced behaviorally by an enhancement in performance. Studies of rTMS/iTBS have shown that neurostimulation is capable of altering neural networks, increasing cerebral blood flow and promoting functional connectivity in a manner that may benefit special populations such as an individual with a history of TBI. Targeting regions such as the DLPFC with iTBS/rTMS has the potential to engender a neural network that is malleable and subsequently capable of adaptive functional changes. Pairing neurostimulation with cognitive interventions has the potential to augment long-term gains and better ensure generalization of rehabilitated and trained skills to everyday life. The proposed framework is intended to be a starting point for using rTMS/iTBS as a tool to remediate cognitive deficits.

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**Keywords:** traumatic brain injury, post-traumatic stress disorder

### **J. DONDERS, V. GARDNER. Short Versions of the TOMM in Pediatric TBI.**

**Objective:** To evaluate the classification accuracy of two abbreviated versions of the Test of Memory Malingering (TOMM) in prediction of results on the full-length instrument in children with traumatic brain injury.

**Participants and Methods:** The sample included 126 children, aged 6-16 years, who were evaluated within 1-12 months after traumatic brain injury.

**Results:** Both a version based on administration of Trial 1 and a version based on administration of only the first 10 items of Trial 1 had acceptable specificity (i.e., > .90) and sensitivity (i.e., > .60) with regard to prediction of pass / fail results on the complete TOMM. Failure on the TOMM suppressed performance on measures of processing speed that were otherwise sensitive to severity of traumatic brain injury.

**Conclusions:** We conclude that these abbreviated versions of the TOMM can be used with reasonable confidence in clinical practice with children with traumatic brain injury.

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**Keywords:** traumatic brain injury, assessment, effort

**G. Y. NAVARRO, A. J. FLYNN, H. K. BASEHORE. Can TBI & PTSD symptom clusters predict alcohol severity in a veteran population?**

**Background:** Between 2000-2019, approximately 414,000 Traumatic Brain Injuries (TBI) were reported among U.S Veterans with a majority reported as mild (mTBI). In addition, many service related TBIs co-occur with Post Traumatic Stress Disorder (PTSD), due to trauma caused by the TBI.

Associated with this comorbidity is alcohol misuse, with many veterans suffering from PTSD and TBI engaging in excessive alcohol consumption. While there is a cogent line of research showing alcohol misuse increases the likelihood of sustaining a mTBI (e.g., drunk driving leads to an accident-related TBI), other research has found the inverse relationship, with TBI identified as a risk factor in substance use disorder. For example, one study found that mTBI was related to an increased risk of alcohol misuse after controlling for PTSD, while another study found that only PTSD, not mTBI, predicted the presence of alcohol use disorder (AUD). However, this research remains ambiguous and has failed to consider how this comorbidity may influence the severity of alcohol misuse.

Consequently, the purpose of this study is to examine whether PTSD, mTBI and age can predict alcohol severity within a veteran population. This research is unique in that no known studies have evaluated this relationship using AUD severity.

**Methods:** 157 veterans were recruited from a residential substance use treatment program. All veterans were administered a structured clinical interview (SCID-5) that assessed for the presence and absence of AUD within the past year. Veterans that had at least three or more symptoms were identified as having AUD and were included in the analysis (n=60). Alcohol severity was assessed using the total score on the AUDIT, a self-report measure. TBI history was assessed via the OSU-TBI Identification Method (OSU) with TBI groups defined as: 1) TBI w/ loss of consciousness (LOC) prior to the age of 20; 2) TBI w/ LOC after the age of 20; 3) never sustaining a TBI. PTSD symptomology was assessed via PCL-5 for the DSM-V; PTSD symptom cluster scores were derived from this scale. Age was also included as a variable in this analysis.

**Results:** A linear regression model was conducted to examine whether PTSD clusters, age of youngest TBI w/LOC, and age could predict alcohol severity. Linear regression analyses revealed that none of the four symptom clusters were significant predictors of alcohol severity: 1) Intrusion (b=-.62, SEb=-3.86, p=.20); 2.) Avoidance (b=.34, SEb=.10, p=.65); 3.) Negative Alterations in Mood and Cognition: (b=.43, SEb=.36, p=.23); 4.) Hyperarousal (b=.25, SEb=.17; p=.54). Additionally, the age at which a TBI was sustained was not a significant predictor of alcohol severity: 1) TBI w/ LOC under 20 (b=2.95, SEb=.16, p=.33); 2.) LOC over 20 (b=4.44, SEb=.22, p=.168). Consequently, the overall model was non-significant (F (54) =1.19, p=.33).

**Discussion:**

Previous research has demonstrated that complexity in evaluating the role of TBI and PTSD in alcohol use severity, with these results failing to clarify the literature. Further research is needed to explore potential reasons behind these inconsistent results, such as the method of evaluating mTBI.

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**Keywords:** alcohol, post-traumatic stress disorder, mild traumatic brain injury

**B. MARTIN, J. SOBER, S. MILLIS, R. A. HANKS, S. RESLAN, B. WALDRON-PERRINE. CVLT-3 Response Bias as an indicator of engagement in a litigating mTBI population.**

**Objective:** Performance patterns on the California Verbal Learning Test-Second Edition (CVLT-II) have been used to differentiate individuals with moderate or severe traumatic brain injury (TBI) from those with uncomplicated mild traumatic brain injury (mTBI) who were insufficiently engaged in the context of pending litigation. However, little research has been conducted examining the efficacy of performance indices on the CVLT-3 for these groups. Delis, Kramer, Kaplan, & Ober, in the CVLT-3 manual, speculated response bias (i.e., the tendency toward answering 'yes' or 'no') would distinguish between persons with true memory deficits demonstrating a 'yes' bias and persons with poor task engagement, demonstrating a 'no' bias. This study examined the efficacy of response bias in differentiating between moderate and severe TBI and mTBI litigating samples with poor engagement.

**Participants and Methods:** Participants included 107 individuals, divided into two groups: moderate to severe TBI (n = 56) and an mTBI litigating group who demonstrated insufficient engagement (n = 51) as measured by failure on at least two performance validity tests. (e.g., TOMM, Word Memory Test, Warrington Recognition Memory Testing, Reliable Digit Span, Dot Counting). Archival CVLT-II data was rescored utilizing the CVLT-3 scoring and normative data. Receiver operator characteristic (ROC) curve analysis was used to evaluate the diagnostic discriminability of the two response bias indices. The ROC area under the curve (AUC) is a measure of discriminability: adequate discrimination was defined as AUC of 0.7 to <0.8; and excellent discrimination was defined as AUC  $\geq$  .8. Parametric and nonparametric response bias scaled scores were compared between groups and the sensitivity and specificity of cutoff scores were determined.

**Results:** The AUC of .793 for parametric response bias and an AUC of .757 for nonparametric response bias was found to differentiate between persons with moderate to severe TBI and persons with mTBI who showed poor engagement. Parametric response bias was found to be a more sensitive predictor of group status than nonparametric response bias ( $z = 2.53, p < .05$ ). Specificity and sensitivity to inadequate engagement/no response bias were calculated for various parametric response bias scaled scores. Sensitivity of 86% and specificity of 66% was associated with a scale score of >10. Specificity increased to 89% while sensitivity decreased to 47% when the scaled score cutoff was >14.

**Conclusions:** The CVLT-3 response bias score shows good sensitivity and specificity when differentiating between individuals with moderate to severe TBI and individuals with mTBI who show insufficient engagement. As speculated by Delis et al. (2017), insufficient engagement is indicated by a no response bias and may be a useful tool to ensure adequate engagement prior to score interpretation within an mTBI population.

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**Keywords:** effort, mild traumatic brain injury, traumatic brain injury

**M. URETSKY, S. CRONIN, D. ROUSSEAU, B. ABDOLMOHAMMADI, E. NAIR, N. SALTIEL, A. SHAH, B. MARTIN, Y. TRIPODIS, B. R. HUBER, T. STEIN, A. MCKEE, M. ALOSCO, J. MEZ. Quantitating Aggressive Symptomology in Chronic Traumatic Encephalopathy: A Factor Analysis of the Brown-Goodwin Assessment for Lifetime History of Aggression.**

**Objective:** Chronic traumatic encephalopathy (CTE) is a neurodegenerative disease associated with exposure to repetitive head impacts (RHI) incurred during contact sports, military combat, and other sources. CTE currently cannot be diagnosed during life and its clinical presentation is ill-defined. Aggression has been described as a core clinical feature in brain donors pathologically diagnosed with CTE. However, the nature and etiology of aggressive behaviors in this setting is unclear. This study aimed to i) characterize subtypes of aggression present in brain donors exposed to RHI; and ii) analyze relationships of neurodegenerative pathology with these subtypes.

**Participants and Methods:** This study examined the properties of the Brown-Goodwin Assessment for Lifetime History of Aggression (BGLHA) among 527 deceased men exposed to RHI. Informants of brain donors were administered the 12-item BGLHA via retrospective telephone interview, with each item rated on a 4-point scale based on the number of occurrences of the behavior, for a total maximum score of 48. Neuropathological examinations were performed as part of the VA-BU-CLF Brain Bank UNITE Study. Neuropathologists diagnosed CTE and assigned a CTE stage based on validated criteria. Principal component analysis with varimax rotation was used to evaluate the factor structure of the BGLHA. Linear regressions examined associations of CTE and CTE stage with total adult BGLHA score and each of the factors, controlling for age at death, education, race (1=White, 0=other), number of concussions, cause of death (1=suicide, 0=other), military history (1=yes, 0=no), BGLHA total childhood score, and Alzheimer's disease pathology (1=present, 0=absent) at autopsy.

**Results:** The mean (SD) age at death was 60.27 (20.25) years, and 452 were American football players (85.77%). Exploratory factor analysis identified four factors—1) Emotional Dysregulation and Impulsivity (4 items) 2) Antisocial Behavior (3 items) 3) Physical Manifestation of Anger (3 items) and 4) Interpersonal Relations (2 items). Factor one accounted for 37.33% of the extracted variance. Factor two accounted for 10.39%, factor three 8.86%, and factor four 8.44%, with a cumulative variance explained of 65.02%. This differs from the literature, which reports two or three factors in small samples. Mean adult BGLHA score was 20.56 (SD=6.88), indicating a high level of aggression. Neither the presence of CTE (beta=-0.61,  $p>.05$ ) nor CTE stage level (beta=-0.32,  $p=.13$ ) were associated with BGLHA score or any of the factors ( $ps>.05$ ). Adult BGLHA score was associated with education level (beta=-0.65,  $p=.01$ ) and age at death (beta=-0.06,  $p<.01$ ).

**Conclusions:** The BGLHA captures different types of aggression in deceased men exposed to RHI including emotional dysregulation and impulsivity, antisocial behavior, physical manifestations of anger, and negative interpersonal relations. After adjusting for baseline childhood levels of aggression and other covariates, higher BGLHA scores were not significantly associated with CTE pathology. Further clinicopathological and *in vivo* research that uses more refined scales of aggression is needed to better understand aggressive behaviors and their etiology, and determinants (including psychosocial and socioeconomic factors) among individuals exposed to RHI. This is indeed a critical next step to facilitate accurate *in vivo* disease detection, diagnosis of CTE, and other neurological disorders associated with RHI.

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**Keywords:** aggression, assessment, sports-related neuropsychology

**A. BICHLMEIER, D. W. LOPEZ-HERNANDEZ, P. Y. LITVIN, R. CERVANTES, F. ZAKARIAN, N. GRAUB, R. RUGH-FRASER, J. KNIGHT, O. UGURU, A. J. BAEZ, I. MUNOZ, A. ARZUYAN, P. M. VESPA, B. CUI, D. PLURAD, D. A. HOVDA, J. FUSTER, D. BUDDING, E. WOO, D. J. HARDY, M. J. WRIGHT.** **The Effect of Anxiety and Depression Symptoms on Switching and Clustering Performance in Traumatic Brain Injury.**

**Objective:** Using the Hospital Anxiety and Depression Scale (HADS), we examined the relationship between symptoms of anxiety (HADS-A) and depression (HADS-D) on letter fluency, semantic fluency, and switching and clustering for both letter and semantic fluency tasks in traumatic brain injury survivors (TBI) and healthy comparison participants (HC).

**Participants and Methods:** The sample included 57 HC (49% with abnormal symptoms of anxiety and 18% with abnormal symptoms of depression), 36 acute TBI adults (ATBI; 31% with abnormal symptoms of anxiety and 28% with abnormal symptoms of depression), and 32 chronic TBI adults (CTBI; 53% with abnormal symptoms of anxiety and 28% with abnormal symptoms of depression).

**Results:** ANCOVAs, controlling for sex and age, revealed the HC group outperformed both TBI groups only on semantic fluency,  $p=.000$ ,  $\eta p^2=.16$ . HC outperformed ATBI participants on letter fluency,  $p=.03$ ,  $\eta p^2=.05$ , and semantic switching,  $p=.001$ ,  $\eta p^2=.11$ . Next, HC outperformed CTBI group on semantic clustering,  $p=.014$ ,  $\eta p^2=.08$ . Furthermore, participants with greater anxiety symptoms showed worse semantic clustering in contrast to those with minimal/normal symptoms of anxiety,  $p=.04$ ,  $\eta p^2=.04$ . Finally, an interaction emerged between semantic fluency and depression ratings, with the CTBI with minimal/normal depressive symptoms outperforming CTBI with clinical levels of depressive symptomology,  $p=.04$ ,  $\eta p^2=.05$ .

**Conclusions:** As expected, the HC group outperformed both TBI groups on various measures of verbal fluency, as expected. We also found that anxiety adversely influenced semantic fluency clustering performance. Additionally, depression tended to have more of a negative impact on CBTI performance on semantic fluency than in HC or ATBI participants. Our data suggests that symptoms of anxiety and depression influence semantic fluency performance more than letter fluency.

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**Keywords:** traumatic brain injury, executive functions, anxiety

**L. WOOD, J. HANSEN, M. R. UDALA, E. S. WANDINGER, J. L. SCOTT, M. LIBBEN, H. MILLER.** **Validity of the Verbal Concept Attainment Test in Traumatic Brain Injury.**

**Objective.** Executive dysfunction predicts poorer functional outcomes in patients with traumatic brain injury (TBI; Ponsford, Draper, & Schonberger, 2008), thus accurate assessment of executive functioning is needed. The most commonly used measures of executive functioning largely rely on nonverbal stimuli. The Verbal Concept Attainment Test (VCAT) is a measure of verbal abstract reasoning, concept formation, and hypothesis testing. Despite preliminary research suggesting that the VCAT may be uniquely equipped to assess verbally-mediated aspects of executive functioning, the clinical utility of the VCAT has yet to be extensively examined in a TBI population. Thus, the objective of the present study was to examine the validity of the VCAT in a TBI sample.

**Participants and Methods.** The sample consisted of 133 patients with TBI referred for neuropsychological evaluation at a private clinic in Western Canada. All participants completed the VCAT as part of their assessment. Patients had a mean age of 37.68 ( $SD = 16.83$ ) years and

an average of 12.11 ( $SD = 2.25$ ) years of education. Information on TBI severity was also collected (mild  $n = 47$ , moderate  $n = 24$ , severe  $n = 23$ , undefined  $n = 37$ ).

**Results.** Scores on the VCAT for the entire sample ranged from 0 to 23 ( $M = 15.41$ ,  $SD = 5.56$ ,  $Mdn = 17.00$ ). Years of education and TBI severity were significantly correlated with VCAT scores. VCAT scores significantly differed between those with mild vs. severe TBI. The VCAT significantly correlated with all 15 neuropsychological measures but was most strongly related to measures of nonverbal perceptual reasoning, executive function (including Consonant Trigrams, Controlled Oral Word Association Test, and the Booklet Category Test), and verbal memory.

**Conclusions.** The results show that the VCAT demonstrates sufficient criterion validity in a sample of TBI patients. Further, the findings show that TBI severity is an important factor to consider when interpreting VCAT scores. Inclusion of the VCAT in future TBI research and assessment will provide important insights into verbally-mediated aspects of executive functioning.

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**Keywords:** assessment, traumatic brain injury, executive functions

**O. UGURU, D. W. LOPEZ-HERNANDEZ, P. Y. LITVIN, A. BUENO, R. RUGH-FRASER, J. KNIGHT, R. CERVANTES, I. RITCHIE, N. GRAUB, A. BICHLMEIER, S. MANGASSARIAN, W. OLMOS, A. J. BAEZ, D. J. HARDY, D. BUDDING, P. M. VESPA, D. A. HOVDA, D. L. MCARTHUR, D. PLURAD, J. FUSTER, E. WOO, M. J. WRIGHT.**  
**Examining Verbal Memory Deficits in Latinx Traumatic Brain Injury Survivors Compared to Healthy Adults.**

**Objective:** We examined the relationship between verbal memory performance and traumatic brain injury (TBI) for Latinx and Caucasian survivors of TBI and healthy comparison participants (HCP).

**Participants and Methods:** The sample consisted of 44 HCP (22 Latinx; 22 Caucasians), 39 acute TBI (ATBI; 13 Latinx; 26 Caucasians), and 26 chronic TBI (CTBI; 9 Latinx; 17 Caucasians) participants. The California Verbal Learning Test Second Edition (CVLT-II) was used to evaluate verbal memory performance.

**Results:** ANOVAs were conducted to determine group differences between participants with and without TBI on the CVLT-II. HCP outperformed the ATBI group on CVLT-II learning trials (LT),  $p = .001$ ,  $n_p^2 = .13$ , short-delay free recall,  $p = .000$ ,  $n_p^2 = .19$ , short-delay cue recall,  $p = .000$ ,  $n_p^2 = .21$ , and recognition discriminability,  $p = .005$ ,  $n_p^2 = .10$ . We found HCP outperformed both TBI groups on long delay free recall (LDFR),  $p = .000$ ,  $n_p^2 = .22$ . Furthermore, HCP and CTBI outperformed the ATBI group on long delay cued recall (LDCR),  $p = .000$ ,  $n_p^2 = .24$ . In addition, Caucasians outperformed Latinx on the LT,  $p = .017$ ,  $n_p^2 = .05$ . An interaction emerged on LDCR,  $p = .041$ ,  $n_p^2 = .06$ , with Caucasian ATBI outperforming Latinx ATBI, Latinx CTBI outperforming Caucasian CTBI, and HCP Caucasian outperforming HCP Latinx participants.

**Conclusions:** Overall, ATBI survivors performed worse than HCP on the verbal list learning task. In addition, Caucasians demonstrated better verbal memory abilities compared to Latinx and the CTBI group demonstrated better LDCR abilities compared to the ATBI group. Moreover, the HCP and CTBI group statistically differed on the LDFR task only, with the HCP group outperforming the CTBI group. These findings give insight into a possible course of verbal memory change across time and multiple stages of TBI recovery.

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**Keywords:** traumatic brain injury

**S. MANGASSARIAN, D. W. LOPEZ-HERNANDEZ, A. BUENO, S. FATOORECHI, W. OLMOS, J. KNIGHT, N. GRAUB, K. E. SMITH, E. LOPEZ, I. MUNOZ, R. RUGH-FRASER, T. L. VICTOR, D. BUDDING, P. M. VESPA, M. RICO, H. RAD, E. WAITE, O. UGURU, D. A. HOVDA, D. L. MCARTHUR, D. PLURAD, J. FUSTER, E. WOO, D. J. HARDY, P. Y. LITVIN, M. J. WRIGHT. Bilingualism Benefits Neuropsychological Function in Traumatic Brain Injury.**

**Objectives:** We examined Spanish-English bilinguals (B) and English-monolinguals (M) traumatic brain injury survivors (TBI) and healthy comparison (HC) adults on several neuropsychological tasks.

**Participants and Methods:** The sample consisted of 50 TBI (30 TBI-M; 20 TBI- B) and 47 HC (24 HC-M; 23 HC-B) participants. All participants passed performance validity testing. Adjusted demographic scores (T-scores) were used to evaluate cognition performances.

**Results:** ANCOVAs controlling for gender, revealed the HC outperformed the TBI group on measures of memory, attention and processing speed, and executive function,  $ps < .05$ ,  $\eta_p^2 = .03-.16$ . Furthermore, main effects were found between language groups with B outperforming M on some measures of attention, memory, executive ability, and language,  $ps < .05$ ,  $\eta_p^2 = .04-.26$ . Interactions emerged on measures of memory and executive function, with TBI-B outperforming TBI-M while HC-M and HC-B participants performed similarly. An additional interaction was observed in response inhibition where HC-M outperformed HC-B while TBI-M and TBI-B performed similarly.

**Conclusions:** As expected, the HC outperformed the TBI group on several neuropsychological tasks. Our data also revealed that on some measures HC-M outperformed HC-B on several tasks consistent with data from published literature. However, we found that bilingualism conferred some benefits in memory and executive ability in individuals with TBI.

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**Keywords:** cognitive functioning, traumatic brain injury

### **Symposium 08: Cognitive Stimulation Therapy (CST) for dementia: Adaptation, validation and implementation challenges in developing regions**

**Chair and Presenter: Elodie Bertrand**

**Presenters: Aimee Spector, Fernanda Fucci, Renata Naylor**

**1:00 PM - 2:00 PM**

**E. BERTRAND, A. SPECTOR, F. FUCCI, R. NAYLOR. Cognitive Stimulation Therapy (CST) for dementia: Adaptation, validation and implementation challenges in developing regions.**

Developing regions account for most people with dementia (PwD) in the world, with an increase in numbers in the next years. Nevertheless, non-pharmacological treatment is seldom offered in

these regions. Cognitive Stimulation Therapy (CST) is an evidence-based psychosocial intervention developed in the UK, with proven positive effects on cognition and quality of life, and established cost-effectiveness.

In this symposium the challenges faced by researchers from developing regions adapting, validating and implementing CST will be discussed, with behavioral and neuroimaging data collected in these regions being presented.

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**Keywords:** dementia - Alzheimer's disease, cognitive rehabilitation, neuroimaging: structural

### **A. SPECTOR. Cognitive Stimulation Therapy for dementia: International implementation in Brazil, India & Tanzania (CST-International).**

**Objective:** Currently, there are 27.3 million people with dementia in lower and middle-income countries (LMICs). Dementia is largely unrecognised and untreated in LMICs due to a lack of awareness among the population and health care professionals, scarcity in resources, limited understanding of supporting sustainable interventions and a lack of priority on health/social agendas of policy makers. CST is a brief, evidence-based, effective and cost effective intervention for people with mild to moderate dementia, developed in the UK, with 14 thematic sessions following a set of guiding principles which include 'mental stimulation', 'new ideas, thoughts and associations' and 'opinions rather than facts'. The key aim of this study is to develop, test, refine and disseminate implementation strategies for CST for people with dementia in three diverse parts of the world. The main objective is to create an ongoing and sustainable CST implementation programme which ultimately increases quality of life and cognition for people with dementia (PwD). A secondary objective is to increase awareness and skills in the detection and management of dementia, both for health workers and families.

**Participants and Methods:** Brazil, India and Tanzania will participate with contribution from health professionals, policy makers, caregivers and PwD. The study was designed around two key models of implementation. Damschroder's Consolidated Framework for Implementation Research (CFIR) and the APEASE model. The plan is divided into 4 phases: 1) Investigation of the likely barriers and facilitators of implementation / ethics procedures; 2) Development of implementation strategy; 3) Testing the implementation strategy; and 4) Pathway to Practice.

**Results:** For each country, a clear, ongoing implementation plan targeting policy maker, clinicians, academics, service users and carers was produced. For local dissemination, oral presentations were conducted, given their perceived effectiveness. Advertisements were made on local websites and newsletters and briefing documents were produced for commissioners exploring the costs and requirements of providing CST. A dissemination workshop for service providers, policy and decision makers will be held in each country at the end of the programme, aiming to discuss the costs, maintenance and upscaling of the proposed plans at local, national and regional levels. In addition, a Dementia Awareness Course (DAC) has been created for each region.

**Conclusion:** Due to limitations on pharmacological treatment, there is an urgent need for the implementation of low cost non-pharmacological interventions. CST is an intervention with proven effectiveness, reducing the burden of dementia and creating substantial engagement with relevant local stakeholders, enabling its ongoing implementation once the project is complete. A positive impact on cognition and quality of life is expected with larger scale implementation of CST, reducing the global costs of dementia.

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#### **F. FUCCI. Challenges for adapting and implementing Cognitive Stimulation Therapy in Brazil .**

**Objective:** Cognitive Stimulation Therapy (CST) is a psychosocial therapy developed at University College London (UCL). Studies have shown that it leads to benefits on cognition, mood, and quality of life. Considering it was developed in the United Kingdom, CST structure and contents needs to be adapted to better suit other regions, being adjusted to Brazil's characteristics such as its health system and sociodemographic profile.

**Participants and Methods:** For adaptation, four focus groups and individual interviews were conducted with healthcare professionals, caregivers and people with dementia (PwD) (n=37). The data was transcribed and then analyzed following the Framework Method. For implementation, focus groups were conducted with three groups (n =15) divided as: a) health policy makers, b) potential facilitators, c) potential recipients and caregivers. Data was transcribed and categorized into a guide with steps for implementation.

**Results:** Regarding adaptation, barriers commonly identified were: transportation; motivation of PwD to be part of the group; more work for the caregivers; and frequency of the sessions. The main facilitators were: caregivers support; more than one session per day; group activities and activities for caregivers. Implementation focus groups highlighted the importance of adapting CST according to the specific setting where it is being implemented, promoting dementia awareness courses, educating general population and policy makers of the benefits of the intervention, including its low-cost effectiveness, and adapting materials to illiterate PwD.

**Conclusions:** The results indicate that CST is a research priority in Brazil due to the lack of validated non-pharmacological interventions for dementia in this country. Cultural and structural adaptations are necessary considering Brazil's cultural diversity and economic disparities. Implementation must follow a guided program to reach a broad coverage nationwide.

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#### **R. NAYLOR. Cognitive stimulation therapy for people with dementia in Brazil (CST-Brazil): Results from a single blind randomized controlled trial.**

**Objective:** Psychosocial interventions are recognized as useful tools to ameliorate the difficulties presented by people with dementia (PwD). Cognitive stimulation therapy (CST) is an evidence-based psychosocial intervention, recommended and implemented in many countries. The present study aims to explore feasibility and obtain preliminary data on the efficacy of CST-Brazil in a sample of 47 people with mild to moderate dementia attending an outpatient unit.

**Participants and methods:** A single-blind design was used, with participants being randomly allocated to either 14 sessions of CST + treatment as usual (TAU; n = 23) or TAU (n = 24) during 7 weeks. Changes in cognition, quality of life, depressive symptoms, caregiver burden and activities of daily living (ADL) were measured.

**Results:** PwD receiving CST and their family caregivers expressed accepted well the intervention, with low attrition and high attendance. Participants receiving CST showed significant improvements in mood and in ADL compared to TAU. There were no significant effects in cognition, quality of life and caregiver burden.

**Conclusions:** CST-Brasil proved to be a feasible and useful intervention to improve mood and, to a smaller degree, ADL in PwD, with high acceptance between study participants. CST-Brasil is a promising psychosocial intervention for dementia and should be explored in other clinical settings to allow generalization to a wider Brazilian context.

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**E. BERTRAND. Cognitive stimulation therapy for people with dementia in Brazil (CST-Brasil): Neuroimaging findings.**

**Objective:** Psychosocial interventions are important tools to improve cognitive and behavioral difficulties in people with dementia (PwD) and their caregivers. Cognitive stimulation therapy (CST) is a psychosocial intervention with a solid base of evidence indicating its beneficial effects in this clinical group. Nevertheless, to date, no study has explored the neural correlated of improvements mediated by CST.

**Participants and methods:** A single-blind design was used, with participants being randomly allocated to either 14 sessions of CST + treatment as usual (TAU; n = 12) or TAU (n = 17) during 7 weeks. Neuroimaging was performed in all participants pre- and post-intervention on a 3T Siemens Trio Scanner. The imaging protocol included the following sequences: 1) high-resolution T1-based magnetization prepared rapid acquisition gradient echo; 2) 3D fluid attenuated inverse recovery; 3) Echo planar imaging (EPI) based functional MRI during rest; 4) EPI-based diffusion tensor imaging.

**Results:** PwD receiving CST showed increases in left hemisphere rostral frontal surface area and increased thickness in right hemisphere supramarginal and poscentral regions. rs-fMRI findings indicate that reduction in depressive symptoms was associated with changes in functional connectivity of the subgenual cortex.

**Conclusions:** Structural and functional changes were observed in response to CST, indicating potential mechanisms of action, from a neurobiological perspective, of this intervention.

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**Symposium 09: Neuropsychological Evaluation of Epilepsy Presurgical Candidates: From the Clinic to the Operating Room**

**Moderator: Cady Block**

**Chair: Kelsy C. Hewitt**

**Co-Chair and Presenter: Amanda Gooding**

**Presenters: Daniel Loring, David Sabsevitz, Daniel Drane**

**1:00 PM - 2:00 PM**

**C. BLOCK, K. C. HEWITT, D. SABZEVITZ, A. GOODING, D. LORING, D. L. DRANE. Neuropsychological Evaluation of Epilepsy Presurgical Candidates: From the Clinic to the Operating Room.**

According to the World Health Organization, more than 50 million people worldwide have epilepsy, nearly 80% of which reside in low- and middle-income countries. Not only is epilepsy

one of the most common neurological disorders, it is also one of the most functionally limiting due to a combination of cognitive and behavioral sequelae as well as social stigma. An estimated 70% of people with epilepsy could be seizure-free if properly evaluated, diagnosed, and treated. Fortunately, treatment nowadays has progressed well beyond pharmacokinetic agents to include newer, more selective surgical techniques, laser interstitial thermal therapy (LITT procedure), or neurostimulation techniques such as deep brain stimulation (DBS) or responsive neurostimulation (RNS).

Even with the advent of new techniques for diagnosing and treating epilepsy, the neuropsychologist remains an especially valuable member of the integrated care team in the assessment and management of these patients. The role of the neuropsychologist is multifaceted. First, outpatient evaluation with standard neuropsychological assessment measures continues to play an important part in the lateralization and localization of eloquent cognitive functions such as language and memory – as well as helpful in the prediction of risk for postoperative cognitive decline in these domains. It is also highly informative with regards to emotional well-being and quality of life. Second, the neuropsychologist continues to be critical in conducting and interpreting the Wada test in order to better understand a patient's language and memory representation within each cerebral hemisphere. More recent is the neuropsychologist's involvement in functional mapping and neurostimulation evaluation and treatment paradigms, both of which have opened up new avenues to understanding the brain and providing treatment options to patients that may not have been considered candidates for traditional surgical approaches.

In this symposium, attendees will learn more about each of these areas in which the neuropsychologist has come to contribute to the evaluation and care of patients with epilepsy: outpatient evaluation, Wada testing, functional mapping, and minimally invasive procedures (LITT, DBS, RNS). The symposium features four expert neuropsychologists who work within epilepsy centers in internationally recognized academic medical institutions:

Amanda Gooding, PhD, ABPP

Associate Professor of Psychiatry

University of California at San Diego; San Diego, California, USA

Daniel Drane, PhD, ABPP

Associate Professor of Neurology

Emory University; Atlanta, GA, USA

Daniel Loring, PhD, ABPP

Professor of Neurology

Emory University; Atlanta, GA, USA

David Sabsevitz, PhD, ABPP

Associate Professor of Neurology

Mayo Clinic; Jacksonville, FL, USA

More specifically, Dr. Gooding will speak to the role of the neuropsychologist in outpatient evaluation. Dr. Loring will speak to the role of the neuropsychologist in Wada testing. Dr. Sabsevitz will speak to the role of the neuropsychologist in functional mapping. Dr. Drane will speak to the role of the neuropsychologist in evaluation and consideration of candidacy for minimally invasive procedures (LITT DBS, and RNS). Note: this event is sponsored by the Epilepsy Special Interest Group (SIG) of the INS, and moderated by one of the SIG Co-Chairs, Dr. Cady Block (Department of Neurology, Emory University; Atlanta, GA, USA).

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**Keywords:** epilepsy / seizure disorders, epilepsy / seizure disorders - surgical treatment, neurostimulation

### **A. GOODING. Role of the Neuropsychologist and Neuropsychological Evaluation in the Epilepsy Presurgical Process.**

**Objective:** To elucidate the role of the neuropsychologist within the integrated epilepsy surgery team, and define the standard of care for patients regarding outpatient neuropsychological evaluations, at specialty epilepsy care centers within academic medical institutions.

**Methods:** Dr. Gooding will discuss common data elements, etiologies, treatments, and the presurgical pathway for potential candidates for epilepsy intervention. She will also review what constitutes an optimal neuropsychological battery for determination of seizure lateralization and localization, integration of objective findings with behavioral observation, interpretation of subjective report measures, and review useful report recommendations related to cognition, neuropsychiatric function, emotional well-being, psychosocial adjustment, and overall quality of life.

**Results:** The epilepsy surgery process is driven by a patient's desire to benefit from seizure freedom and improved quality of life – and the neuropsychologist is an important member the integrated epilepsy care team, helping to ascertain seizure lateralization/localization as well as associated emotional and functional impacts. As the field has developed further, it has come to some agreement on what constitutes best measures (i.e., NIH Common Data Elements), interpretation of findings, and application of findings to outcome prediction. In fact, neuropsychological performance has indeed been shown to be related to postsurgical outcomes.

**Conclusions:** The WHO estimates around 50 million people worldwide have epilepsy, and it is recognized as one of the most functionally limiting neurological disorders given its range of cognitive and behavioral sequel along with its associated social stigma. While the advent of imaging technology has vastly increased our understanding of epilepsy and the brain, especially the structural and functional implications of seizure disorders, traditional neuropsychological assessment continues to offer something unique and maintains its status as an important component in the presurgical epilepsy process as well as the overall care of this patient population.

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### **D. LORING. Use of the Wada Test in Epilepsy Presurgical Candidates.**

**Objective:** To provide information and case application of the Wada test, a unique contribution of neuropsychology in the evaluation of presurgical epilepsy candidates.

**Methods:** Dr. Loring will present on the Wada test, first providing a brief background of the procedure with respect to historical impetus, development, initial interpretations, adaptation to include a memory component, and attempts at standardization in the decades since its inception. Dr. Loring will then review one such protocol, developed at the Medical College of Georgia in Georgia, USA. He will also discuss the differences for stimuli, timing, dosages, anesthetic agents, and interpretation of test performance. He will then address testing concerns, interpretation, and include an applied case presentation component to facilitate understanding of

the use of this technique with real clinical patients and how it can help to inform postsurgical risks to cognition as well as potentially improve health-related quality of life.

**Results:** The Wada test is a technique conducted in the operative suite that involves arterial administration of amobarbital or other short-acting barbiturate to transiently inactivate brain function in the distribution of the injected artery. Following injection, the neuropsychologist conducts bedside cognitive testing is performed. This procedure became a routine component of the pre-operative evaluation for epilepsy surgery in the mid-1950s although memory testing was not added until the 1960s. Despite the increase in other imaging techniques, Wada testing in epilepsy surgery continues to be a routine neuropsychological procedure to evaluate surgical candidates whose language or memory function warrants further evaluation.

**Conclusions:** With learning the Wada's history and case presentation, this presentation will increase awareness in interpretation and potential pitfalls with Wada testing. Though Wada testing has been increasingly displaced by EEG video monitoring, MRI of the hippocampus, PET, SPECT, fMRI, and even multi-modality imaging, it continues to play a critical role in understanding brain-behavior relationships.

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#### **D. SABZEVITZ. Functional Mapping in Epilepsy Presurgical Candidates.**

**Objective:** To provide information and case application of functional mapping, a relatively more recent but growing contribution of neuropsychology in the evaluation of presurgical epilepsy candidates.

**Methods:** Dr. Sabsevitiz will discuss functional mapping, a technique conducted in the operative suite that is primarily used to identify the functional correlate (e.g., language) of a particular brain region. He will discuss his experiences as a neuropsychologist participating in functional mapping at academic medical institutions, including his current institution the Mayo Clinic at Jacksonville. He will review brain targets, techniques, protocols, and interpretation of performance as well as provide applied examples. He will also review a tablet-based testing platform called NeuroMapper that he developed in 2016, which has now been used with over 200 surgical patients.

**Results:** Functional mapping is a technique conducted in the operative suite where patients with epilepsy or brain tumors have electrodes placed on or within brain tissue. These electrodes help to stimulate and map the underlying function (e.g., sensation, motor function, or language) associated with a given brain region. In this context, the neuropsychologist is critical in helping neurosurgeons safely navigate the patient's brain and avoid any surgical complications related to cognitive function. Neuropsychologists are increasingly involved in functional mapping, and are helping to lead the way in the development of novel and more sensitive technologies for use with patients with epilepsy (e.g., NeuroMapper).

**Conclusions:** Not only do neuropsychologists play an important role in the outpatient evaluation of patients with epilepsy, but also play a growing role in the world of functional neurosurgery. Functional mapping is one such example, in which the neuropsychologist works side-by-side with neurologists and neurosurgeons to evaluate in real-time a patient's cognitive performance to better understand brain organization and prevent adverse cognitive outcomes.

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**D. L. DRANE. Minimally Invasive Procedures for Epilepsy Surgery.**

**Objective:** To provide context for the role of the neuropsychologist in evaluation and consideration for patients to undergo minimally invasive procedures.

**Methods:** Dr. Drane will provide attendees with information and recommendations for how to discern an appropriate surgical option for best-recommended course of action when interpreting the comprehensive pre-surgical evaluation to include neuropsychological scores, the nature, cause, and impact of the patient's epilepsy for candidates that are unable to be considered for traditional surgical approaches. He will review three such minimally invasive procedures in particular: laser interstitial thermal ablation (LITT procedure), deep brain stimulation (DBS), and responsive neurostimulation (RNS) – including indications, typical targets, special considerations, and potential side effects of each.

**Results:** Refractory epilepsy treatment has progressed beyond pharmacokinetic agents to include newer, more selective surgical techniques to include laser interstitial thermal therapy (LITT procedure), or neurostimulation techniques such as deep brain stimulation (DBS) or responsive neurostimulation (RNS). There are unique indications, targets, considerations, and side effects associated with these procedure types – and the epilepsy neuropsychologist should be familiar with each.

**Conclusions:** Epilepsy remains a challenge to treat, with 30 to 35% of patients being unresponsive to medical treatment. Newer minimally invasive procedures (e.g., LITT, DBS, RNS) are making seizure reduction (or resolution) possible for a greater number of patients with epilepsy. This advancement in treatment paradigms also allows for new avenues in understanding the brain and providing treatment options tailored specifically to each surgical candidate. However, there remains a heightened need for knowledge of the neural underpinnings of function with regards to each of these procedures.

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**Paper Session 13: Training/Drug and Other Related Disorders/Tumor****2:00 PM - 3:00 PM****S. J. TOWNS, L. M. GUIDOTTI BRETING, A. M. BUTTS, B. L. BRETT, E. B. LEAFFER, D. M. WHITESIDE. Personal and Emotional Consequences of the COVID-19 Pandemic on Neuropsychology Trainees: Survey from the Student Affairs Committee of the AACN.**

**Objective:** To determine the impact of the early stages of the COVID-19 pandemic on the personal and emotional functioning of neuropsychology trainees.

**Participants and Methods:** A total of 874 neuropsychology trainees (81% female) completed a 69 item survey in April 2020. Of the included trainees, 48% were doctoral students, 17% were interns, and 35% were postdoctoral residents (50% of resident respondents were in their first year).

**Results:** Over half of trainees reported that personal stressors such as childcare (of the 30% with children), personal health and safety, or the health and safety of family members results in either a moderate or considerable amount of stress. In contrast, the majority of trainees reported experiencing no or little stress related to financial and professional concerns. Over half of the

trainees indicated that the COVID-19 crisis has personally affected them either directly, such as testing positive (<1% of respondents), or indirectly, such as through having a loved one, family member, friend, or colleague test positive, be hospitalized, or die as a result of COVID-19 (52% of respondents) as of April 14, 2020. A notable percentage of trainees reported increased personal mental health symptoms (i.e. anxiety [74%] and depression [54%]). While these results did not differ among trainees of different ages, races, areas of residence (i.e. urban or rural), or whether they were still seeing patients in person at the time, there was a significant effect for gender, with women more likely to report both increased depression,  $X^2(4, 687) = 38.84, p < .001$ , and anxiety,  $X^2(4, 731) = 36.88, p < .001$ . Inquiries were made with regard to the coping mechanisms trainees used to deal with these personal effects. Trainees reported using reading, sleep, watching television, and exercise as coping mechanisms; however, only increased digital communication with family and friends was reported as a strategy that has increased as a result of COVID-19 by the majority of trainees. The majority of trainees (89%) also reported increased maladaptive coping strategies including: eating more unhealthy food (34.1%), increased alcohol consumption (22.9%), and exercising less (22.2%).

**Conclusions:** The COVID-19 pandemic is impacting the well-being of neuropsychology trainees. These results, surveyed from the initial stage of the pandemic, highlight the importance of attending to the personal, as well as professional, consequences of the COVID-19 pandemic on trainees. As conditions evolve so will the stressors and needs of neuropsychology trainees. It will be essential for supervisors and other neuropsychologists to be responsive to these different personal effects as training programs adapt to the pandemic.

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**Keywords:** quality of life

### **R. HIRST, R. C. THOMPSON. A survey of pre-doctoral internships with specialized training in clinical neuropsychology: Updated selection criteria.**

**Objective:** The selection criteria reported by internships specializing in neuropsychology were first described by Mittenberg et al. (2000) and then updated by Ritchie et al. (2012). The present study aims to update the selection criteria, gather a more diverse sample of internships offering training in neuropsychology, as well as make longitudinal comparisons and present novel cross-sectional comparisons for other relevant criteria of interest.

**Participants and Methods:** Internships offering specialized training in neuropsychology were identified from the directory of the Association of Psychology Postdoctoral and Internship Centers. Clinical training directors or supervising neuropsychologists from 80 internships (70% response rate) completed the survey. Most training directors and/or supervising neuropsychologists (70%) worked for an internship housed within a university-affiliated or VA medical center, and most internships were APA-accredited (88%) and reportedly met HC/SCN guidelines (61%). Half of the internships ( $n = 40$ ) offered 50% or more training time in neuropsychology. One-third of respondents were board-certified, and the mean number of board-certified neuropsychologists on staff was 1.1 ( $SD = 1.3$ ).

**Results:** Across the entire sample ( $n = 80$ ), the five most important selection criteria (in order of importance) were clinical experience in assessment, the applicant's personal interview, specialization in neuropsychology during graduate school, clinical experience in psychotherapy or other intervention, and letters of recommendation written by a neuropsychologist. A majority of respondents considered practicum training experiences in flexible battery approaches to be

essential or very important (85%), preferably trained at a university-affiliated or Veterans Affairs medical center. When comparing internships offering 50% or more training in neuropsychology longitudinally, clinical experience in assessment, the applicant's personal interview, and specialization in neuropsychology during graduate school were consistently the three most important selection criteria. Compared to previous years, research activity was not as strongly emphasized in this sample of internships with 50% or more training in neuropsychology ( $n = 40$ ), and new selection criteria added in 2020 (e.g., letters of recommendation written by a neuropsychologist, clinical experience with culturally diverse populations) ranked in the top 10 most important. Lastly, internships offering 50% or more training in neuropsychology were more often located in university-affiliated medical centers with 97% meeting HC/SCN guidelines (self-reported) and 92% considering a graduate school curriculum that meets HC/SCN guidelines to be essential or very important.

**Conclusions:** These findings are broadly consistent with the literature reported over the past twenty years and indicate a consistent preference of the educational, clinical, and scholarly competencies defined by HC/SCN when applying to internships offering specialized training in neuropsychology. The present survey demonstrates that internships offering a major area of study in neuropsychology as defined by SCN compared to those offering an emphasis, experience, or exposure in neuropsychology similarly emphasize prior clinical experience in assessment but differentially value many selection criteria. Additionally, clinical experience with diverse populations prior to internship ranked in the top half of criteria, underscoring the importance of cultural diversity experience prior to internship. In sum, the present study highlights the importance of both quality and breadth of experience in neuropsychology prior to internship.

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**Keywords:** assessment, neuropsychological assessment

**E. DE WATER, M. ROCKHOLD, D. ROEDIGER, A. KRUEGER, M. BRYON, C. BOYS, M. SCHUMACHER, S. MATTSON, K. JONES, K. LIM, C. CONSORTIUM, J. WOZNIAK. Social Behaviors and Gray Matter Volumes of Brain Areas Supporting Social Cognition in Children and Adolescents with Prenatal Alcohol Exposure.**

**Objective:** Children and adolescents with prenatal alcohol exposure (PAE) show social skills deficits and a number of brain anomalies including smaller gray matter volumes in regions supporting social cognition. However, previous research has not explored if there are specific relationships between these developmental brain anomalies and social behaviors in children and adolescents with PAE. The aims of this study were to examine: 1) differences in parent-reported prosocial and antisocial behaviors between children and adolescents with and without PAE; 2) differences in gray matter volumes of brain areas supporting social cognition between children and adolescents with and without PAE; 3) correlations between gray matter volumes of brain areas supporting social cognition and parent-reported prosocial and antisocial behaviors.

**Participants and Methods:** Parents of children and adolescents ages 8-16 years completed measures on their prosocial and antisocial behaviors (i.e., Behavior Assessment Scale for Children, Vineland Adaptive Behaviors Scales, and Child Behavior Checklist) ( $n = 84$ ; 41 with PAE, 43 without PAE). Seventy-nine participants (40 with PAE, 39 without PAE) also completed a structural Magnetic Resonance Imaging (MRI) scan with quality data. Gray matter volumes of seven brain areas supporting social cognitive processes were computed using

automated procedures (FreeSurfer 6.0), including the bilateral fusiform gyrus, superior temporal gyrus, medial orbitofrontal cortex, lateral orbitofrontal cortex, posterior cingulate cortex, precuneus, and temporal pole.

**Results:** Children and adolescents with PAE showed decreased prosocial behaviors ( $t = -9.70$ ;  $p < 0.001$ ) and increased antisocial behaviors ( $t = 9.28$ ;  $p < 0.001$ ) as well as smaller volumes of the precuneus ( $t = -2.35$ ;  $p = 0.021$ ) and lateral orbitofrontal cortex ( $t = -2.13$ ;  $p = 0.037$ ), even when controlling for total intracranial volume. Associations were observed between larger precuneus volumes and decreased prosocial behaviors ( $r = -0.33$ ;  $p = 0.063$ ), and larger lateral orbitofrontal cortex volumes and increased antisocial behaviors ( $r = 0.40$ ;  $p = 0.023$ ) in children and adolescents with PAE.

**Conclusions:** These findings suggest that atypical gray matter volumes of brain areas supporting self-awareness, perspective-taking and emotion-regulation may be associated with poor social functioning in children and adolescents with PAE.

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**Keywords:** social cognition, brain structure, alcohol-related brain damage

**C. G. ZUNDEL, M. H. KRENGEL, R. TOOMEY, R. KILLIANY, L. STEELE, N. KLIMAS, E. SISSON, T. HEEREN, P. JANULEWICZ LLOYD, K. SULLIVAN. Impact of Gulf War-Specific Neurotoxicant Exposures on Neuropsychological Functioning More Than 25 Years Post-War .**

**Objective:** Gulf War (GW) veterans were exposed to numerous neurotoxicants during deployment including chemical/biological warfare, pesticides, vaccines, pyridostigmine bromide (PB) pills, combustion byproducts from smoke of oil well fires, and solvents contained in chemical agent resistant coating (CARC) paint. After returning from deployment many veterans began reporting numerous health symptoms, including cognitive and mood issues. These symptoms have now collectively been termed Gulf War Illness and have been associated with the many neurotoxicant exposures experienced during the war. Neurotoxicants, however, can produce latent or delayed effects, with the additional stress of aging or through chronic inflammatory processes that may result in neurodegeneration years after exposure. Therefore, it is important to continually document the health of GW veterans in relation to the specific neurotoxicant exposures from deployment. This study examines the impact of these exposures on neuropsychological functioning more than 25 years post-war.

**Participants and Methods:** Participants included 199 GW veterans (33 women) with varying self-reported exposure to GW-specific neurotoxicant exposures. The mean age was 53 years old with an average of 15 years of education. This sample of GW veterans were predominately Caucasian (82.4%), with 36% meeting the diagnostic criteria for current PTSD. GW veterans were administered a comprehensive battery of neuropsychological tests examining executive functioning, attention, motor function, visuospatial function, memory, and mood.

**Results:** Multiple linear regression analyses showed that pesticide exposure was associated with decreased processing speed, inhibition, and motor functioning, and increased inattention and mood complaints as evidenced by poor performance on the DKEFS color word interference task, Connors' continuous performance task (CPT), controlled oral word association task (COWAT), finger tapping task (FTT), and the Profile of Mood States (POMS) ( $p$ 's  $< 0.05$ ). Chemical warfare agent exposure was associated with visuospatial dysfunction, slowed processing speed, and increased mood complaints, as evidenced by poor performance on the WAIS-IV Block

Design substest, COWAT, CPT, FTT, and the POMS ( $p$ 's < 0.05). Exposure to vaccines during deployment was associated with increased errors on the COWAT and increased mood complaints on the POMS ( $p$ 's < 0.05). Exposure to solvents from CARC paint was associated with inattention as evidenced by increase commissions on the CPT ( $p$  < 0.05). Exposure to PB pills and smoke from oil well fires were not associated with neuropsychological performance ( $p$ 's > 0.05).

**Conclusions:** Nearly 25 years after the war, GW veterans are continuing to exhibit cognitive and mood dysfunction that is associated with the GW-specific neurotoxicant exposures experienced during deployment. Future studies should follow these veterans longitudinally to track change in cognitive and mood functioning over time and specific interventions should be developed and applied to prevent further neurodegeneration in this population.

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**Keywords:** cognitive functioning, drug / toxin-related disorders, neuropsychological assessment

**W. WATSON, E. E. MORGAN, E. PAOLILLO, R. J. ELLIS, S. L. LETENDRE, I. GRANT. Cannabis Use and 7-year Longitudinal Cognitive Trajectories Among Older Adults.**

**Objective:** Over 90% of older adults live with one or more chronic diseases and are at risk for cognitive decline and late-life dementias. Cannabis use is rapidly increasing among older adults in the U.S. to ameliorate symptoms of age-related health conditions. In the general adult population, daily cannabis use has been linked to declines in memory and processing speed. Longitudinal studies of cannabis use and cognitive decline in vulnerable, aging populations are lacking. We sought to determine the influence of cannabis use on baseline cognitive function and rates of decline among adults ages 50+ with or without HIV.

**Participants and Methods:** 563 older adults completed comprehensive study visits every 6-12 months for up to seven years (average total years in study = 2.7; age range at baseline = 50–87, average age at baseline = 57; 70% older people with HIV (PWH); 30% older adults without HIV). Practice-effect corrected scaled scores characterized cognitive performance over time in seven domains. Cumulative cannabis use was determined by averaging self-reported frequency of cannabis use within participants across visits. Multilevel models examined baseline cognitive performance and rates of decline in memory, processing speed, verbal fluency, executive function, learning, working memory, and motor skills as a function of cannabis use, HIV status, and their interactive effect. Analyses adjusted for the effects of age, sex/gender, and education on cognitive performance.

**Results:** Older adult cannabis users ranged from frequent (daily to weekly) users with median 0.5 grams per day of use to infrequent (< weekly) users with median 0.15 grams per day of use. Higher cumulative cannabis use was associated with better performance in verbal fluency ( $est = 1.46$ ,  $p = 0.02$ ) at baseline only among older adults without HIV. Over time, a significant interaction was detected between cannabis use and HIV on rate of decline in verbal fluency ( $p = 0.03$ ), such that greater cannabis use predicted less steep declines in verbal fluency ( $p = 0.02$ ) among older adults without HIV, but not among PWH. In the other six cognitive domains, cannabis use was not associated with baseline performance nor longitudinal declines. Independently, HIV was associated worse baseline performance in processing speed, executive function, and motor skills at baseline ( $ps < 0.05$ ). Over time, HIV disease predicted steeper declines in learning ( $p = 0.003$ ), and was not associated with declines in the other six domains.

**Conclusions:** Moderate cannabis use does not appear to have a harmful impact on cognitive performance nor decline among older adults with or without HIV. Findings suggest that greater cannabis use may have a protective effect on verbal fluency among older adults without HIV. Future investigations are necessary to determine whether the anti-inflammatory and neuroprotective effects of cannabinoids demonstrated in recent pre-clinical studies have some preference for the complex frontotemporal circuitry underlying verbal fluency function. Importantly, as interest and use of cannabis increase among older adults in the U.S., the effects of specific cannabinoids, their combinations, and doses on cognitive and functional outcomes must be examined to inform age-appropriate cannabis use guidelines.

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**Keywords:** cannabis, aging (normal), HIV/AIDS

**M. E. FOX, J. A. TURNER, B. CROSSON, R. D. MORRIS, T. Z. KING. Default Mode Network Recruitment During Attention and Working Memory Tasks in Survivors of Childhood Brain Tumors.**

**Objective:** Studies of functional connectivity can provide insight into recruitment of neural networks and changes that result from neurological insult or injury. The present study sought to explore differences in the default mode network (DMN) across healthy controls and survivors of childhood posterior fossa tumors using independent component analysis (ICA) during an attention and working memory task.

**Participants and Methods:** Participants were 17 to 35 years old. Survivors were at least 5 years past diagnosis. 40 healthy controls (HC;  $M_{age}=23.0$ ,  $SD_{age}=4.6$ ) and 23 posterior fossa tumor survivors (9 low grade tumor survivors [LGS;  $M_{age}=24.2$ ,  $SD_{age}=4.5$ ;  $M_{years\ since\ dx}=13.8$ ,  $SD_{years\ since\ dx}=7.1$ ], and 14 high grade survivors [HGS;  $M_{age}=23.3$ ,  $SD_{age}=6.2$ ;  $M_{years\ since\ dx}=15.5$ ,  $SD_{years\ since\ dx}=6.6$ ]) underwent a magnetic resonance imaging scan in a 3T Siemens Trio scanner. The scan sequence included a letter n-back task comprised of four levels (0-, 1-, 2-, and 3-back). The Group ICA of fMRI Toolbox (GIFT) was used to conduct ICA on task scans, and beta weights were extracted to assess the degree of synchrony between independent components (ICs) and task levels. SPSS 25.0 was used to conduct ANOVAs evaluating task load and group effects.

**Results:** Seven ICs were identified as belonging to the DMN. Task load effects were observed across all seven ICs such that higher load was related to more negative task-related recruitment (i.e., disengagement of the IC). Four ICs also exhibited group effects. In IC1 and IC16, LGS demonstrated less disengagement than HGS and HC, and in IC1, more disengagement was correlated with better task performance for HC. In IC17 and IC22, LGS demonstrated more disengagement than HGS and HC, but no correspondence to task performance was observed. The components in which LGS showed less disengagement than their peers had positive clusters in the medial prefrontal cortex (mPFC), while those for which LGS showed more disengagement had negative clusters in similar regions.

**Conclusions:** Across HC and cerebellar brain tumor survivors, the DMN is disengaged as demands of cognitive tasks increase, and in some cases, greater disengagement is related to better working memory abilities in HC. Distinct DMN recruitment patterns are observed in LGS, a less-frequently studied population than their HGS peers. The mPFC may play a unique role in the DMN in LGS; it may be that instead of disengaging these regions as part of DMN functioning, this group is recruiting the mPFC to support working memory networks that might otherwise be compromised due to tumor treatment and resection. It may be a result of neural

plasticity in response to a treatment protocol that, while less neurotoxic than the chemoradiation protocols undergone by their HGS peers, still results in structural and functional changes to LGS' brains. Such findings highlight the need for long-term follow-up of LGS and HGS.

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**Keywords:** brain tumor, neuroimaging: functional connectivity, outcome

## Paper Session 14: Aging: Multicultural Factors

2:00 PM - 3:00 PM

### **E. A. BOOTS, M. LAMAR, D. A. FLEISCHMAN, S. E. LEURGANS, D. L. FEINSTEIN, L. L. BARNES. Acute Versus Chronic Inflammatory Markers and Cognition in Older Black Adults: Results from the Minority Aging Research Study.**

**Objective:** It is well documented that inflammation is involved in the pathogenic process leading to dementia, and thus may play an important role in cognition and cognitive decline. Inflammation is typically higher in Black adults due, in part, to the cumulative effect of chronic cardiovascular health conditions across the lifespan. However, relatively few studies have investigated the role of inflammation in cognitive decline in this population, and of those, findings have been mixed. Our objective was to statistically characterize patterns of acute and chronic inflammation and their role in change in cognition in a cohort of older Black adults followed between 2 and 15 years (mean=9 years).

**Participants and Methods:** 280 older Black adults without known dementia from the Minority Aging Research Study (mean baseline age=72.99 years; 69.6% female; mean education=14.98 years) completed annual cognitive evaluations and a blood draw at baseline. Blood serum was assayed using highly-sensitive multiplexed sandwich ELISA for 9 inflammatory markers: interleukin-6 (IL-6), interleukin-10 (IL-10), IL-6 receptor (IL-6r), matrix metalloproteinase 9 (MMP9), vascular cell adhesion molecule (VCAM), interleukin-1beta (IL-1b), tumor necrosis factor-alpha (TNF-a), C-reactive protein (CRP), and interleukin-1 receptor agonist (IL-1ra). All inflammatory markers were log-transformed. Raw scores from 19 neuropsychological tests were converted to z-scores using baseline evaluations and combined to create a global cognitive functioning composite score and five cognitive domains: episodic memory, semantic memory, working memory, visuospatial ability, and perceptual speed. Principal component analysis (PCA) with varimax rotation characterized patterns of inflammation using all inflammatory markers with factor loadings >0.6 per rotated component contributing to z-scored and averaged composite scores. These PCA-derived composite scores were used as predictors in separate linear mixed regression models that examined associations with baseline level and longitudinal change in global cognition and the 5 cognitive domains (separately) adjusting for age, sex, education, vascular risk factors, body mass index, and statin medication use.

**Results:** PCA with varimax rotation resulted in a two rotated factor solution (60.3% of the variance). Composite 1 (38.2% of the variance) consisted of IL-6, IL-10, IL-1b, TNF-a, and IL-1ra, suggesting an upstream/acute pattern of inflammation; Composite 2 (22.1% of the variance) consisted of MMP9, VCAM, and IL-6r, suggesting a downstream/chronic pattern of inflammation. Higher baseline levels of upstream/acute inflammatory markers were associated with lower baseline levels of semantic memory ( $p=.040$ ) and perceptual speed ( $p=.047$ ), but were

not related to cognitive decline ( $p's > .05$ ). By contrast, higher baseline levels of downstream/chronic inflammatory markers did not associate with baseline cognition (all  $p's > .05$ ), but were related to faster cognitive decline in global cognition ( $p = .010$ ), episodic ( $p = .028$ ) and working memory ( $p = .005$ ).

**Conclusions:** In older Black adults, patterns of inflammation suggested that upstream/acute markers of inflammation negatively associated with cognitive function at baseline, but downstream/chronic inflammation predicted faster cognitive decline over time. Thus, for older Black adults, chronic, but not acute, inflammation may be more deleterious to cognition longitudinally, and may provide clarity to conflicting results of previous research in older populations.

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**Keywords:** aging (normal), diversity, cognitive course

**D. WARREN, E. A. BOOTS, A. WILLIAMS, V. N. POOLE, C. M. GLOVER, B. D. JAMES, M. LAMAR, L. L. BARNES. The Influence of Occupational Complexity on Late-Life Cognition in Older Black Adults: Results from the Minority Aging Research Study.**

**Objective:** Prior work in primarily White cohorts has demonstrated that greater levels of occupational complexity (OC) are associated with higher levels of cognitive function and reduced cognitive decline, suggesting OC may promote cognitive reserve. Older Black adults face a critical burden of cognitive impairment in old age, and while researchers have begun to examine overall relationships between OC and cognition in diverse populations, no studies have characterized the heterogeneity of work functions in older Black adults to examine how the complexity within specific occupations associates with cognition. Our objective was to characterize OC for main occupations in older Black adults and investigate its role in late-life cognition.

**Participants and Methods:** Older Black adults ( $N = 669$ ; mean baseline age = 73.7 years; 77.9% female; mean education = 14.8 years) without known dementia at baseline from the Minority Aging Research Study reported main lifetime occupation and completed annual cognitive evaluations (mean follow-up =  $6.58 \pm 4.30$  years). OC was rated via O\*NET according to the 1970 U.S. Census Dictionary of Occupational Titles for OC of work with data, people, and things (separately). Ratings were reverse coded such that higher scores reflected greater complexity. Raw scores from 19 neuropsychological tests were converted to z-scores using the baseline mean and standard deviation and combined to create composite scores for global cognition and five cognitive domains: episodic memory, semantic memory, working memory, visuospatial ability, and perceptual speed. Separate ordinal logistic regression models characterized associations between demographic factors and OC indices. Separate linear mixed regression models examined associations of OC indices with baseline level and longitudinal change in global cognition and the five cognitive domains while adjusting for age, gender, and education.

**Results:** Participants with greater baseline age held occupations with lower OC for work with data ( $p = .045$ ) and people ( $p = .008$ ), but higher OC for work with things ( $p = .002$ ). Men held occupations with higher OC for work with data than women ( $p = .009$ ), but there were no gender differences for work with people or things. Those with higher education held occupations with higher OC for work with data ( $p < .001$ ) and people ( $p < .001$ ), and lower OC for work with things ( $p < .001$ ). Greater OC for work with data was associated with higher baseline levels of global cognition ( $p = .003$ ), semantic memory ( $p = .009$ ), working memory ( $p = .001$ ), visuospatial

ability ( $p=.001$ ), and perceptual speed ( $p<.001$ ). Greater OC for work with people was associated with higher baseline levels of semantic memory ( $p=.021$ ) and visuospatial ability ( $p=.002$ ). There were no associations between OC for work with things and baseline cognition. There were no associations between any OC index and longitudinal change in cognition.

**Conclusions:** All OC indices associated with age and education, and men had greater OC for work with data than women. Greater OC for work with data and people, but not things, was associated with greater baseline cognition, but no OC indices affected rate of cognitive decline. Findings suggest that occupational complexity for older Black adults does not seem to protect against cognitive decline.

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**Keywords:** aging (normal), cognitive functioning, diversity

**M. L. ESTRELLA, R. A. DURAZO-ARVIZU, C. R. SALAZAR, L. C. GALLO, A. STICKEL, J. MATTEI, P. M. VASQUEZ, K. ELDEIRAWI, K. M. PERREIRA, F. J. PENEDO, C. R. ISASI, J. CAI, D. ZENG, W. TARRAF, H. M. GONZÁLEZ, M. L. DAVIGLUS, M. LAMAR. Allostatic Load and Cognitive Function among Middle-Aged and Older Hispanics/Latinos: Findings from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL).**

**Objective:** Previous research has demonstrated that allostatic load, a multi-system measure of physiological dysregulation due to exposure to chronic stress, is associated with poorer cognitive function including worse global cognition (GC) and executive functioning in samples largely comprised of older non-Hispanic white adults. The objective of this study was to examine the cross-sectional association of allostatic load with cognitive function among middle-aged and older Hispanics/Latinos living in the United States. We hypothesized that higher allostatic load would be associated with lower GC and individual scores of verbal learning, memory, and executive function among Hispanics/Latinos.

**Participants and Methods:** Participants ( $n = 5,784$ ; mean age = 56.3, 64% female) from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL; 2008–2011) aged 45–74 years completed cognitive and health biomarker testing. Cognitive tests included the Brief-Spanish English Verbal Learning Test (B-SEVLT), Word Fluency, and Digit Symbol Substitution (DSS). Individual z-scores of verbal learning, memory, and executive functioning were averaged to create the GC score. Allostatic load was assessed using 16 biomarkers representing the cardiometabolic, glucose, cardiopulmonary, parasympathetic, and inflammatory systems. The allostatic load score was calculated as the number of biomarkers for which a participant had a high-risk quartile (i.e., a count-based score) with higher scores representing greater dysregulation (range: 0 to 16). Survey-weighted linear regression models adjusted for age, sex, education, Hispanic/Latino background, annual household income, and preferred language were used to examine associations of allostatic load with GC and each cognitive test score. An interaction term for sex was included to determine whether associations varied by sex.

**Results:** Mean allostatic load score was 4.8 (SD = 3.0) and was significantly higher among men compared to women. In adjusted models, among the overall target population, higher allostatic load was associated with lower GC, memory, and word fluency but not with verbal learning or DSS. Sex modified the association of allostatic load with GC, word fluency, and DSS (all  $p$ -interaction  $<0.05$ ). Specifically, among women, higher allostatic load was associated with lower GC, word fluency, and DSS but not with verbal learning or memory. Among men, allostatic load

was inversely associated with word fluency but no associations were observed with other cognitive measures.

**Conclusions:** Our findings extend previous research on the associations of allostatic load with cognitive function to include middle-aged and older Hispanics/Latinos and also highlight important sex differences in the associations of allostatic load with GC, word fluency, and DSS. Specifically, despite having lower levels of allostatic load, women appear to bear a greater burden of the relationship between allostatic load (i.e., a multi-system measure of chronic stress-related physiological dysregulation) and cognitive function compared to men.

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**Keywords:** minority issues, cardiovascular disease, chronic stress

**J. AVILA-RIEGER, P. ESIE, J. M. VONK, M. ARCE RENTERÍA, I. C. TURNEY, P. LAO, N. SCHUPF, R. P. MAYEUX, A. M. BRICKMAN, J. J. MANLY. Sex/Gender Differences in Age-Related Memory Decline within Race by Education Groups.**

**Objective:** We examined whether sex/gender differences in age-related memory decline vary as a function of race and education.

**Participants and Methods:** The cohort included 3001 non-Latinx White (White) and non-Latinx Black (Black) men and women in the Washington/Hamilton Heights/Inwood Columbia Aging Project, aged 65 years and older and not demented at baseline. Neuropsychological tests were administered at baseline and every 18–24 months, for up to 24 years. High and low education was determined based on the median split of years of education for White (16 years) and Black (12 years) participants separately. Multiple-group latent growth curve modeling examined memory trajectories for each race by education subgroup, simultaneously. Time was centered at age 70 and divided by 5 to characterize rates of memory decline in five-year increments. Growth factors (Intercept [memory at age 70] and linear and quadratic slope terms) were regressed on sex/gender to examine differences between men and women within each subgroup. Retest effects were evaluated by including a retest term. Potential effects of differential attrition due to death were accounted for by inclusion of a joint time-to-death model.

**Results:** While Black women demonstrated higher average memory performance at age 70 years compared with Black men, across high and low education groups, Black men and women declined at a similar rate. For Whites, sex/gender differences varied by education group. Low education White women demonstrated higher initial memory performance but similar rates of decline compared with low education White men. For high education Whites, initial performance was similar between men and women. After age 70, high education White men demonstrate a steeper instantaneous decline compared with White women ( $B = .191$  [.082, .300]), however, after age 75 women begin to decline more rapidly ( $B = -.042$  [-.077, -.014])

**Conclusions:** Our results suggest that sex/gender differences in age-related memory decline vary as a function of race and education. Failure to examine variability in sex/gender across other social groups and positions may hinder efforts to advance understanding of important differences in late-life cognitive health among men and women.

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**Keywords:** cognitive functioning, cross-cultural issues, cognitive reserve

**E. P. MORRIS, I. C. TURNEY, E. AMARANTE, J. M. BEATO, A. CHESEBRO, R. P. MAYEUX, J. J. MANLY, A. M. BRICKMAN, L. B. ZAHODNE. Racial/Ethnic Differences in the Relationship between Financial Worry and White Matter Hyperintensities in Diverse Older Adults.**

**Objective:** Subjective aspects of SES (e.g., financial worry) are associated with cognition above and beyond objective aspects of SES (e.g., income and education). While objective SES is also related to brain health, unique associations between subjective SES indicators and brain health have rarely been studied. Subjective measures of SES may better capture stress than objective measures, and stress has negative effects on vascular health, including increased risk of white matter hyperintensities (WMH). While extant research indicates that links between objective SES and brain health are moderated by race/ethnicity, it is not clear whether this is also true of subjective measures of SES. Therefore, this study examined whether: 1) financial worry, a subjective aspect of SES, is associated with WMH volume above and beyond objective SES; and 2) this association differs across racial and ethnic groups.

**Participants and Methods:** Participants included 232 Hispanic, 192 non-Hispanic Black, and 153 non-Hispanic White older adults ( $M_{age}=76.54$ ,  $SD=5.68$ ) in the Washington Heights-Inwood Columbia Aging Project. Participants were asked, "How much do you worry that your total income will not be enough to meet your expenses and bills?" to assess financial worry. WMH volume was derived from T2-weighted FLAIR images obtained with a 3T MRI scanner. Linear regressions examined the association between financial worry and WMH, controlling for objective measures of SES (i.e., years of education and income) and sociodemographics. Interaction terms and model stratification by race/ethnicity examined group differences in this relationship.

**Results:** Hispanic participants reported more financial worry than non-Hispanic White and non-Hispanic Black participants. There were no differences in financial worry between non-Hispanic White and non-Hispanic Black participants. Greater financial worry was associated with more WMH ( $\beta=.086$ ,  $p=.047$ ), but this association differed across race/ethnicity. An interaction between financial worry and race/ethnicity revealed that greater financial worry was more strongly associated with more WMH in Hispanic participants than non-Hispanic Black participants ( $\beta=.103$ ,  $p=.022$ ), who had the most WMH regardless of financial worry ( $\beta=-.165$ ,  $p=.002$ ). In stratified models, greater financial worry was associated with more WMH among Hispanic ( $\beta=.234$ ,  $p<.001$ ), but not non-Hispanic Black ( $\beta=-.067$ ,  $p=.374$ ) or non-Hispanic White ( $\beta=.072$ ,  $p=.389$ ) participants, above and beyond education and income.

**Conclusions:** Financial inadequacy may be particularly detrimental for cerebrovascular health among Hispanic older adults, who were at the highest risk of poverty and its negative psychosocial effects in this sample. The lack of association between financial worry and WMH among non-Hispanic Black participants may reflect their lower levels of financial worry and/or additional cardiovascular risk factors that could mask the unique effects of financial worry. Among non-Hispanic White participants, the lack of association may reflect their lower levels of financial worry and/or greater availability of protective resources that could mitigate the impact of financial worry when present. Future research should explore whether interventions to decrease poverty and associated financial stress among Hispanic older adults could improve brain health and reduce dementia inequalities.

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**Keywords:** ethnicity, neuroimaging: structural, aging disorders

**S. FARIAS, M. L. CHAN, A. WEAKLEY, D. HARVEY, J. CARSEY, D. MUNGAS. Using the Everyday Cognition Scales (ECog) to Predict Conversion to Cognitive Impairment in Different Ethnoracial Groups.**

**Objective:** Mounting evidence suggests that subjective cognitive concerns (SCCs) are an early indicator and/or risk factor for development of clinical Alzheimer's disease (AD). However, little work has examined whether there are differences in the relevance of SCCs in predicting development of subsequent cognitive impairment or dementia in different racial/ethnic groups. The present study examined whether the predictive utility of SCC differs by ethnoracial group.

**Participants and Methods:** Participants included 205 Caucasians, 101 African Americans, and 95 Hispanics who are part of a longitudinal cohort followed annually at the University of California, Davis Alzheimer's Disease Center. SCC was measured using the self report version of the Everyday Cognition Scales (ECog) (total score and Everyday Memory domain). At study baseline, all individuals were cognitively normal based on consensus diagnosis. Over the course of an average of 4.7 years, 116 developed Mild Cognitive Impairment (MCI) or dementia. Associations with incident impairment (MCI or dementia) were assessed using Cox proportional hazards models, adjusted for age and education. Initial models assessed differences in the association between ECog scores and incident impairment by racial/ethnic group by testing the significance of the interaction between race/ethnicity and the ECog score. Models were then run separately in each racial/ethnic group.

**Results:** There was a significant interaction between racial/ethnic group and SCC (both ECog scores), suggesting a difference in the association between ECog and incident cognitive impairment by racial/ethnic group; the primary difference was between Caucasians and Hispanics. In analyses stratified by racial/ethnic group, greater SCC at the initial visit was associated with increased risk of progressing to mild cognitive impairment or dementia in Caucasians and African Americans. However, ECog scores were generally not associated with progression to a cognitive disorder in Hispanics.

**Conclusions:** There may be sociocultural differences in the degree to which SCCs are a risk factor for developing subsequent cognitive impairment. These findings suggest that SCC may have different relevance and meaning in different ethnoracial groups. More research is needed to better characterize the value of SCC in predicting cognitive decline and conversion to MCI or dementia in Hispanic older adults.

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**Keywords:** aging disorders, dementia - Alzheimer's disease, mild cognitive impairment

**Symposium 10: Beyond Social and Emotional Phenotypes: Perspectives for Neuropsychological Intervention Models**

**Chair and Presenter: Nara Cortes Andrade**

**Presenters: Miriam Beauchamp, Vicki Anderson, Claudia B. Mello**

**2:00 PM - 3:00 PM**

**N. C. ANDRADE, M. BEAUCHAMP, V. ANDERSON, C. B. MELLO. Beyond Social and Emotional Phenotypes: Perspectives for Neuropsychological Intervention Models.**

Human abilities are rooted in the propensity to engage with others, learn from them and use acquired social information to effectively navigate the complex interactions that make up our daily activities. Social Cognition is a neuropsychological domain that explores how organisms understand and respond to social and emotional information from others. Impairments in social cognition are present in a range of clinical populations, including neurodevelopmental, neurological, psychiatric disorders and genetic syndromes. Social determinants of health, such as adversity associated with poverty, social isolation, exposure to violence and lack of peer and/or family support, are also associated with socio-cognitive difficulties. Interventions focused on social cognition in children and adolescents show promise in improving social and emotional abilities, preventing and mitigating mental health disorders and may even positively impact academic outcomes. In this symposium, we reflect on how the study of social and emotional phenotypes in clinical populations with genetic syndromes, acquired brain injury or neurodevelopmental disorders contributes to developing preventive and remedial intervention models in neuropsychology. To address this question, an international perspective on social assessment and intervention is presented through the work of researchers from Canada, Australia, Brazil and Chile. The presentations include studies of children, adolescents and adults with Williams Syndrome (WS), Traumatic Brain Injury (TBI), Autism Spectrum Disorder (ASD), Tourette's Syndrome (TS) and Typical Development (TD). Specifically, a prospective, longitudinal case-control design study characterizes recovery trajectories in children and adolescents with TBI examining the factors that predict good and poor outcomes in this population. Youth with WS participated in a study looking at emotion recognition in music and discussing brain modularity with respect to face processing. The socio-cognitive abilities of youth with TS are explored and their association with behavioral outcomes. The ability of youth and adults with ASD to integrate information to form a meaningful whole (central coherence theory) is analyzed using eye-tracking and thematic content methods. Finally, evidence for the effectiveness of a serious video game-based intervention tool is presented in typically developing adolescents. The findings from the five studies presented suggest that an integrative model of social cognition intervention should consider recovery and neurodevelopmental trajectories, individual and culturally-sensitive neuropsychological profiles, and adaptive intervention approach with multiple sensory inputs. Future research is under development exploring comprehensive and culturally-sensitive social cognitive measures and interventions. The present work is the first part of a set of joint objectives of the laboratories involved in the efforts to strengthen research in social cognition from cross-cultural perspectives, in addition to fortifying affective and social neuropsychology in Latin America.

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**Keyword:** social cognition, affective processing disorders, pediatric neuropsychology

**M. BEAUCHAMP, A. LAMY-BRUNELLE, A. TATO, J. LAURENDEAU-MARTIN, A. BLONDIN, A. DUFRESNE. Gamifying social skills: Can playing a video game improve social reasoning in adolescents?**

**Objective:** Navigating complex social interactions calls upon social cognition, a set of mental processes used to perceive and process signals, stimuli and social environments, underpinned by the activity of the social brain. In particular, socio-moral reasoning (SMR) is critical to an individual's ability to analyze social conflicts with reference to moral criteria and social norms and to make appropriate decisions in society. For some, adolescence is characterized by social, emotional or moral conflicts, jeopardizing the quality of social relationships and mental health. In order to support the optimal development of social skills, particularly with respect to socio-moral decision-making and prosocial behaviors, it is imperative that youth have validated social remediation tools at their disposal. The objective of this project was to assess the potential of a serious video game as a learning tool for optimizing SMR. **Methods:** Sixty-three adolescents (30 females) between 12 and 17 years ( $M=14.46$ ;  $SD=1.34$ ) played either a non-adaptive ( $n=27$ , i.e., with no feedback) or an adaptive ( $n=36$ , i.e., with feedback and reinforcement) version of a serious video game (SoGAME) designed to target SMR. In the game, participants' level of moral maturity was measured in a pre-post design using the Socio-Moral Reasoning Aptitude Level task (So-Moral), as well as throughout the game using an automated coding algorithm across nine visual, dynamic dilemmas presenting everyday socio-moral conflicts. **Results:** Results indicate that participants improved their SMR by playing the adaptive version ( $F(1,12) = 28.77, p < .001$ ), but not the non-adaptive version ( $F(1,21) = 2.73, p = .114$ ). **Conclusions:** The findings suggest that using a serious video game that includes social reinforcements may be a

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**Keywords:** social cognition, affective processing disorders, cognitive rehabilitation

#### **V. ANDERSON. Recovery of social skills following traumatic brain injury in children: a search for predictors to guide interventions.**

**Objective:** Social impairment is found in up to 50% of children who sustain serious traumatic brain injury (TBI), and is often described by parents and children as the most debilitating consequence of their injury. Despite this, there is limited evidence available to progress our ability to identify children at greatest risk of social problems, to understand the mechanisms underlying these social problems or the most effective approaches to treatment. Our study aimed to plot recovery of social skills over the two years following child TBI, to characterize likely recovery trajectories and to examine the factors that predict good and poor outcome. **Participants and method:** Using a prospective, longitudinal case-control study design, we followed 107 children and adolescents with TBI for two years post-injury, at baseline, 3, 6 and 24 months. Children underwent MRI brain scans acutely and also completed cognitive, behavioral and social cognition measures. Parents reported on their child's adaptive, social, emotional and behavioral function, as well as their own mental health and coping skills. **Results:** Trajectory analysis identified five robust trajectories: i) deteriorating social skills (7%), ii) persisting moderate social impairment (15%), iii) stable intact social skills (42%), iv) above average social skills (29%), v) early resolving social impairment (7%). Pre-injury child function (cognition, behavior, adaptive skills) and family factors were linked to trajectory membership, with injury factors less predictive. **Conclusion:** Our findings suggest that, post child TBI, attention to modifiable child and family factors provide an opportunity to optimize social skills recovery.

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**C. B. MELLO, M. C. MELO, S. V. TASSINI. Central Coherence Theory in Autism Spectrum Disorder.**

**Objective:** Social Cognition (CS) concerns a set of complex cognitive processes such as Theory of Mind and recognition of emotions. Central Coherence Theory (CCT) is a theoretical construct also associated with CS and refers to the ability to integrate information to form a meaningful whole. There is evidence that individuals with Autism Spectrum Disorder (ASD) show weak central coherence, but this process has been scarcely investigated. The objective of this study was to investigate CCT in ASD. **Methods:** Samples of high functioning ASD individuals (aged 18-35 years;  $n=27$ ) and controls ( $n=27$ ) matched by age and level of schooling were submitted to a computerized task involving several stimuli which demand predominately visual (Navon letter stimuli style) or social (drawings of social interaction situations) processing. Participants were asked to answer questions such as “What this image shows”; “What are people thinking/feeling”. Verbal reports were analyzed qualitatively using Thematic Content method to identify semantic categories concerning social interpretation. Eye Tracking was used to analyze fixation characteristics in areas of interest (e.g. faces in social stimuli). **Results:** There were statistical differences in reaction time between groups (Wlad  $\chi^2 = 297,901$ ,  $df = 1$ ,  $p < 0.05$ ) and type of stimulus (Wlad  $\chi^2 = 110.755$ ,  $df = 1$ ,  $p < 0.05$ ). Contrary to controls, for ASD participants gaze fixation was more intense on details of stimuli and semantic categories were more variable, indicating flaws in interpretation of social contexts. **Conclusion.** Findings confirm specific central coherence deficits in ASD, which can contribute to heterogeneity of SC weaknesses.

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**N. C. ANDRADE. The Melody of Joy: Music Emotion Recognition and Perspectives for Interventions in Williams Syndrome.**

**Objective:** Williams Syndrome (WS) is a neurogenetic condition resulting from a homozygous deletion on chromosome 7q11.23. WS has a unique neuropsychological profile characterized by peaks and valleys, presenting significant cognitive impairments, such as deficits in visuospatial skills, and relative preservation of expressive language, facial processing and music skills. Among the paradoxes found, is the relative maintenance of cognitive and motor skills related to music that overlap with brain regions that are responsible for impaired cognitive functions. Musical skills are referred to as an area of strength within the cognitive profile of WS. However, this is still not a consensual field and studies with musical stimuli are scarce. The present study aimed to characterize the processing of musical affective stimuli in children and adolescents with WS.

**Participants and Method:** nineteen children and adolescents (6-19 years,  $M=12.4$ ,  $SD=3.5$  years, 57,9% females) with WS were matched in terms of chronological age, sex and place of residence with typically developing controls. WS participants confirmed gene deletion through FISH (Fluorescence in situ hybridization) or MLPA (Multiplex Ligation-dependent Probe Amplification) tests. 42 musical excerpts were presented through a digital questionnaire with the mediation of an interviewer. The stimuli, with an average duration of 12 seconds each, were randomized. Participants were asked to identify the emotion and to evaluate the affective valence of each musical excerpt.

**Results:** Children and adolescents with WS had greater difficulty in recognizing songs that express negative emotions, fear ( $U = 98$ ,  $p = 0.01$ ) and sadness ( $U = 41$ ,  $p < 0.01$ ). However, WS

obtained results compatible with TD in the recognition of happy music ( $U = 137.5$ ,  $p < 0.01$ ). Generalized estimation equation model corroborated main effects for groups ( $\chi^2(1) = 19.96$ ,  $p < 0.01$ ) and emotional categories ( $\chi^2(2) = 49.85$ ,  $p < 0.01$ ). The model did not reveal an effect of interaction between groups and type of emotion or with the participant's gender. Children and adolescents with WS had a 46% ( $D = 7.1$ ) more chance of correctly labeling happy songs when compared to sad songs while this difference was only 23% ( $SD = 4.4$ ) in the population with TD. The groups did not present differences regarding the attribution of affective valence in the different negative emotions of fear ( $U = 167.5$ ,  $p = 0.70$ ) or sadness ( $U = 159.5$ ,  $p = 0.54$ ). However, happy songs were rated as more pleasurable by individuals with WS ( $U = 75$ ,  $p < 0.01$ ). In human faces, children and adolescents with WS, also had a pattern of relative preservation of the recognition of joy at the expense of negative emotions.

**Conclusions:** The findings highlight the debate about the modularity of discrete primary emotional processing in the brain. The results also suggest the relative preservation of skills to understand positive emotions in music and to the relevance of a neuropsychological intervention approach with multiple sensory inputs integrating the phonological loop and the visuospatial sketchpad.

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### **Symposium 11: Current and Future Directions of Cognitive Assessment: The (Overdue) Turn Toward Consideration of Culture and Linguistic Background in Cognitive Measurement**

**Chair: Theone S. E. Paterson**

**Presenters: Melanie Cohn, Khush-Bakht Zaidi, Angela Gutches, John A. E. Anderson**

**2:00 PM - 3:00 PM**

#### **T. S. E. PATERSON, M. COHN, K.-B. ZAIDI, A. GUTCHESS, J. A. E. ANDERSON. Current and Future Directions of Cognitive Assessment: The (Overdue) Turn Toward Consideration of Culture and Linguistic Background in Cognitive Measurement.**

As clinicians and researchers in neuropsychology, the vast majority of our clinical tools have been psychometrically developed and normed within the context of western culture, primarily in North America or Europe. This is recognized as increasingly problematic given continually shifting population demographics deemphasizing the mono-lingual, and mono-cultural groups many of these tests have historically drawn their normative data from. In acknowledgment of this, the American Academy of Clinical Neuropsychology estimates that by 2050, as much as 60% of those living in the US will be “untestable” using the tools most often currently relied upon by our profession. In the context of our increasingly multicultural society, there is a significant, and growing need to redouble research efforts toward the examination of the level of appropriateness of existing test stimuli for the increasingly diverse population in North American and European contexts, as well as the impacts of culture and linguistic profile on the expression of cognitive processes and variability in response biases to cognitive tasks. This symposium focuses on emerging research in these areas, with the aim of sounding a clarion call for further

focus on these domains. Recent work is presented highlighting the biases inherent in cognitive tools in current frequent use, including screeners and measures of visuospatial and executive functions (Statucka & Cohn) and the Boston Naming Test (Zaidi et al.). Findings are also presented examining the impacts of culture on cognitive processes, including qualitative differences in spatial frequency representation in memory (Gutchess et al.), and evidence for the protective effects of bilingualism on cognitive function and reserve (Anderson et al.).

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**Keywords:** cognitive functioning, cross-cultural issues, bilingualism

### **M. STATUCKA, M. COHN. Multiculturalism and Cognitive Testing in Parkinson's Disease.**

**Objective:** Cognitive decline is common in Parkinson's disease (PD), and screening and comprehensive cognitive assessments are important for diagnosis and prognosis. Several tools are recommended to assess cognition in PD, but the degree to which these may be culturally biased is unknown. Most measures are developed in Anglosphere cultures (USA, UK, Canada), and thus may be inherently biased when used with immigrants born outside these countries.

**Participants and Methods:** We examined cultural bias on cognitive screeners and on measures of visuoperceptual/visuospatial, attention, memory, and executive functions in Canadians with PD born in Anglosphere countries versus born in other regions (International group). We compared performance between groups, and investigated whether differences were explained by demographic, clinical, immigration and societal characteristics.

**Results:** The International group performed more poorly on cognitive screeners and all visuoperceptual and some executive function tasks, but not on attention or memory measures. These biases were not explained by demographic, clinical or immigration variables. A societal variable, the Historical Index of Human Development of the participants' country of birth, mediated group differences in executive and visuospatial skills, but not on cognitive screeners.

**Conclusions:** In sum, our findings demonstrate lasting biases on cognitive tools despite significant exposure to, and participation in, Canadian culture. Striking biases on tasks without a verbal component, which many considered to be "culture-fair", are consistent with the growing evidence from cross-cultural neuropsychology. Importantly, not all tasks showed such bias, including verbal memory and attention measures, which highlights the importance of investigating cultural bias across existing tests.

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### **K.-B. ZAIDI, K. T. SHAIKH, C. DIMECH, D. WONG GONZALES, K. A. STOKES, T. S. E. PATERSON. An Examination of Cultural Bias in The Boston Naming Test.**

**Objective:** Despite growing literature identifying an influence of cultural factors on cognitive test performance, neuropsychologists continue to rely on these measures to assess cognition within multicultural communities. The Boston Naming Test (BNT), a widely used neuropsychological measure that assesses confrontation naming, is frequently used with older adults, in conjunction with other tests, to differentiate normal aging from mild cognitive impairment or dementia. The present study aimed to examine the effects of cultural factors on the BNT and other neuropsychological measures.

**Participants and Methods:** Using a retrospective study design, we examined neuropsychological test performance of 614 older adults who presented at a geriatric hospital in a large multicultural city (Toronto, Canada). We compared total scores on the BNT as well as individual item accuracy among older adults born in Anglosphere countries (e.g., Canada, the US and UK), and those from non-Anglosphere countries (International group). Differences in cognitive performance were also assessed on additional measures of language, as well as other cognitive domains, including intelligence, executive functions and visuospatial abilities.

**Results:** Our findings show that relative to individuals with Anglosphere background, individuals from non-Anglosphere countries demonstrate greater impairment on the BNT when examining both the total score and all individual items of the test. Further, a societal factor, the Historical Index of Human Development of the participants' country of birth, significantly predicts BNT scores. This test bias also extends to other language measures (verbal and category fluency and vocabulary) in comparison to those born in Anglosphere countries. This pattern persists across other neuropsychological tests, with differences on measures of executive functions, intelligence and visuospatial abilities being observed despite controlling for English proficiency.

**Conclusions:** Overall, our findings demonstrate cultural bias in several commonly used neuropsychological measures used to assess language and other cognitive domains. The fact that the International group performance is worse on every item of the Boston Naming Test suggests that test stimuli may be systematically biased against individuals born outside of Anglosphere countries. We caution that normative data derived from predominantly Caucasian groups may not be appropriate for use within current, multicultural societies. These findings are particularly relevant for those using the BNT to make diagnostic decisions with patients born outside of Anglosphere countries.

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### **A. GUTCHESS, K. R. LEGER, T. LIN, R. SEKULER. Cross-Cultural Differences in Memory and Perception.**

**Objective:** The growing awareness of cross-cultural differences in cognition initially focused on the contribution of top-down processes, such as differences in cultural values or goals. Recent work, however, establishes that cultural differences extend to lower-level cognitive processes such as memory for objects and perception. I will present research investigating such differences.

**Participants and Methods:** We compared Americans and East Asians on tasks of episodic memory (e.g., photos of objects, such as a bicycle) and perception. To test visual processes, we used EEG to assess cultural differences in the prioritization of low versus high spatial frequency information during the viewing of Gabor patches.

**Results:** Americans exhibited more detailed memories for objects than did Easterners. Differences in pattern separation — the process by which new, but potentially similar, exemplars are discriminated from previously-encountered exemplars — did not seem to account for cultural difference in object memory. Cultural differences were more pronounced for the correct recognition of items that had been previously studied rather than distinguishing similar from old exemplars. For the perceptual task, Easterners exhibited a greater P3 response than Americans across different spatial frequencies, indicating cultural differences in attention and expectations.

**Conclusions:** Our findings add to the growing literature establishing cultural differences in lower-level cognitive processes, including the representation of information in memory. Based

on this initial work, it seems premature to conclude that different prioritization of spatial frequencies in vision contribute to cultural differences in memory, but more work is needed at the interface of perceptual and mnemonic processes.

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**J. A. E. ANDERSON, J. G. GRUNDY, E. BIALYSTOK. Bilingualism Leads to Cognitive Reserve in Older Adults.**

**Objective:** Increases in incidence of Alzheimer's disease is a major health concern. Bilingualism is a cognitive reserve factor and can delay dementia symptoms by 4 years despite steadily increasing neuropathology. Here, we present data from a cross-sectional experiment tested whether effects of bilingualism were detectable earlier in healthy aging.

**Participants and Methods:** A sample of 99 older bilingual and monolingual adults participated in a working memory study (N-Back) while being scanned with structural and functional MRI. voxel-based-morphometry and tract-based-spatial-statistics were used to extract gray and white matter values. Analyses were conducted with multivariate partial least squares.

**Results:** In our sample of healthy older adults, bilinguals had lower fractional anisotropy values in white matter and lower gray matter volume scores than monolingual peers. Despite this, balanced integration scores, (i.e., standardized percent correct minus standardized reaction times), revealed no performance differences in working memory. fMRI revealed different functional connectivity patterns between bilinguals and monolinguals while performing the task. Bilinguals had greater brain-behavior connectivity with salience and frontoparietal networks during the one-back and two-back, while monolinguals had higher brain-behavior coupling in these networks during the two-back only.

**Conclusions:** In a sample of healthy older adults, we showed equivalent cognitive function but worse structural integrity in older adult bilinguals than monolinguals. Functional data support the notion that bilinguals may be using compensatory or adaptive recruitment of brain networks to support sustained cognitive performance. This pattern of evidence is consistent with cognitive reserve.

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**Keywords:** aging (normal), brain plasticity

**FRIDAY, FEBRUARY 5, 2021**

**CE Workshop 11: Social Cognitive and Affective Neuroscience: From the Clinic and into the Wild**

**Presenter: Agustín M. Ibáñez**

**8:00 AM - 9:30 AM**

**A. M. IBÁÑEZ. Social Cognitive and Affective Neuroscience: From the Clinic and into the Wild.**

Having overcome several shortcomings of old-fashioned neuroscience, social cognitive affective neuroscience (SCAN) represents a promising new approach. Nevertheless, SCAN entails new challenges for a translation into everyday cognitive life. Most of SCAN still conceives human cognition as resulting from the operation of compartmentalized, reflexive, and context-free mechanisms. Our experimental paradigms have provided precise correlates for fragments of analytically decomposed units, such as bodiless faces, intention-blind interactions, language-free actions, and situation-independent words. We have accumulated massive knowledge about isolated phenomena that never manifest as such outside the laboratory. However, the mind is situated beyond experimental precautions in its daily workings. Social interactions in real life involve continuous and active negotiations with other people in profoundly changing conditions. From a theoretical viewpoint, classical theories supporting segregated models, the limits of multilevel and transdisciplinary co-construction, and the theoretical distance among disciplines represent essential barriers. I will propose a new research framework called Intercognition. I will provide support for this view from neurocognitive naturalistic social cognitive process such as ecological tasks assessing social cognition, interoception, language and action; as well as their applications to different psychiatric (depression, anxiety, panic attack, OCD) and neurodegenerative diseases (Alzheimer's disease, Parkinson's disease, frontotemporal dementia, multiple sclerosis, ataxia). I will also introduce relevant translational applications of SCAN to everyday cognition in different domains such as violence, behavioral insights, and brain capital. I will propose experimental designs (tapping the social-linguistic-motoric triangle; second-person and two-person neuroscience, semiotic integration of multimodal process) and methodological implementations (dynamics of self-organizing networks; machine learning; hyperscanning; decoding) to foster a more naturalistic and ecological approach to intercognition. By moving towards this horizon, the SCAN will plunge from the laboratory into the core of social life.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe basic limits and possibilities of social cognitive affective neuroscience (SCAN) 2) Compare SCAN applications to different domains (clinic, ecological cognition, policy makers) 3) Utilize current state-of-the-art to anticipate future SCAN innovations working beyond the laboratory

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## **CE Workshop 12: The Brain in Space: Implications for Human Explorations of Mars and Human Conditions on Earth**

**Presenters: Vonetta Dotson, Ajitkumar Mulavara**

**8:00 AM - 9:30 AM**

### **V. DOTSON, A. MULAVARA. The Brain in Space: Implications for Human Explorations of Mars and Human Conditions on Earth.**

This CE will provide an overview of our current understanding of the effect of spaceflight on brain structure and function from the perspective of NASA's CNS/Behavioral

Medicine/Sensorimotor (CBS) Integrated Research Plan. The CBS research approach was implemented to help accelerate the characterization and mitigation of risks to the central nervous system associated with spaceflight, from the combined exposure to space radiation, isolation & confinement, and altered gravity. We will also discuss how the CBS Integrated Research Plan both informs and is informed by interdisciplinary research on brain health and brain dysfunction in patient populations such as dementia.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe at least one risk to the brain associated with exposure to space radiation, isolation & confinement, and altered gravity 2) Explain the potential synergistic interaction of spaceflight stressor impacts on the sensorimotor, adverse cognitive or behavioral conditions and psychiatric disorders associated with space flight 3) Apply interdisciplinary research on the brain in space to neurodegenerative disorders and brain health promotion in patient populations.

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### **Paper Session 15: Aging, Neuroimaging and Hormones**

**8:00 AM - 9:00 AM**

**K. J. BANGEN, K. R. THOMAS, D. SANCHEZ, E. EDMONDS, A. J. WEIGAND, L. DELANO-WOOD, M. W. BONDI. Reduced Entorhinal Perfusion Predicts Future Cognitive Decline, Neurodegeneration, and White Matter Hyperintensity Progression in Nondemented Older Adults.**

**Objective:** Alzheimer's disease (AD) research has increasingly focused on methods for early detection of individuals at risk for future cognitive decline, with a particular focus on the roles of amyloid and tau pathologies. In this context, cerebrovascular pathology has also garnered increased attention, as evidence has emerged that vascular changes may be part of early AD pathogenesis or accelerate AD-related cognitive decline. Altered cerebral blood flow (CBF) has been linked to increased risk for AD; however, whether altered CBF accelerates future cognitive decline, neurodegeneration, and/or small vessel cerebrovascular disease remains unclear. Therefore, we examined whether baseline entorhinal CBF is associated with changes in cognition, entorhinal cortical thinning, and white matter hyperintensity (WMH) volume over time in a well-characterized sample of nondemented older adults.

**Participants and Methods:** One-hundred forty-seven Alzheimer's Disease Neuroimaging Initiative (ADNI) participants without dementia underwent baseline arterial spin labeling (ASL) magnetic resonance imaging (MRI) to measure CBF and serial neuropsychological evaluations and structural MRI examinations. Composite scores reflecting memory, language, and executive functioning validated in previous studies within the ADNI cohort were used. FreeSurfer-derived entorhinal cortical thickness was selected as a dependent variable given its implication in early stages of AD. In addition, a FreeSurfer-derived entorhinal cortex region of interest was applied and used to extract mean CBF in this region for each participant. Global WMH volume was quantified on fluid-attenuated inversion recovery (FLAIR) scans using automated procedures. Linear mixed effects models examined whether baseline entorhinal CBF is predictive of 5-year rate of change in memory, language, and executive function and 4-year rate of change in entorhinal cortical thickness and WMH volumes.

**Results:** Adjusting for age, sex, education, apolipoprotein E (APOE) e4 positivity, cerebrospinal fluid (CSF) p-tau/A $\beta$ , and neuronal metabolism (i.e., fluorodeoxyglucose [FDG] standardized uptake value ratios [SUV<sub>R</sub>]), lower baseline entorhinal CBF predicted faster rates of decline in memory [ $t(122.08)=2.90$ ,  $p=.004$ ,  $r=0.25$ ], language [ $t(136.88)=2.78$ ,  $p=.006$ ,  $r=0.23$ ], and executive functioning [ $t(133.56)=2.22$ ,  $p=.028$ ,  $r=0.19$ ]. Lower baseline entorhinal CBF also predicted faster rates of entorhinal thinning [ $t(130.37)=3.32$ ,  $p=.001$ ,  $r=0.28$ ] and a faster increase in WMH volume [ $t(96.86)=-2.21$ ,  $p=.029$ ,  $r=0.22$ ].

**Conclusions:** Reduced entorhinal CBF predicts faster rates of cognitive decline across multiple domains, as well as neurodegeneration and progression of small vessel cerebrovascular disease, even after adjusting for well-established AD risk factors in a sample of nondemented older adults with low vascular risk burden. Our findings add to an expanding literature suggesting that ASL MRI measures of CBF are useful markers of early neurovascular changes that may help clarify the mechanisms that precede the development of irreversible parenchymal damage and serve as a useful early biomarker of risk of cognitive decline. Further, ASL MRI has advantages over PET imaging and lumbar puncture for CSF data collection given its noninvasive nature. Findings support the notion that even relatively mild cerebrovascular dysfunction plays a role in progression of cognitive decline, neurodegeneration, and WMH in the context of aging. Future research focused on CBF may further improve our understanding of AD pathogenesis and facilitate the development of interventions aimed at improving cerebrovascular health.

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**Keywords:** cerebral blood flow, aging disorders, dementia - Alzheimer's disease

**L. K. MCEVOY, D. J. HAGLER, JR, R. R. LEE, A. M. DALE, E. T. REAS. Lower Hearing Acuity Among Older Adults Predicts Reduced Thickness and Intracellular Diffusion in Cortical Areas Related to Auditory Perception and Language Processing 10 Years Later.**

**Objective:** Hearing loss is prevalent among older adults and has been associated with accelerated cognitive decline and increased risk of dementia. Mechanisms underlying these associations are not well understood. It has been hypothesized that hearing impairment leads to changes in the brain that result in impaired cognitive function. Here, we used structural MRI and restriction spectrum imaging (RSI, an advanced form of diffusion weighted imaging) to investigate whether reduced hearing acuity in older adults predicts decreased cortical thickness or altered microstructure in cortical regions critical for auditory perception and language processing.

**Participants and Methods:** 131 community-dwelling older adult participants (mean age 76.6  $\pm$ 7.6; 66% women) of the longitudinal Rancho Bernardo Study of Healthy Aging had hearing thresholds measured in a research visit in 1996-98 and underwent MR imaging during a research visit in 2014-2016. Using *Freesurfer* software to identify regions of interest, we calculated mean thickness and RSI-based diffusion metrics in primary auditory cortex (transverse temporal gyrus), auditory association cortex including Wernicke's areas (superior temporal gyrus), inferior frontal cortex containing Broca's area (pars triangularis), as well as the lateral occipital cortex, which we included as a control region. For RSI measures, we focused on an aggregate measure of restricted isotropic and oriented diffusion, which is thought to reflect diffusion within intracellular space, including neurites and cell bodies. We used linear regression, adjusting for

sex and age, to examine whether elevated average pure tone hearing thresholds in the better-hearing ear were associated with reduced thickness or intracellular diffusion.

**Results:** We observed significant negative associations between hearing thresholds and thickness in bilateral transverse temporal gyri and pars triangularis, with somewhat stronger associations for the right hemisphere (RH) than for the left hemisphere (LH) (transverse temporal: RH: standardized  $b = -0.23$ ,  $p = 0.02$ ; LH:  $b = -0.19$ ,  $p = 0.03$ ; pars triangularis RH:  $b = -0.26$ ,  $p = 0.006$ ; LH:  $b = -0.19$ ,  $p = 0.04$ ). Thickness of the superior temporal gyrus and lateral occipital cortex was not associated with hearing acuity. Poorer hearing acuity was associated with reduced restricted diffusion in the right transverse temporal gyrus ( $b = -0.28$ ,  $p = 0.006$ ), superior temporal gyrus ( $b = -0.21$ ,  $p = 0.02$ ) and pars triangularis ( $b = -0.31$ ,  $p = 0.001$ ). Associations in the left hemisphere failed to reach significance. No significant associations were observed in the lateral occipital cortex (all  $p$  values  $> 0.1$ ).

**Conclusions:** Poorer hearing acuity at baseline was associated with thinner cortex and reduced intracellular diffusion in primarily RH cortical areas involved in auditory perception and language processing 10 years later, but not in areas related to visual processing. It is possible that the LH's greater role in language processing may provide a buffer against structural changes related to reduced auditory input. Further study is needed to determine whether these associations reflect a causal role of hearing impairment on altered brain structure, and if so, whether early adoption of hearing aids may prevent such changes.

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**Keywords:** aging (normal), auditory processing (normal), neuroimaging: structural

**C. BOLTON, O. A. KHAN, E. E. MOORE, K. R. PECHMAN, L. DAVIS, D. LIU, M. MOORE, B. A. LANDMAN, T. J. HOHMAN, K. A. GIFFORD, A. L. JEFFERSON.**  
**Smaller grey matter volumes and increased white matter hyperintensities predict more rapid functional decline in older adults.**

**Objective:** Maintaining functional independence positively affects quality of life among older adults. Imaging biomarkers that reliably predict future functional decline could have important implications for predicting adverse patient outcomes and to inform late life planning for patients and families. This study investigates associations between baseline structural neuroimaging biomarkers and longitudinal functional status among older adults with and without cognitive impairment.

**Participants and Methods:** Vanderbilt Memory and Aging Project participants ( $n=324$ ,  $73 \pm 7$  years, 41% female) underwent baseline 3T multi-modal brain MRI to capture total and regional grey matter volumes on T<sub>1</sub> and total and regional white matter hyperintensities (WMHs) on T<sub>2</sub>-FLAIR. Participants also serially completed the Functional Capacity for Activities of Daily Living (FCADL) scale (Glosser et al., 2002), a 50-item assessment of functional status, at study entry, 18-months, 3-years, and 5-years ( $4.3 \pm 1.2$  year follow-up). Linear mixed effects models with follow-up time interaction terms related baseline grey matter volumes and WMHs to FCADL trajectory adjusting for baseline age, sex, education, race/ethnicity, apolipoprotein E (*APOE*) e4 status, Framingham Stroke Risk Profile, cognitive diagnosis, intracranial volume, and follow-up time. Follow-up models assessed *structural MRI x cognitive diagnosis* and *structural MRI x APOE-e4 status* interactions on FCADL trajectory.

**Results:** Smaller total and regional grey matter volumes in the frontal, temporal, and parietal lobes, the hippocampus, and Alzheimer's disease signature regions as well as larger inferior

lateral ventricle volume were each associated with faster decline on FCADL (p-values<0.006). Occipital grey matter volume was not associated with FCADL (p=0.24). Greater total WMHs and regional frontal, parietal, and occipital lobe WMHs were each associated with faster decline on FCADL (p<0.003). Cognitive diagnosis and *APOE*-e4 status each interacted with all grey matter variables (p-values<0.005) except occipital lobe volume (p-values>0.63) on FCADL scores, such that associations were stronger in participants with mild cognitive impairment (MCI) and in participants who were *APOE*-e4 positive. Diagnosis also interacted with total and occipital lobe WMHs on FCADL scores (p-values<0.04), such that associations were stronger in participants with MCI. The remaining interaction models were null (p-values>0.15).

**Conclusions:** Among community-dwelling older adults free of clinical dementia, results suggest both smaller baseline grey matter volumes and greater WMH burden are associated with faster functional decline over a mean 4-year follow-up period. Grey matter associations with functional decline were most prominent among individuals at increased risk of Alzheimer's disease (MCI and *APOE*-e4 carriers). Taken together, smaller grey matter volumes among *APOE*-e4 carriers and individuals with cognitive impairment as well as higher WMH burden may be important biomarkers for predicting older adults at greatest risk of future functional decline.

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**Keywords:** cognitive functioning

**K. R. THOMAS, A. J. WEIGAND, I. H. COTA, E. EDMONDS, C. E. WIERENGA, M. W. BONDI, K. J. BANGEN. Intrusion Errors Moderate the Relationship Between Blood Glucose and Regional Cerebral Blood Flow in Cognitively Unimpaired Older Adults.**

**Objective:** Regional cerebral blood flow (CBF) has consistently shown a dynamic relationship with cognitive functioning such that cognitively unimpaired individuals at risk for Alzheimer's disease (AD) may show regional hyperperfusion, while those with frank cognitive impairment tend to show hypoperfusion. Type 2 diabetes and intrusion errors from a word-list learning and memory measure have both been shown to confer greater risk of cognitive decline and progression to mild cognitive impairment (MCI) or AD dementia. Our study aimed to examine the associations between blood glucose, intrusion errors, and regional CBF.

**Participants and Methods:** One-hundred thirteen cognitively unimpaired older adults from the Alzheimer's Disease Neuroimaging Initiative underwent arterial spin labeling MRI, which was used to measure CBF in *a priori* AD vulnerable regions of interest: medial temporal lobe, inferior parietal lobe, precuneus, medial orbitofrontal cortex, and pericalcarine (control region). Intrusion errors were defined as the total number of non-target words said during all recall trials of the Rey Auditory Verbal Learning Test. Hierarchical linear regressions, adjusting for age, sex, education, *APOE* ε4 carrier status, body mass index, pulse pressure, FDG PET, and reference CBF region (precentral gyrus), were used to examine the main effects of fasting blood glucose and frequency of intrusion errors on regional CBF as well as whether intrusion errors moderated the relationship between glucose levels and CBF.

**Results:** Higher blood glucose was associated with higher CBF in the precuneus ( $\beta = .134$ ,  $p = .039$ ), inferior parietal ( $\beta = .173$ ,  $p = .001$ ), and medial orbitofrontal cortex ( $\beta = .182$ ,  $p = .009$ ).

There was not a significant main effect of intrusion errors on CBF across regions. However, when the blood glucose x intrusion errors interaction was added to the model, intrusion errors moderated the relationship between glucose and regional CBF such that having higher glucose levels and more intrusion errors was associated with reduced CBF in the medial temporal lobe ( $\beta = -.186$ ,  $p = .013$ ) and precuneus ( $\beta = -.146$ ,  $p = .022$ ). These interaction effects persisted even when participants with diabetes ( $n = 14$ ) were excluded.

**Conclusions:** These findings may reflect early neurovascular dysregulation, whereby higher CBF is needed to maintain unimpaired cognitive performance in individuals with higher glucose levels. However, lower regional CBF in cognitively unimpaired participants with both higher glucose *and* more intrusions errors suggests a failure in this early compensatory mechanism that may signal a decrease in neural activity in AD vulnerable regions. This pattern of hypoperfusion is consistent with more advanced stages of clinical AD progression such as MCI or dementia. The findings remained significant when excluding participants with diabetes suggesting that even pre-diabetes levels of glucose may negatively impact blood flow in the context of an additional risk factor such as intrusion errors.

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**Keywords:** cerebral blood flow, diabetes, cognitive functioning

**T. R. BELL, J. A. ELMAN, O. K. PUCKETT, C. E. FRANZ, W. S. KREMEN. The Association between Locus Coeruleus and Subjective Cognitive Decline in Late Midlife.**

**Objective:** One in 10 older adults report subjective cognitive decline which is associated with increased likelihood of Alzheimer's disease and other dementias. Neuroimaging studies have elucidated biological differences possibly explaining later cognitive decline risk. This largely involves smaller neocortical volumes in people with subjective cognitive decline compared to peers. Nonetheless, investigating associations with subcortical structures is pertinent due to their possible early involvement in the Alzheimer's pathological process. One area to consider is the locus coeruleus (LC), a structure integral to memory, attention, and arousal, and perhaps the earliest site of tau deposition. In the present study we hypothesized that lower LC integrity would be associated with higher levels of subjective cognitive decline reported in late middle age.

**Participants and Methods:** We examined 443 community-dwelling men (mean age=67.58;  $SD=2.59$ ) in the Vietnam Era Twin Study of Aging (VETSA) who underwent neuromelanin signal detection in 3T MRI scanners. Using signal values derived from rostral and caudal LC regions and a pontine tegmentum reference region, contrast-to-noise ratios were calculated, with higher scores indicating greater LC integrity. Subjective cognitive decline was assessed using participant and informant reports on the 39-item Everyday Cognition (ECog) scale ( $\alpha_s = .81$  to  $.86$ ). Participants and informants rated perceived 10-year decline in memory, executive function, language, and visuospatial abilities. Associations with LC integrity were examined using structural equation modeling. Models adjusted for age, depressive symptoms, comorbidities, and clustering of twin data. As a sensitivity analyses, results also controlled for objective cognitive decline from assessments approximately 12 years prior.

**Results:** For participant ratings, lower rostral LC integrity was associated with greater 10-year subjective decline in memory ( $b = -2.10$ ,  $SE = 1.02$ ,  $\beta = -.11$ ), executive function ( $b = -2.25$ ,  $SE = .81$ ,  $95\%CI: \beta = -.13$ ), language ( $b = -1.95$ ,  $SE = .85$ ,  $\beta = -.11$ ), and visuospatial abilities ( $b = -2.23$ ,  $SE = .82$ ,  $\beta = -.15$ ,  $ps < .05$ ). For informant ratings, lower LC integrity was associated with greater subjective decline in memory ( $b = -2.10$ ,  $SE = .96$ ,  $\beta = -.10$ ,  $p = .030$ ) but not other

domains. There were similar patterns of findings for caudal LC integrity as well ( $\beta$ s range from -.10 to .13,  $ps < .05$ ). Associations remained after controlling for objective cognitive decline.

**Conclusions:** LC integrity is associated with ratings of subjective cognitive decline, more in participants than informants. Findings align with our previous work showing that rostral LC associated with objective cognition, but also highlight a significant role of the caudal LC with respect to subjective decline. Overall, the LC-norepinephrine system modulates cognitive function, and dysfunction in this system has been associated with the need for increased cognitive effort even in cognitively normal adults. It is plausible that such early suboptimal function, particularly experiencing the need to exert increased effort to perform cognitive tasks, could be a factor underlying subjective concern. These findings provide further support that subjective cognitive concern may be associated with early Alzheimer-related brain changes.

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**Keywords:** cognitive functioning, subcortical, memory complaints

**E. E. SUNDERMANN, M. PANIZZON, R. A. BERNIER, D. GALASKO, M. ANDREWS, S. J. BANKS. Elucidating the Relationship between Testosterone and Cognitive Function: Moderating Roles of APOE4 and Sex.**

**Objective:** There are sex differences in Alzheimer's disease (AD) including the higher prevalence, steeper cognitive decline and a stronger effect of the apolipoprotein E  $\epsilon$ 4 allele (APOE4) on AD risk in women versus men. These sex differences suggest an underlying role of sex hormones. Animal studies indicate that low testosterone promotes the hyperphosphorylation of tau (p-Tau), and human studies suggest that low testosterone levels relate to poorer cognitive function and higher AD risk; however, these findings are inconsistent and mostly derived from male samples despite similar age-related declines in testosterone in women. Both animal and human studies demonstrate that the effects of testosterone may be moderated by APOE4 genotype, which may explain some of the inconsistencies in results. Here, we examined how testosterone relates to cognitive function in women versus men across the aging-mild cognitive impairment (MCI)-AD trajectory and the moderating role of APOE4 genotype.

**Participants and Methods:** Analyses included 215 women (57 cognitively normal, 111 MCI, 46 AD dementia; 51% APOE4 carriers) and 346 men (101 cognitively normal, 185 MCI, 60 AD dementia; 52% APOE4 carriers) from the Alzheimer's Disease Neuroimaging Initiative (ADNI) who had baseline data on cognitive function and plasma-based testosterone levels as measured by the Rules Based Medicine Human DiscoveryMAP Panel. Participants were aged 55-90 years. Our cognitive outcomes included a test of global cognitive status (Mini Mental Status Exam, MMSE), verbal memory (Logical Memory-Delayed Recall, LM-DR), executive function (Trail Making Test, Part B, TMTB), processing speed (Digit Symbol Substitution Test, DSST) and language (Boston Naming Test, BNT). In sex-stratified samples, we conducted a series of linear regressions to examine whether testosterone levels and their interaction with APOE4 status relate to cognitive performance while adjusting for age, education, body mass index and history of cardiovascular disease.

**Results:** In men, testosterone or the testosterone-by-APOE4 interaction did not relate to cognitive outcomes, whereas, in women, an APOE4-by-testosterone interaction was significant for MMSE ( $p=.01$ ), LM-DR ( $p=.04$ ) and DSST ( $p=.02$ ). Interactions in women revealed that higher testosterone levels positively related to MMSE ( $p=.07$ ), LM-DR ( $p=.05$ ) and DSST ( $p=.04$ ) scores among female APOE4 carriers, whereas testosterone levels inversely related to

cognitive scores among female non-carriers although not significantly ( $p \geq .10$ ). Testosterone or the APOE4-by-testosterone interaction did not relate to TMTB or BNT performance in women.

**Conclusions:** Despite most studies focusing on testosterone links to cognition in men, our results indicate that it is as important, if not more, to examine these links in women. Our results also stress the importance of considering APOE4 status and specific cognitive domains when examining testosterone and cognition links given that low testosterone levels related to poorer global, memory and processing speed performance only in female APOE4 carriers. Overall, our findings suggest that the lower testosterone levels that typically characterize women may be a contributing factor to the worse AD outcomes in women, particularly among APOE4 carriers.

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**Keywords:** hormones, apolipoprotein E, cognitive functioning

## Paper Session 16: Mood and Other Psychiatric Disorders

8:00 AM - 9:00 AM

### Z. TAIWO, E. TIGHE, E. TONE, S. LIGHT, V. DOTSON. Motivational Depressive Symptoms may be Uniquely Linked to White Matter Hyperintensities in Late-Onset Depression.

**Objective:** A growing literature, based on the vascular depression hypothesis, posits that depression in older adults may have a vascular origin—particularly when onset of depressive symptoms occurs in older adulthood (late-onset depression). Despite increasing focus on symptom-level approaches in depression research, limited work has examined whether different symptom profiles of late-onset depression have distinct associations with white matter hyperintensities (WMH). The current study examines associations between empirically derived symptom profiles of late-onset depression and volume of WMH.

**Participants and Methods:** We evaluated cross-sectional data from the National Alzheimer's Coordinating Center Data Set. Participants were included if they were  $\geq 65$  years old, community dwelling, without cognitive impairment or a history of depression in earlier life ( $N = 423$ , mean age =  $77.8 \pm 7.23$ , 61% female), and had quantified volumes of T2 FLAIR WMH. Depressive symptom profiles were identified using a latent class analysis of the Geriatric Depression Scale (GDS-15). ANCOVA models were conducted to examine differences in WMH between depression symptom profiles, controlling for age, education and race.

**Results:** Three distinct symptom profiles were identified: 1) a General Depression profile with a higher probability of endorsing all depressive symptoms on the GDS-15, 2) a Motivation/Withdrawal profile with a high probability of endorsing motivational depressive symptoms, and 3) an Asymptomatic profile with no probability of endorsing depressive symptoms. In WMH analyses, the Motivation/Withdrawal symptom profile was associated with greater WMH volume compared to the General Depression and Asymptomatic symptom profiles, but the comparison with General Depression was not significantly different.

**Conclusions:** Findings suggest that amotivation and withdrawal symptoms may be uniquely associated with vascular pathology. These results highlight the importance of a symptom-level approach to assessing depression in older adults.

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**Keywords:** mood disorders

**G. A. THOMAS, E. T. GUTY, K. RIEGLER, P. A. ARNETT. The Influence of Self-Report Mood Difficulties on Baseline Symptomatology in College Athletes.**

**Objective:** To explore differences in self-reported symptomatology across 5 symptom clusters of the Post-Concussion Symptoms Scale (PCSS) in athletes with significant mood symptoms. While symptomatology, as expressed on measures like the PCSS, is typically correlated with an athlete's recovery following concussion, it is unclear how this symptomatology is related to mood symptoms at baseline. Further, by understanding factors associated with athletes' symptomatology at baseline, we may be better equipped to understand their relative functioning following concussion. This may also give valuable insight as to which symptom clusters are driving overall effects.

**Participants and Methods:** 829 (M=618,F=211) collegiate athletes completed a comprehensive neuropsychological test battery at baseline which included self-report measures of anxiety, depression, and the PCSS. Athletes were separated into 4 groups (Healthy Control (HC)( $n=577$ ), Depression Only( $n=136$ ), Anxiety Only( $n=54$ ), Comorbid Depression/Anxiety( $n=62$ )) based on their anxiety and depression scores. PCSS scores were divided into 5 symptom clusters (e.g. cognitive, physical, affective, sleep, and headache) as recommended by previous research (Merritt et al., 2015).

**Results:** MANOVA results revealed that, overall, the three affective groups reported significantly greater symptomatology than HCs, with the comorbid group showing the highest symptomatology compared to HCs,  $F(5,633)=43.71$ ,  $p<0.001$ ,  $\eta^2=0.26$ .

While all symptom clusters were significantly elevated in the comorbid group, the factors with the largest effects relative to HCs were the affective cluster,  $F(1,637)=209.19$ ,  $p<0.001$ ,  $\eta^2=0.25$ , cognitive cluster,  $F(1,637)=80.59$ ,  $p<0.001$ ,  $\eta^2=0.11$ , and sleep cluster,  $F(1,637)=42.33$ ,  $p<0.001$ ,  $\eta^2=0.06$ . The depressive symptoms only group reported significantly elevated symptomatology, compared to HCs, on every symptom cluster except headache. The factors with the largest effects were the affective cluster,  $F(1,711)=25.63$ ,  $p<0.001$ ,  $\eta^2=0.03$ , and the cognitive cluster,  $F(1,711)=20.12$ ,  $p<0.001$ ,  $\eta^2=0.03$ . The anxiety symptoms only group reported significantly increased symptomatology, compared to HCs, on only the cognitive symptoms cluster,  $F(1,629)=9.59$ ,  $p=0.002$ ,  $\eta^2=0.02$ .

The depressive symptoms only and anxiety symptoms only groups did not significantly differ on any of the symptom clusters. However, the comorbid group reported significantly increased PCSS symptomatology, overall, compared to the depressive symptoms only and anxiety symptoms only groups,  $F(5,246)=11.05$ ,  $p<0.001$ ,  $\eta^2=0.18$ . Additionally, the comorbid group reported significantly elevated symptomatology across all 5 symptom clusters. The factors with the greatest effects were the affective cluster,  $F(1,250)=53.45$ ,  $p<0.001$ ,  $\eta^2=0.18$ , cognitive cluster,  $F(1,250)=15.02$ ,  $p<0.001$ ,  $\eta^2=0.06$ , and physical cluster,  $F(1,250)=12.32$ ,  $p=0.001$ ,  $\eta^2=0.05$ .

**Conclusions:** Our findings suggest that athletes experiencing comorbid depressive/anxiety symptoms report significantly greater levels of symptomatology across all 5 PCSS symptom clusters compared to HCs. Further, results suggest that athletes experiencing psychiatric comorbidity tend to report greater symptomatology than those with only one affective disturbance. Unsurprisingly, the effect sizes for the affective cluster were consistently the highest, but the cognitive symptomatology effect size was next highest. This latter finding supports previous research showing that those experiencing psychiatric comorbidity perform

significantly worse than HCs on objective neuropsychological measures. These findings are important because, despite the absence of concussion, the comorbid group demonstrates significantly elevated symptomatology at baseline. Thus, future comparisons with post-concussion data should account for this increased symptomatology, as test results may be skewed by affective disturbances at baseline.

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**Keywords:** concussion, mood disorders, sports-related neuropsychology

**Z. MAHMOOD, A. V. KELLER, H. C. LYKINS, E. PARRISH, D. PERIVOLIOTIS, E. GRANHOLM, E. W. TWAMLEY. An Integrated Cognitive-Behavioral Social Skills Training and Compensatory Cognitive Training Intervention for Negative Symptoms of Psychosis.**

**Objective:** Negative symptoms in schizophrenia (SZ) remain an unmet treatment need as they are highly prevalent, associated with poor functional outcomes, and resistant to pharmacologic treatment. Similarly, cognitive impairment is common in schizophrenia and is closely tied to negative symptoms and functional deficits. Two psychosocial interventions, Cognitive-Behavioral Social Skills Training (CBSST) and Compensatory Cognitive Training (CCT), have independently been linked to improved cognitive functioning, and have demonstrated clinically significant effect sizes in reducing negative symptoms; however, neither has been used to specifically target negative symptoms as the primary outcome and they have not yet been integrated. The two intervention strategies are likely to have different mechanisms of action, and bundling of these interventions may contribute to stronger, synergistic treatment effects. As such, the current pilot randomized controlled trial examined the efficacy of an integrated CBSST-CCT intervention compared to Goal-focused Supportive Contact (SC) on negative symptoms and objective cognitive performance.

**Participants and Methods:** 55 adults with SZ or schizoaffective disorder with moderate-to-severe negative symptoms were randomized to receive 25 twice-weekly, 1-hour manualized group sessions (12.5 weeks total duration) of either CBSST-CCT or SC delivered by master's level clinicians in five community settings. CBSST was modified to strengthen its impact on negative symptoms. CCT was included to bolster impaired functions in prospective memory, attention, learning, and memory, thereby enhancing attention to CBSST content, learning of content, and memory for content. SC was used as a robust control condition, supporting systematic recovery goal setting by teaching participants to break down goals into short-term goals and SMART goal steps. SC provided the same frequency and amount of therapist and group member contact as CBSST-CCT. Hierarchical linear models (HLMs) and/or analyses of covariance (ANCOVAs) examined treatment-related improvements in negative symptom severity (Scale for the Assessment of Negative Symptoms [SANS]) and neuropsychological performance (MATRICS Consensus Cognitive Battery) at post-treatment and 6-month follow-up.

**Results:** The sample consisted of mostly male (60%), white (66%) participants, aged 22-65 ( $M=50.6$ ,  $SD=9.8$ ), with a mean of 11.7 years of education ( $SD=2.7$ ). Most participants were never married (60%), living independently (62%), and prescribed second generation antipsychotic medication (64%). Participants in the SC group were significantly older than those in the CBSST-CCT group (mean age=53 vs. 48;  $p=.035$ ); thus, age was included as a covariate in analyses except for cognitive outcomes given the use of demographically adjusted scores. HLMs

demonstrated that compared to the SC group, the CBSST-CCT group had more negative symptom improvement on the SANS at post-treatment ( $p=.0498$ ,  $r=0.22$ ), with improvements in diminished motivation/pleasure driving this effect ( $p=.0391$ ,  $r=.24$ ). These improvements, however, were not maintained at follow-up. Moreover, CBSST-CCT participants demonstrated marginally improved verbal learning at post-treatment compared to SC participants ( $p=.064$ ,  $\eta p^2=.114$ ), with significant improvement by follow-up ( $p=.049$ ;  $r=.23$ ). No other significant group differences were found.

**Conclusions:** CBSST-CCT has the potential to improve negative symptom severity and cognitive functioning in high-negative-symptom patients. CBSST-CCT warrants larger investigations to examine its efficacy in treating negative symptoms, along with other symptoms, cognition, and functioning.

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**Keywords:** cognitive rehabilitation, neurocognition, clinical trials

### **H. C. LYKINS, Z. MAHMOOD, E. PARRISH, A. V. KELLER, D. PICKELL, E. GRANHOLM, E. W. TWAMLEY. Modifiable Predictors of Objective and Subjective Functioning in Individuals with Schizophrenia-Spectrum Disorders and High Levels of Negative Symptoms.**

**Objective:** Individuals with schizophrenia and high levels of negative symptoms are at greater risk for poor functional outcomes. However, the strongest predictors of psychosocial functioning in those with high negative symptoms are not well-understood. As such, we aimed to examine the strongest modifiable predictors of performance-based functional capacity and social skills, and self-reported functioning, in a negative symptom-enriched sample of individuals with schizophrenia and schizoaffective disorder.

**Participants and Methods:** 55 adults with moderate-to-severe negative symptoms were administered tests of neuropsychological performance (MATRICS Consensus Cognitive Battery along with a test of premorbid IQ), functional capacity (UCSD Performance-Based Skills Assessment-Brief [UPSA-B]), social skills (Social Skills Performance Assessment [SSPA]), self-reported functioning (Independent Living Skills Survey [ILSS]; Specific Levels of Functioning Scale [SLoF]), psychiatric symptom severity (Clinical Assessment Interview for Negative Symptoms [CAINS]), and defeatist/asocial beliefs and intrinsic motivation (Defeatist Performance Attitude Scale [DPAS]; Asocial Belief Scale [ABS]; derived 3-item measure of sense of purpose, motivation, and curiosity [QLS-3] from the Heinrichs-Carpenter Quality of Life Scale). Multiple linear regression was used to examine the strongest modifiable predictors of both performance-based and subjective indices of functioning. To minimize Type II error, covariates were selected based on bivariate significance at  $p<.05$  via Pearson correlations.

**Results:** For the UPSA-B, bivariate correlations determined that race, education, premorbid IQ, MCCB global performance, and QLS-3 scores were associated with UPSA-B performance. Together, these variables explained 61% of the variance in UPSA-B performance [ $F(5, 47)=14.64$ ,  $p<.001$ ,  $R^2=0.61$ ]. MCCB global performance and QLS-3 scores uniquely explained 20% of UPSA-B variance, with only the MCCB global score emerging as a significant predictor ( $p<.001$ ). For the SSPA, bivariate correlations determined lower scores on the CAINS motivation/pleasure subscale, as well as higher QLS-3 and MCCB global scores, were associated with better social skills performance. Together, these variables explained 23% of variance in SSPA performance [ $F(3, 50)=4.85$ ,  $p=.005$ ,  $R^2=0.23$ ], with CAINS motivation/pleasure and the

MCCB global score emerging as the only significant predictors ( $p=.034$  and  $p=.011$ , respectively). For the ILSS, bivariate correlations determined that higher levels of education and QLS-3 scores were associated with better ILSS performance. Together, these variables explained 25% of the variance in ILSS scores [ $F(2, 48)=7.94$ ,  $p=.001$ ,  $R^2=0.25$ ]; QLS-3 scores uniquely explained 13.2% of the variance ( $p=.006$ ). For the SLoF, bivariate correlations determined that lower scores on the CAINS motivation/pleasure subscale, ABS, DPAS, and higher QLS-3 scores were associated with higher SLoF scores. Multiple linear regression determined that these variables explained 39% of variance [ $F(4, 50)=7.81$ ,  $p<.001$ ,  $R^2=0.39$ ], with ABS and QLS-3 scores emerging as the only significant predictors ( $p=.034$  and  $p=.009$ , respectively).

**Conclusions:** Functional capacity and social skills performance were positively associated with neuropsychological functioning, with less severe negative symptoms (particularly diminished motivation/pleasure) also associated with better social skills performance. Intrinsic motivation and asocial beliefs appear to play a particularly strong role in predicting perceived psychosocial functioning. Improving neuropsychological functioning and motivation may improve functioning in individuals with high negative symptom severity.

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**Keywords:** neurocognition, everyday functioning, social processes

**S. BABAD, V. FAIRCHILD, M. BURSKY, G. ROBINSON, R. MAHARAJ, M. FLORES-ORTEGA, S. RAZAK, Z. GROS SCHWARTZBLATT, V. NIKULINA. Prior Trauma History and Adherence to Public Health Recommendations: The Role of Impulsive Decision Making.**

**Objective:** To limit the spread of the Novel Coronavirus Disease 2019 (COVID-19), governments have proposed public health recommendations (PHRs), including social distancing, mask wearing, and increased personal hygiene. However, the factors that contribute to adherence to PHRs are not well understood. There is evidence that trauma history (e.g., physical abuse) is related to increased engagement in health risky behavior, such as illicit drug use. There is also evidence that, in general, impulsive decision making when under stress is related to increased engagement in health risk behaviors. Conceptualizing lack of PHR adherence as a health risk behavior, the current study aims to determine whether impulsive decision making is a risk factor for decreased PHR adherence in trauma survivors.

**Participants and Methods:** Subjects ages 18 to 65 were recruited through the online platform, MTurk, during the months of March and April 2020. Extensive data validation was conducted, resulting in a final sample of  $N = 324$  subjects ( $M$  age = 37.80,  $SD = 18.11$ ; 11% Hispanic ( $n = 36$ ); 38% female ( $n = 123$ ); 9.3% African American ( $n = 30$ ); 7.4% Asian ( $n = 24$ ). Self-reported emotion regulation (Difficulties in Emotion Regulation Scale), trauma history (PTSD Symptom Scale for DSM-5), and PHR adherence (Six questions about hand washing, covering coughs, staying 6 feet apart, limited socializing, and self-quarantine on a Likert scale from 1 to 5). Six regression analyses were run, each with a PHR domain as an outcome and trauma history, impulsivity, and the interaction between the two as predictors.

**Results:** Results revealed that in those with a trauma history (vs. those without trauma history), impulsive decision making when under stress was associated with decreased engagement in mouth and nose covering after sneezing ( $Beta = -.50$ ,  $p < .01$ ) and in decreased likelihood of staying home after contracting COVID-19 ( $Beta = -.45$ ,  $p < .05$ ).

**Conclusions:** These findings suggest that during an acute stressor, like the COVID-19 pandemic, prior trauma history, when combined with impulsive decision making, is associated with decreased adherence to public health recommendations (PHR). To enhance PHR adherence, it is important to first understand the factors that contribute to individual variations in adherence.

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**Keywords:** decision-making, emotional processes, inhibitory control

**Y. ISSARI, M. ARCE RENTERÍA, R. FLORES, I. MARTINEZ ABREU, M. MONTOYA, A. M. BRICKMAN, J. J. MANLY. Early Life Adverse Experiences, Immigration Status, and Cognition Among Middle-Aged Latinx Adults.**

**Objective:** Early life adverse experiences (ELAs) such as traumatic events (i.e., abuse, neglect), financial insecurity, and poor parent-child ties are associated with worse health outcomes in adulthood. While a higher burden of ELAs are associated with worse cognitive outcomes in predominantly White populations, little is known about their association within Latinx communities. In addition, it is unclear how immigration status may modify the effect of ELAs on cognition, given that immigrants have been shown to have better health and cognitive outcomes – the “Hispanic Paradox”. We investigated if a higher burden of ELAs is associated with poorer cognition in a Latinx population and whether the association of ELAs on cognition is stronger among US-Born compared to immigrant Latinx.

**Participants and Methods:** We assessed 643 middle-aged Latinx adults ( $n=501$  immigrants,  $M_{age}=56.3$  yrs,  $SD=11.1$ ; 69.7% women). Childhood financial insecurity and parent-child ties were self-reported. Data on adverse childhood experiences (ACEs, i.e., neglect, abuse) were only available among a smaller sub-sample ( $n=82$ ). The cognitive domains of executive functioning, working memory, attention, and processing speed were measured with the NIH-TB Cognition Battery and episodic memory was assessed with the Selective Reminding Test. Depressive symptoms were assessed with the Center for Epidemiologic Studies Depression Scale (CES-D 10). General linear models tested main effects and interactions of ELAs and immigration status on cognitive outcomes, adjusting for age, sex, and parental education.

**Results:** Neither childhood financial insecurity, poor parent-child ties, or adverse childhood experiences were reliably associated with cognitive performance (all  $p$ 's  $>.10$ ). Immigrant Latinx participants performed worse on tests of executive function ( $B=-.51$ ,  $[-1.016, -.006]$ ) and working memory ( $B=-1.46$ ,  $[-2.307, -.613]$ ) compared with US-Born Latinx participants. Stratified models indicated that among immigrant adults, higher ACEs were associated with better scores on tests of working memory ( $B=2.84$ ,  $[.135, 5.552]$ ). However, there was no significant ELAs x immigration status interaction on cognitive outcomes. Post-hoc analyses showed that childhood financial insecurity and poor parent-child ties were associated with greater depressive symptoms ( $B=1.69$ ,  $[.603, 2.767]$ ,  $B=1.46$ ,  $[.343, 2.579]$ ; respectively). Adverse childhood experiences were associated with greater depressive symptoms, although this was not statistically significant ( $B=2.089$ ,  $[-.621, 4.799]$ ).

**Conclusion:** Adverse childhood experiences, childhood financial insecurity, and poor parent-child ties were not reliably associated with cognitive outcomes, but ELAs were associated with greater depressive symptoms in adulthood. The lack of significance in this association may be due to the complex relationship between ELAs and parental education such as that, in our sample, those with higher parental education were more likely to endorse adverse childhood experiences and higher parental education is strongly associated with better cognitive outcomes.

Future studies will examine the relationship between ELAs, depression and late-life cognitive outcomes.

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**Keywords:** minority issues, cognitive, aging (normal)

## Poster Session 7: ADHD, Autism Spectrum and Other Pediatric Conditions

8:30 AM - 9:30 AM

### **N. COULTIS, E. HEIDEMAN, A. KIRSCH. Predicting Executive Functioning, Social Impairment, and Internalizing Symptoms in Youth with ADHD and Sluggish Cognitive Tempo.**

**Objective:** Sluggish cognitive tempo (SCT) is a group of attention-related symptoms that are characterized by slowed behavior and thinking, mental confusion or foginess, excessive daydreaming, and drowsiness (Saez et al., 2019). Studies have found that individuals with SCT have higher rates of depression, anxiety, and social isolation (Saez et al., 2019). Additionally, recent publications have shown that aspects of executive functioning (EF) may be impacted in children with SCT (Plourde, 2019). A recent meta-analysis confirmed that most SCT research has focused on parent and teacher report, and only a few studies have used self-report measures (Becker et al., 2016). There is an increased need for studies examining SCT with self-report (Servera et al., 2018). Therefore, this study will examine how SCT is related to EF and self-reported social isolation and internalizing symptoms in youth with Attention-Deficit/Hyperactivity Disorder (ADHD).

**Participants & Methods:** Participants were youth aged 8 to 18-years with ADHD ( $N = 130$ ) referred for neuropsychological testing. Participant demographics: males ( $N = 82$ , 63.1%). Measures included the Wechsler Intelligence Scale for Children/Wechsler Adult Intelligence Scale (WISC-V/WAIS-IV) Processing Speed Index (PSI), Conners Continuous Performance Test (CPT) Hit Reaction Time (HRT), Delis-Kaplan Executive Function System Color Word Identification (CWI) and Tower subtests, Behavior Assessment Systems for Children (BASC) self-report scales, and Personality Assessment Inventory-Adolescent (PAI-A) scales.

**Results:** Multiple regression analysis found significant models for outcome variables CWI Inhibition ( $R^2=0.29$ ,  $F=25.981$ ,  $p<.001$ ), with PSI ( $\beta=0.51$ ,  $p<.01$ ) and CPT HRT ( $\beta=-0.15$ ,  $p<.05$ ) accounting for significant variation in the model; CWI Inhibition/Switching ( $R^2=0.32$ ,  $F=29.179$ ,  $p<.001$ ), with PSI ( $\beta=0.52$ ,  $p<.01$ ) and CPT HRT ( $\beta=-0.18$ ,  $p<.05$ ) accounting for significant variation in the model; and Depression ( $R^2=0.05$ ,  $F=3.425$ ,  $p<.05$ ).

**Conclusions:** SCT was related to EF and self-reported internalizing symptoms. The PSI had more predictive power than the CPT HRT in explaining variance in EF, depression, and social isolation.

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**Keywords:** attention deficit hyperactivity disorder, executive functions, depression

### **T. HAI, H. FRANK, R. SWANSBURG, J. F. LEMAY, F. P. MACMASTER. Cerebellar Volume in Paediatric Attention-Deficit/Hyperactivity Disorder.**

**Objective:** Attention-deficit/hyperactivity disorder (ADHD) is a common neurodevelopmental disorder. Symptoms typically include inattention or impulsivity and hyperactivity. Along with their core symptoms, children with ADHD also face difficulties with Executive Function (EF), specifically on tasks related to working memory and inhibition.

While regions in the fronto-striatal pathways are most commonly studied in ADHD, recently, there has been an increased interest in understanding the role of the Cerebellum in ADHD. Some studies have suggested changes in the fronto-cerebellar circuit, specifically reduced cerebellum activation on functional Magnetic Resonance Imaging studies (MRI) and reduced gray matter volume on structural MRI studies compared to typically developing children (TDC). However, limited studies have examined the role of the cerebellum in different performance-based EF tasks. The current study examined the volumetric differences in the cerebellum and its relations with performance on EF tasks to address this gap in the literature.

**Participants and Methods:** Twenty-six children with ADHD and 24 TDC between the ages of 7 and 16 years old underwent T1-weighted sequence MRI. Participants also completed EF assessments measuring response inhibition (Continuous Performance Task; CPT-3) and working memory (Digit Span Backwards). The images were analyzed through an automatic parcellation pipeline (CERES 1.0) developed specifically for cerebellar parcellation. Independent t-tests, multivariate analysis of variance (ANOVA) and Pearson Correlations were conducted in SPSS.

**Results:** There were no significant group differences in total gray matter volume between children with ADHD and the TDC group ( $p > .05$ ). Participants in the ADHD group made more errors on the CPT-3 task compared to the TDC group ( $F(1, 48) = 5.29, p = .026, \text{Partial Eta Squared} = .10$ ). No group difference was observed in the working memory tasks. Lastly, Pearson correlations did not find any significant relations between total cerebellar volume and performance on the response inhibition task ( $p > .05$ ).

**Conclusions:** The findings from the current study showed no significant differences in total cerebellar gray matter volume in children with ADHD. These findings were in contrast to previous studies. These differences in results could be due to the heterogeneity of the ADHD sample, changes in diagnostic criteria, treatment effects, improved MRI resolution and comorbid disorders. In terms of EF performance, the current study observed some challenges on the inhibition task but not on the Working memory task, suggesting variable EF performance. While differences in inhibition were observed, these challenges did not relate to cerebellar volume. Future research, with larger sample size, is needed to replicate findings to better understand the cerebellum's role in pediatric ADHD.

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**Keywords:** attention deficit hyperactivity disorder, cerebellum, everyday functioning

**L. M. SCIMECA, K. J. JENNETTE, G. P. OVSIEW, Z. J. RESCH, W. SONG, N. H. PLISKIN, J. R. SOBLE. The Clinical Utility of the Trail Making Ratio Scores in Adults with Attention-Deficit/Hyperactivity Disorder.**

**Objective:** Adults with Attention-Deficit/Hyperactivity Disorder (ADHD) tend to have lower Trail Making Test (TMT) performances, particularly on TMT Part B. A TMT ratio score (TMT B/TMT A) has been proposed as a more complex measure of divided attention and executive functioning that controls for the effects of processing speed. Among other clinical populations, TMT B/A ratio scores  $>3$  have been associated with executive dysfunction; however, this relationship remains poorly understood among individuals with ADHD. This study examined the

clinical utility of TMT B/A ratio cut scores in an adult ADHD sample and whether this ratio differentiated ADHD subtypes.

**Participants/Method:** This study included data from 129 consecutive adults who underwent neuropsychological evaluation, met diagnostic criteria for ADHD (50 Predominantly Inattentive Type; 79 Combined Type), and had valid test performance established via multiple performance validity tests. Mean age was 27.43 (SD=6.75) and mean education was 15.50 years (SD=2.22). The sample was 52% female, 52% Caucasian, 24% Hispanic, 12% African American, 8% Asian, and 4% other race/ethnicity. Patients were divided into three groups, based on TMT ratio score [i.e., ratio score <2 (N=24), 2-3 (N=61), or >3 (N=44)]. Twenty-two consecutive cases referred for ADHD evaluation who did not meet criteria for ADHD served as a clinical control group.

**Results:** Mean TMT ratio score for those who met diagnostic criteria for ADHD was 2.9 (SD=1.5). No significant TMT ratio score group differences were detected based on educational attainment  $F(2,128)=1.33$ ,  $p=0.27$ ,  $h^2=.02$ . Similarly, TMT ratio scores did not significantly differ by ADHD subtype (i.e., Inattentive vs. Combined),  $F(1,128)=3.09$ ,  $p=0.08$ ,  $h^2=.02$ . Finally, no significant TMT ratio score differences emerged between those who did (M=2.9; SD=1.5) versus did not (M=2.3; SD=0.6) meet diagnostic criteria for ADHD,  $F(1,150)=3.67$ ,  $p=0.06$ ,  $h^2=.02$ .

**Conclusions:** TMT ratio scores in adults with ADHD had a relatively even distribution among groups, with most having scores between two and three. No group differences in scores were found and educational attainment did not account for group differences. Additionally, TMT ratio scores did not differ significantly based on ADHD subtypes or presence/absence of ADHD diagnosis. Overall, the TMT ratio cut score may help distinguish other clinical groups; however, they did not demonstrate clinical utility in differentiating amongst adults with ADHD.

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**Keywords:** attention deficit hyperactivity disorder, everyday functioning, assessment

## **E. MARCELLE, J. W. KAM, Y. ZHAO, N. KARIMI, R. T. KNIGHT, S. P. HINSHAW.** **Examining External Distractibility in Adult ADHD.**

**Objective:** The goal of the present study is to investigate differences in auditory distraction processing between young adults with and without Attention-Deficit/Hyperactivity Disorder (ADHD), using EEG. More specifically, we aim to examine group differences in attentional capture by distraction as indexed by the P3a response to distracting stimuli. As ADHD becomes increasingly conceptualized as a disorder of distractibility as opposed to a disorder of sustained attention, examining neural differences in distraction processing between adults with and without ADHD is a crucial area of focus. Although preliminary studies have begun to investigate associated neural processes in children, given the lifelong nature of the disorder in most cases, adult investigations are warranted.

**Participants and Methods:** Participants ( $n = 26$ ) were recruited from a larger and well-characterized subject pool of individuals both with and without ADHD. The present sample consists of 13 young adults with and 13 young adults without ADHD. Participants completed a three-stimulus auditory oddball task while EEG data were collected. Standard (500Hz tone, probability  $P = 0.80$ ), Target (1000Hz tone,  $P = 0.10$ ), or Distractor (e.g., bell, whistle, tone sweep,  $P = 0.10$ ) sounds were played. Each sound was presented for 200ms with a random stimulus onset asynchrony jittered between 1000ms and 1500ms. Participants were instructed to respond by (right arrow key) button press to target sounds vs. (left arrow key) button press to

standard and distractor sounds as quickly and as accurately as possible. Participants completed a total of six task blocks lasting 5 minutes each. EEG data were collected by a 64-channel BioSemi ActiveTwo system with a sampling rate of 512 Hz. Mean P3a amplitude in response to distracting stimuli was computed.

**Results:** Behavioral: Behaviorally, no significant group differences were found in standard tone or target tone response time mean or standard deviation (SD). Also, no significant group differences were found in distractor tone mean response time. However, near significant group differences were found in correct distractor and false alarm distractor standard deviations ( $p = 0.07$  and  $p = 0.08$  respectively), with participants in the ADHD group showing greater correct distractor and false alarm distractor SD.

EEG/ERP: A paired-samples t-test comparing P3a amplitude response to distractor and target tones revealed a marginally significant difference between amplitudes in the ADHD group ( $p = 0.09$ ), with response to distractor tones showing a significantly greater amplitude than response to target tones. No significant differences between P3a amplitude to distractor and target tones were found in the comparison group.

**Conclusions:** Preliminary findings in a study investigating differences in distraction processing between adults with and without ADHD revealed near significant differences in behavioral and neural measures of distraction processing between groups. Increased response time variability in adults with ADHD mirrors prior findings in children. Increased P3a response to distracting auditory stimuli in adults with ADHD may indicate increased attentional capture by distraction in these adults, compared to peers. Implications of behavioral and EEG findings for future conceptualization of adult ADHD will be discussed.

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**Keywords:** electroencephalography, attention deficit hyperactivity disorder, event-related potentials

### **G. VITALE. A Call for More Research on ADHD Presentations in Native American Populations.**

**Objective:** Given the documented unique behavioral beliefs and practices among Native American groups, one is compelled to ask whether a disorder such as ADHD presents differently and/or is approached differently in these populations. One immediate issue when doing research with this population is the vast diversity within the ethnic identifier of “Native American.” Most of the current research uses the term American Indian/Alaska Native (AI/AN) to refer to the peoples who inhabited North America before the arrival of European settlers, but it is important to remember that they are not a homogeneous group.

**Participants and Methods:** A literature review using the keywords “Native American,” “American Indian,” “Alaska Native,” or “AI/AN” alongside “ADHD” or “Attention Deficit” was conducted across PubMed, Google Scholar, and PsycINFO.

**Results:** Many reviewed studies resorted to combining AI/AN research participants with other groups because the samples were too small to analyze separately. Of the results, a handful of articles were able to publish research examining ADHD presentation, course, and perception in the Native American population more directly. These articles overall suggest that 1) ADHD subtypes (inattentive and hyperactive/impulsive symptom categories) are by-in-large appropriate for use in AI/AN populations; 2) prevalence is about the same as African American and European American children; and 3) ADHD in AI/AN boys is rated as more severe than AI/AN

girls overall and that this gender difference is even more pronounced in AI/AN children than in other ethnocultural groups.

**Conclusions:** A proposed cause of the larger gender gap is that AI/AN cultures maintain expected traditional gender roles more often, which may encourage earlier and stronger punishment for disruptive behavior in girls. The literature concludes that ADHD symptoms do not appear to be culture-bound, at least not as they apply to the handful of sampled AI/AN children. The literature further posits that Native American children can improve their ADHD symptoms in similar ways to Caucasian children, suggesting that interventions for ADHD may be ubiquitous. Despite these findings, some studies from the review challenge the notion that cultural background does not affect ADHD prognosis. Some AI/AN tribes, for example, may have historically better relationships with Western medicine and thus have access to evidence-based intervention options. Other considerations such as socioeconomic status, education, and mental health stigma all contribute to why a disorder like ADHD may incur more complications in Native Americans compared with Caucasian Americans. Our review found no articles on the persistence of ADHD into adulthood in these populations. Even externalizing behaviors likely considered within-normal-limits in other ethnicities may be more likely viewed as misbehavior and punished in the traditional Native American culture (i.e., eye contact, the absence of which is usually considered a sign of inattention in Eurocentric cultures, is traditionally considered disrespectful in AI/AN cultures). As such, further research is called for, not only for determining important nuances in presentation and prevalence for an underserved and underrepresented ethnocultural group and their subgroups, but also potentially for providing more general clarification in defining and diagnosing ADHD.

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**Keywords:** diversity, attention deficit hyperactivity disorder, ethnicity

**R. KEEZER, K. J. JENNETTE, G. P. OVSIEW, Z. J. RESCH, W. SONG, N. H. PLISKIN, J. R. SOBLE. Masking Effect of High IQ on the Rey Auditory Verbal Learning Test in an Adult ADHD Clinical Population.**

**Objective:** The DSM-V Attention Deficit Hyperactivity Disorder (ADHD) diagnostic criteria have been criticized as being based mostly on research with children, despite evidence revealing the disorder evolves as children transition into adulthood. Recent literature suggests that adults with above average IQ are able to better compensate for ADHD-related deficits on performance-based neuropsychological tests, which may produce a “masking effect.” This study examined this masking effect on Rey Auditory Verbal Learning Test (RAVLT) performance in an adult ADHD clinical sample. While primarily a verbal list learning/memory test, the RAVLT is commonly considered to have a strong executive functioning component, which is thought to be a core deficit in ADHD. Thus, it was hypothesized adults with confirmed ADHD and above average IQ would produce better learning and recall than those with average IQ, thus demonstrating a masking effect.

**Participants/Method:** This cross-sectional study included data from 126 adults with ADHD and objectively validated neuropsychological test performance who completed the RAVLT as part of a comprehensive evaluation. The Test of Premorbid Function was used to estimate premorbid IQ, resulting in average IQ (i.e., 90-109; M=101.3; SD=4.9; n=78) and above average IQ (i.e., 110-120; M=113.9; SD=2.6; n=48) IQ groups. The sample was 52% female; 52% White, 23.6% Hispanic, 12.6% Black, 7.9% Asian, and 4% other race/ethnicity. Mean age was 27.5 (*SD*=6.8)

and mean education was 15.61 years ( $SD=2.1$ ). Analyses of variance (ANOVAs) tested for significant differences in RAVLT performance between IQ groups.

**Results:** Mean RAVLT Total Learning T-scores were significantly higher for those with above average IQ ( $M=48T$ ;  $SD=11.2$ ) compared to those with average IQ ( $M=40T$ ;  $SD=13.8$ ),  $F(1,125)=10.46$ ,  $p<.01$ ,  $h^2=.08$ . Moreover, while the groups did not differ in RAVLT learning Trials 1 and 2 ( $p>.05$ ) performance on Trials 3, 4, and 5 were significantly different lower in the average IQ group relative to the above average IQ group ( $p<.01$ ; ( $h^2=.06-.09$ ). Similarly, the above average IQ group performed significantly better on both short delay ( $M=50T$ ;  $SD=11.3$  vs.  $43T$ ;  $SD=12.5$ ),  $F(1,125)=9.20$ ,  $p<.01$ ,  $h^2=.07$ , and long delay ( $M=51T$ ;  $SD=11.1$  vs.  $M=45T$ ;  $SD=11.4$ ),  $F(1,125)=8.00$ ,  $p<.01$ ,  $h^2=.06$ , free recall.

**Conclusions:** Despite previously being considered relatively unaffected by IQ, verbal list learning and free recall significantly differed among patients with ADHD and above average vs. average IQ. As such, those with higher IQs might be able to better compensate on tasks, thereby masking their deficits on performance-based tests as seen in previous studies. Interestingly, the first two trials on the RAVLT were not significantly different between IQ groups and might reflect the greater working memory demand involved in the first two trials, reflecting the pervasive impact of ADHD on working memory regardless of the compensatory benefits of higher IQ. Results suggested that adult ADHD may be a more nuanced disorder than pediatric ADHD, possibly due to more learned compensatory strategies allowing for better performance on tests conducted in an artificial, time-limited, and structured testing environment.

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**Keywords:** attention deficit hyperactivity disorder, neuropsychological assessment, intelligence

## **L. TURKELSON, Q. MANO, J. GUERIN, K. JASTROWSKI MANO, C. STOUGH. Measuring Mind-Wandering in Mindfulness Research: A Systematic Review.**

Mind-wandering, defined as an attentional shift towards task-unrelated thoughts, may comprise as much as 50% of our waking thought-processes. Maintaining contact with the present moment, or mindfulness, is often described as the opposite of mind-wandering and is considered a potential intervention for mind-wandering. The present systematic review sought to summarize the ways mind-wandering is measured in mindfulness research and determine which metrics of mind-wandering were most improved following mindfulness training. Peer-reviewed correlational and experimental studies were included. Across mindfulness studies, mind-wandering was operationalized using three methods: 1) experience sampling 2) continuous performance tasks (CPTs), and 3) questionnaires. Our final sample included  $n = 11$  studies, with  $n = 9$  describing a significant relationship between mindfulness and mind-wandering. Experience sampling and performance on CPTs were most reliably improved by mindfulness training. A variety of CPTs were utilized and results suggest that both reaction-time variability (but not mean reaction time) and commission errors (but rarely omission errors) were improved by mindfulness training. Implications of these results are considered as well as ideas for future research.

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**Keywords:** attention, awareness, psychometrics

**B. L. CALLAHAN, P. SHAMMI, R. TAYLOR, S. BLACK. Clinical and Cognitive Differences Between Cases of Late-Life ADHD Who Report Recent vs. Childhood Symptom Onset.**

**Objective:** A core step in the assessment of attention-deficit/hyperactivity disorder (ADHD) in adults is ascertaining that symptoms began in childhood (prior to age 12). There is reason to suspect this criterion may be futile in later life (e.g., age 50+), because the validity of >40-year retrospective recall is compromised by memory fallibilities related to normal aging (Devitt et al., 2016) and to ADHD itself (Hervey et al., 2004), and supporting evidence (e.g., from parents) is unavailable. On the other hand, there is equal reason to suspect the childhood-onset criterion may be a crucial feature in older adults to rule out false positive cases that are better explained by other age-related cognitive disorders. If this criterion reveals something specific to ADHD, there should be reliable differences between those who do vs. do not fulfill it. Conversely, if this criterion is ineffectual in older adults, participants who do vs. do not recall childhood onset should be phenotypically indistinguishable (as has been reported previously in young-adult cohorts: Chandra et al., 2016). We aimed to test this in the current study. Prior studies of this issue have involved only young adults and onset was determined with the additional benefit of ancillary (parental) reports. Considering the central role of self-report (and its fallibilities) in determining onset in older adults, it is necessary to address this question in this demographic.

**Participants and Methods:** Twenty-five adults aged 49-79 met all current diagnostic criteria for ADHD, either with (n=14) or without (n=11) self-reported childhood onset. They completed ADHD symptom rating scales, ADHD family history, and comprehensive neuropsychological assessment. The groups were compared using  $\chi^2$  or t-tests.

**Results:** Both groups were of similar age ( $t=-0.208$ ,  $p=.837$ ), education ( $t=-0.245$ ,  $p=.809$ ), race ( $\chi^2=3.490$ ,  $p=.479$ ), and sex ( $\chi^2=1.066$ ,  $p=.302$ ). Participants without childhood symptoms reported onset of inattention or impulsivity 3-30 years prior to study enrollment ( $M=11.5$ ,  $SD=9.2$ ), though many were unsure. Both groups reported comparable current ADHD symptom severity ( $t=-1.108$ ,  $p=.280$ ,  $d=-0.439$ ), but the childhood-onset group reported more frequent ADHD symptoms in their children ( $t=-2.151$ ,  $p=.043$ ,  $d=-0.947$ ). This group also performed better on tests of immediate word list cued recall ( $t=-2.250$ ,  $p=.047$ ,  $d=-1.153$ ), delayed word list free recall ( $t=-2.322$ ,  $p=.031$ ,  $d=-1.077$ ), and phonemic fluency ( $t=-2.530$ ,  $p=.019$ ,  $d=-1.063$ ). The groups' performance was comparable on story and complex figure recall, semantic fluency and naming, Trails A and B, card-sorting, and complex figure reproduction.

**Conclusions:** In this small sample, clinical and cognitive differences between ADHD cases with and without childhood symptoms tentatively suggest that adult onset of inattention, hyperactivity or impulsivity may constitute false positives (perhaps an age-related cognitive disorder). A second interpretation is that adults with 'true ADHD' who have more compromised memory abilities have greater difficulty recalling events from their early life, leading them to report a more recent onset of symptoms. Worse language performance and weaker ADHD family history in the recent-onset group provide relatively stronger support for the former conclusion, but follow-up work examining physiological neurodegenerative biomarkers (e.g., hippocampal atrophy) or susceptibility genes (e.g., ApoE) will allow for a more compelling interpretation.

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**Keywords:** aging (normal), neuropsychological assessment

**S. LEIB, C. HAAK, E. MARSTON, E. CHIN. Utility of Performance-Based Measures to Identify ADHD in a Clinical Pediatric Neuropsychology Sample.**

**Objective:** The objective assessment of Attention Deficit/Hyperactivity Disorder (ADHD) symptoms is critical for diagnostic accuracy and treatment planning. Although the neuropsychological deficits associated with ADHD (i.e. working memory, response inhibition, cognitive flexibility, sustained attention) are well-documented, the utility of current neuropsychological measures to identify ADHD within a clinical neuropsychology sample remains unclear. This study examines the utility of frequently used performance-based measures to distinguish pediatric neuropsychology referrals diagnosed with ADHD from non-ADHD diagnosed referrals.

**Participants/Method:** This cross-sectional study included clinical data from outpatient pediatric neuropsychology referrals. Participants were included in the current study if they had an IQ>55, were diagnosed with ADHD (with no other comorbid diagnoses; N=44, 19 female, average FSIQ=98.97) or received a diagnosis other than ADHD (N=82, 29 female, average FSIQ=97.40), and completed all neuropsychological measures of interest. Diagnoses in the non-ADHD group were representative of a typical outpatient neuropsychology population and included: adjustment disorder, autism, learning disorders, depressive disorders, anxiety disorders, developmental coordination disorders, and language disorders. The overall sample was 31% female, 70% Caucasian, 10.3% Hispanic, 4.8% Asian, 2.4% African American, and 9.2% other racial/ethnic identity/unknown. A two-block binary logistic regression was utilized to test the contributions of commonly used neuropsychological measures (CPT-3 (omission, commission, perseveration, variability), Wechsler Processing Speed/Working Memory Indices, DKEFS (Tower Achievement, Category Switching, Color-Word Switching)) in predicting the likelihood a patient belongs in the ADHD group, after controlling for demographic factors including age, gender, ethnicity, and Verbal IQ.

**Results:** The model with demographic/IQ factors only (Block 1) was nonsignificant ( $X^2=6.245$ ,  $p=.715$ , Nagelkerke  $r^2=.067$ ), with no significant predictors of group membership. When the performance-based measures were added (Block 2), the overall model was significant ( $X^2=33.476$ ,  $p=.015$ , Nagelkerke  $r^2=.321$ ) with 75.4% total classification accuracy. Significant predictors of group membership included Verbal Comprehension Indices ( $B=-.049$ ,  $p<.05$ ), Working Memory Indices ( $B=.052$ ,  $p<.05$ ), Processing Speed Indices ( $B=.052$ ,  $p<.05$ ), DKEFS Color/Word Switching ( $B=-.229$ ,  $p<.05$ ), and CPT Omission Errors ( $B=.051$ ,  $p<.05$ ).

**Conclusions:** Findings suggest that performance-based measures demonstrate utility in distinguishing outpatient neuropsychology patients diagnosed with ADHD from other diagnostic groups. Contrary to hypotheses, as processing speed and working memory scores increased, participants were more likely to belong in the ADHD group. Therefore, these general measures may lack specificity to detect ADHD in a clinical pediatric neuropsychology sample. In support of hypothesis, as scores on the DKEFS Color/Word Switching Task and CPT-Omission scale improved, patients were significantly less likely to belong in the ADHD group. Continued research on classification utility for ADHD vs. specific diagnostic groups is warranted.

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**Keywords:** attention deficit hyperactivity disorder, assessment

**E. MARSTON, S. LEIB, C. HAAK, E. CHIN. Assessing the Convergent Validity of Performance-Based Measures and Rating Scales of Executive Functioning within a Pediatric ADHD Population.**

**Objective:** Executive function deficits in children and adolescents with ADHD have been well documented. These deficits are regarded as an important component in understanding ADHD. However, the efficacy of performance-based measures and rating forms to measure executive functioning is mixed. The current study examines the utility of performance-based measures and the Behavior Rating Inventory of Executive Functioning 2 (BRIEF-2) in identifying ADHD within a clinical pediatric neuropsychology sample.

**Participants/Method:** Patients were evaluated at a pediatric neuropsychology clinic ( $N = 331$ , 37.3% female,  $M_{FSIQ} = 96.14$ ,  $SD = 14.98$ ) and completed a broad neuropsychological battery. The three most prevalent ethnicities were Caucasian (63.0%), Hispanic (12.3%), and other racial/ethnic identity or unknown (8.0%). The ADHD group was comprised of 126 patients and included all subtypes of ADHD diagnosis: Combined  $N = 88$ , Predominantly Inattentive  $N = 28$ , Predominantly Hyperactive  $N = 6$ , Other Specified  $N = 3$ , and Unspecified  $N = 1$ . The non-ADHD group ( $N = 225$ ) consisted of clinical controls with a multitude of other diagnoses such as Autism Spectrum Disorder, Language Disorder, General Anxiety Disorder, and Dyslexia. A Pearson's  $r$  correlation was used to evaluate the relationship between indices of the BRIEF-2 and select performance based measures. A logistic regression was utilized as a secondary analysis to determine the utility of performance-based measures and the BRIEF-2 in predicting ADHD group membership.

**Results:** The BRIEF-2 parent Inhibit index mildly correlated with NEPSY-II Inhibition-Inhibition Combined  $r = .30$ ,  $p < .05$ .) and the BRIEF-2 teacher Inhibit index mildly correlated with DKEFS Color-Word Inhibition  $r = .19$ ,  $p < .05$ ). There were no significant correlations between the BRIEF-2 Initiate indices and performance-based measures. The D-KEFS Category Fluency and D-KEFS Letter Fluency were significantly correlated  $r = .48$ ,  $p < .01$ ). The BRIEF-2 parent Working memory indices were not significantly correlated with any respective performance based measures. Neither performance-based measures or BRIEF-2 indices significantly predicted ADHD/clinical control group membership.

**Conclusion:** Current results support prior research that highlights inconsistent correlations between self-report and performance-based measures of executive function. Mixed findings in the current study suggest that self-report and performance-based measures of executive functioning may not represent the same underlying constructs. Findings highlight the importance of the joint use of performance-based measures and report measures to obtain a more comprehensive assessment of executive functioning in children with ADHD. Future research should examine alternative performance-based measures and report forms that better capture similar constructs of executive functioning.

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**Keywords:** attention deficit hyperactivity disorder, executive functions, assessment

**C. HAAK, E. MARSTON, S. LEIB, E. CHIN. Utility of collateral-report measures to identify ADHD in a clinical pediatric neuropsychology sample.**

**Objective:** With ADHD prevalence of 7-8% of children and adolescents, accurate diagnosis and treatment planning is needed. Due to the high rate of co-occurring conditions, the American Academy of Pediatrics recommends screening for both ADHD along with other conditions. This

study sought to evaluate the clinical utility of collateral, parent report on differentiating ADHD from other clinical conditions based on reports of attention, hyperactivity, mood, and executive functioning symptoms within a pediatric clinical population of individuals with ADHD as well as clinical controls.

**Participants and Methods:** The sample consisted of a cross-sectional clinical sample presenting to a pediatric neuropsychology clinic for evaluation. Participants were included in the study if they had an IQ greater than 55 and were diagnosed solely with ADHD (N = 74) or another clinical condition (N = 135). Diagnoses among clinical controls included autism spectrum disorder, concussion, specific learning disorder, and mood/anxiety disorder. The overall sample was 63.8% male, 61.9% Caucasian, 9% Hispanic, and 20.4% other/multiracial. A four-block logistic regression was utilized to test the contributions of parent collateral report for ADHD symptoms, depression, and anxiety (BASC-3) as well as executive functioning (BRIEF-2) in predicting ADHD diagnosis after controlling for age, gender, and Verbal IQ.

**Results:** The model with demographic and IQ factors (Block 1) was not significant ( $X^2=4.071$ ,  $p=.254$ , Nagelkerke  $r^2=.027$ ), with no significant predictors of group membership. When ADHD symptom measures were added (Block 2), the model remained nonsignificant ( $X^2=6.031$ ,  $p=.303$ , Nagelkerke  $r^2=.039$ ), with no significant predictors. Executive functioning scales of the BRIEF-2 were added in Block 3, but the model remained nonsignificant ( $X^2=7.830$ ,  $p=.450$ , Nagelkerke  $r^2=.051$ ), with no significant predictors. The model remained nonsignificant after the addition of depressive and anxiety symptoms in Block 4 ( $X^2=8.460$ ,  $p=.584$ , Nagelkerke  $r^2=.055$ ), with no significant predictors.

**Conclusions:** Findings suggest that the report of symptoms in different domains of functioning is insufficient to differentiate individuals with ADHD from other clinical disorders. Given the high prevalence of difficulties with attention, executive functioning, depression, and anxiety between the two groups, other forms of evaluation beyond rating forms is needed to determine whether difficulties are attributable to ADHD or another disorder. These findings suggest that additional sources of information (i.e., performance-based measures and clinical interviews) are essential to an effective evaluation when attempting to diagnose ADHD. Further research on differentiating clinical groups effectively is needed, particularly as it relates to ADHD.

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**Keywords:** attention deficit hyperactivity disorder, pediatric neuropsychology

#### **H. BEDNARZ, R. KANA, M. T. LECHTRECK, I. RAJPARI, G. SHERROD, A. SVANCARA, D. STAVRINOS. Symptoms of Inattention and Driving Difficulties in Young Drivers with ADHD.**

**Objective:** Several studies have found that symptoms of inattention contribute to driving difficulty in individuals with attention-deficit/hyperactivity disorder (ADHD). The goal of the current study was to examine whether inattention symptoms were related to self-reported driving errors and violations among young drivers with ADHD or with typical development (TD), and to examine whether this relationship differed among groups with ADHD versus TD.

**Participants and Methods.** The sample included 40 licensed drivers (ages 16-30 years), including 20 ADHD and 20 TD participants. In an online survey, participants completed the Driver Behavior Questionnaire (DBQ) and the Conners' Adult ADHD Rating Scales (CAARS) to measure self-reported driving behavior and symptoms of ADHD, respectively. Independent-samples t-tests were performed to examine group differences in DBQ Total Violations and

Errors raw score, CAARS Inattention/Memory Problems raw score, and CAARS Hyperactivity/Restlessness subscale raw score. Next, a linear regression was performed with CAARS Inattention/Memory Problems and CAARS Hyperactivity/Restlessness subscale raw scores as predictors of the DBQ Total Violations and Errors raw score. A follow-up regression was performed to examine whether diagnosis of ADHD moderated the relationship between CAARS and DBQ scores.

**Results.** Groups differed significantly in DBQ Total Violations and Errors raw score ( $t(38) = 3.174, p=.003$ ), such that the ADHD group ( $M=16.45, SD=8.52$ ) had a higher DBQ score compared to TD group ( $M=9.15, SD=5.76$ ), indicating a higher number of violations and errors reported while driving. As expected, the ADHD group had higher scores on the CAARS Inattention/Memory Problems ( $t(38)=5.946, p<.001$ ) and Hyperactivity/Restlessness subscales ( $t(38)=4.031, p<.001$ ). Among all participants, the regression model including the CAARS subscales significantly predicted DBQ scores ( $F(2, 37)=21.27, p<.001, Adjusted R^2 = .510$ ). However, only the CAARS Inattention/Memory Problems subscale was predictive of the DBQ score ( $\beta = .816, p<.001$ ); the Hyperactivity/Restlessness subscale was not predictive. A follow-up regression model indicated that diagnosis of ADHD was not a significant moderator of the relationship between the CAARS Inattention/Memory Problems subscale and DBQ Total Violations and Errors score.

**Conclusions.** The results of the current study are consistent with prior research that indicates that inattention is associated with driving difficulties in ADHD. This study suggests that drivers with ADHD, compared to TD, have greater difficulty with driving behavior as measured by the DBQ, such as tailgating, almost hitting other vehicles, or missing yield signs. Additionally, our findings suggest that symptoms of inattention play a more significant role in driving difficulties, rather than symptoms of hyperactivity. This may be due to the nature of the DBQ, which includes many questions related to not paying attention while driving. Future studies should relate the CAARS to other measures of driving in these populations. Interestingly, a diagnosis of ADHD did not moderate the relationship between inattention symptoms and self-reported driving behaviors, suggesting that poor attention in a TD sample is also related to driving violations and errors.

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**Keywords:** attention, driving

### **Y. LIAO, N. GUO, B. SU, S. CHEN, H. TSAI, K. LEE. Failure Inhibition in Posterior Cortex of ADHD Children in Visual Distract Task.**

**Objective:** Children with attention deficit hyperactivity disorder (ADHD) have lower frontal inhibition ability in attention tasks with fewer beta activities among their scalp, mostly frontal and central areas. However, there was less discussion about the role of the posterior cortex in inhibition ability with QEEG studies. We investigated whether ADHD children would hold their inhibition ability while the attention task increased its visual complexity.

**Participants and Methods:** The multilevel executive attention tasks investigated 51 ADHD children and 50 typical development controls (TD), including focus attention (FA), search attention (SA), two Go/No-Go tasks (motor inhibition and visual distract task) with simultaneous EEG. The frequency analysis would be done, including beta (13-21 Hz), high-beta (22-30 Hz), and gamma (31+ Hz) activities at the frontal, central, and posterior scalps.

**Results:** Two groups had similar intelligence quotient, socio-economy status, and home environment. ADHD children showed low objective and subjective EA functions in EA tasks

and questionnaires than TD children. The repeated measure ANOVA showed that the TD group showed higher frontal beta activity in FA and SA tasks, whereas ADHD showed higher posterior high-beta (21-30 Hz) and gamma (31-50) activities in the distract task. Further regression showed that the higher posterior (P3) high-beta activity could predict less accuracy in the distract task.

**Conclusions:** The results revealed that when the task was simple, focus and search attention, ADHD children showed less frontal top-down inhibition to maintain attention on the task. While the task's demands increased with visual interference, ADHD children showed more posterior high-beta and gamma activity, representing their failure to inhibit non-target stimuli. The study showed the failure inhibition in the posterior cortex of ADHD children, and it seems like the overarousal effect.

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**Keywords:** attention deficit hyperactivity disorder, attention, electroencephalography

### **E. NG, L. A. FRICK, I. W. LIEM, B. A. PYYKKONEN. Investigating the Relationship between Processing Speed and FSIQ in ADHD and Non-ADHD Groups.**

**Objective:** Numerous studies have evaluated executive functioning in children and adults with Attention-Deficit Hyperactivity Disorder (ADHD). Deficits in processing speed are one of the most common findings across studies (Li et al., 2017; Mayes & Calhoun, 2007; Moura et al., 2019). Deficits in processing speed have been implicated in memory performance, and the other way around (Kolfer et al., 2019). However, variable findings related to domain-based correlates have been reported as related to IQ. Brown et al. (2009) and Brydes et al. (2015) identified significant deficits in processing speed in adults with ADHD and high IQ. In contrast, Whitaker et al. (2013) concluded youths with ADHD and high IQ performed better on measures of verbal memory. The current study examines the relationship between ADHD, processing speed, and FSIQ; specifically exploring the relationship between PSI and FSIQ in individuals with and without ADHD.

**Participants and Methods:** This study uses archival data from a neuropsychology service at a multidisciplinary behavioral health clinic in the Midwest. A total of 255 participants (80 with ADHD diagnoses, and 175 without ADHD diagnoses), aged 18 and older, were examined in this study. Participants with co-morbid mental health disorders were included in the study. FSIQ, GAI, and PSI indices from the WAIS-IV were analyzed for groups differences and correlations with SPSS version 22 software.

**Results:** No significant mean differences were found between the ADHD and non-ADHD groups for GAI ( $p = .958$ ), PSI ( $p = .071$ ), or FSIQ ( $p = .650$ ). In the both groups, significant positive correlations were identified between GAI (ADHD:  $r = .534$ ,  $p < .001$ , Non-ADHD:  $r = .689$ ,  $p < .001$ ), PSI (ADHD:  $r = .704$ ,  $p < .001$ , Non-ADHD:  $r = .805$ ,  $p < .001$ ), and FSIQ (ADHD:  $r = .962$ ,  $p < .001$ , Non-ADHD:  $r = .971$ ,  $p < .001$ ). However, correlations were notably higher between PSI and GAI in the non-ADHD group (ADHD  $R^2 = .285$ ; Non-ADHD  $R^2 = .475$ ). In the non-ADHD group, age was negatively correlated with FSIQ ( $r = -.289$ ,  $p = .005$ ), PSI ( $r = -.304$ ,  $p = .001$ ), and GAI ( $r = -.328$ ,  $p = 0.12$ ), whereas in the ADHD group, age was positively correlated with FSIQ ( $r = .373$ ,  $P = .001$ ).

**Conclusion:** There were no differences between ADHD and non-ADHD groups in FSIQ, PSI, and GAI. Consistent with expectations, the relationship between GAI and PSI was notably

stronger in the non-ADHD group relative to the ADHD group. Interestingly, in this sample age was positively correlated with higher FSIQ, but not GAI or PSI in the ADHD group.

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**Keywords:** attention deficit hyperactivity disorder, executive functions, fluid intelligence

**G. FORCHELLI, M. COLVIN, P. VUIJK, A. WARD, A. DEWS, A. DOYLE, E. BRAATEN. Functional Implications of Weak Processing Speed in Clinically-Referred Youth.**

**Objective:** Processing Speed (PS) refers to the time it takes to perceive, process, and respond to stimuli. There is growing evidence that PS deficits in youth with neuropsychiatric conditions associate with functional difficulties, including academic and social weaknesses (Cook et al., 2018; Braaten, Ward, Forchelli et al., 2020). There lacks consistency in how PS weakness is defined. Studies examined PS impairment compared to a normative sample or in a discrepancy model against overall intelligence. Given the limited prior attention in the literature, we examined the contribution of weak PS to functional and psychopathology outcomes both independently and in relation to different levels of cognitive ability. Such insights are critical to identifying youth who may require targeted interventions.

**Participants and Methods:** The sample included 1,261 unrelated youth ages 6 – 17 (62.9% boys), consecutively referred for neuropsychiatric evaluation at a pediatric assessment clinic within Massachusetts General Hospital (MGH) participating in the Longitudinal Study of Genetic Influences on Cognition. Weak PS was defined by Wechsler Processing Speed Index < 85 across levels of the Verbal Comprehension Index (VCI): below average VCI < 90; average  $90 \leq \text{VCI} \leq 110$ ; above average VCI > 110. Outcome measures include academics (Word Reading & Numerical Operations from WIAT-III), adaptive skills (Parent ratings on ABAS-3), and psychopathology (Internalizing and Externalizing Indices on CBCL). A latent profile analysis using Mplus 8 explored subgroups based on VCI and PSI. Then, 2-way ANCOVA models examined the effect of weak PS at levels of VCI while controlling for age, sex and medication. In youth with above average VCI, ANCOVA examined if a relative PS weakness (discrepancy between VCI and PSI  $\geq 15$ ) was associated with worse outcomes on the aforementioned areas. STATA 14 was used for most analyses. A False Discovery Rate (FDR) q-value of .05 was used to correct for multiple testing.

**Results:** LPA yielded a 4-class solution; one class was characterized by a discrepant profile (i.e., high VC and lower PS). Significant PSI x VCI level interactions were found on adaptive composites: conceptual ( $F(2,1068)=4.46, p = .01$ ); practical ( $F(2,1068)=4.46, p = .01$ ); social ( $F(2,1095)=4.83, p = .008$ ). There was a stronger effect of weak PS at below average VCI. For academics, a significant PS x VC level interaction was found for math ( $F(2,1252)=9.64, p = .0001$ ) and reading ( $F(2,1235)=3.57, p = .028$ ). Weak PS was associated with worse academic outcomes at all levels; more at below average and above average VC. No significant associations were found for general psychopathology. In above average VCI group, a relatively lower PS (<15 points) was associated with ~3.5 points lower score on conceptual adaptive skills ( $F(1,28)=4.12, p = .04$ ), ~ 6 index points lower score on math ( $F(1,345)=14.29, p < .001$ ), and ~ 4 points lower score on reading ( $F(1,336)=9.13, p = .003$ ).

**Conclusions:** Results suggest weak PS impacts academic and adaptive functioning interactively with level of general verbal cognition. While increasing levels of ability can be protective of the

impact of weak PS on adaptive outcomes, youth across all abilities with weak PS were impacted on academics. Weak PS should be considered as having functional implications.

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**Keywords:** executive functions, academic achievement, adaptive functioning

### **J. HAMMOND, J. BROOKS. Computerized Wisconsin Card Sorting Task (WCST) Performance Among Children with ADHD.**

**Objective:** The Wisconsin Card Sorting Test (WCST) is among the quintessential neuropsychological assessments of executive functioning. There have been multiple articles describing the need for additional research on the difference between the traditional 128 card administration and the computerized version of administration—some articles indicate there are minimal differences, whereas others suggest substantial changes in performance based on administration.

**Participants and Methods:** A community sample of children diagnosed with ADHD from the Northeastern United States (N=208) completed the WCST:CV4, the most recent computerized version available. The 128 card version of the computerized WCST was administered as part of a comprehensive neuropsychological battery at a private out-patient clinical neuropsychology practice. Data was retrospectively reviewed from 2005 to 2017. The ages of the children ranged from 7 to 12 years (M=9.01, SD=1.69; 52% female) and were primarily white. Three cases were excluded from the sample due to technical issues from the computer administration. Local normative data from this sample was calculated and compared to other normative data for children with ADHD.

**Results:** Average number of trials administered was commensurate with other data in the literature; however, fewer total errors (M=39.56, SD=22.69) were committed than recently reported by Filippetti et al. (2020). Although this appears to be clinically relevant, it merely approached statistical significance ( $p=0.6$ ). Failure to maintain set (FMS) was lower (M=1.61, SD=1.35) than expected based on previous reports of about 4. Fewer perseverative responses were observed (M=19.67, SD=12.83) and was significantly different from recently reported normative data ( $p=.02$ ).

**Conclusions:** Overall, normative data collected from the local community was more reflective of normative data published in the WCST manual, with few if any notable clinical or statistical differences. Variations were noted between our sample and other reported computerized samples. This reflects the importance of collecting and gathering local normative data for appropriate psychometric comparison and neuropsychological interpretation. Although performance on the computerized version of the WCST has been reported to reflect worse performance for children with ADHD compared to traditional administration of the WCST, we did not necessarily observe such findings. While fewer perseverative responses and FMS was observed, suggesting better performance than anticipated, performance across multiple domains appeared commensurate with non-computerized normative data. Additional statistical analyses need to be run with corresponding neuropsychological test data (e.g. IQ, verbal fluency) to explain other reasons for these observed differences

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**Keywords:** executive functions, computerized neuropsychological testing, normative data

**S. A. MANDELBAUM, S. JACOBS, H. A. BENDER, R. RIBAKOVE. Behavioral Observations in Pediatric Teleneuropsychology Evaluation: The New Normal of Two or More Settings.**

**Objective:** Despite the recent shift to teleneuropsychological (TeleNP) evaluations in response to the novel coronavirus (COVID-19), there are relatively few studies examining the utility of remote evaluations in the pediatric population. Specifically, the ability to accurately assess behavioral sequelae via TeleNP has been of concern to neuropsychologists given that these are often included in diagnostic criteria for neurodevelopmental disorders, including attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorder (ASD). Symptoms such as , distractibility, fidgeting, tapping hands/feet, hyperactivity, and variable eye contact are critical to accurate diagnostic decision-making; however, the contextual impact of “two or more settings” is now one that is difficult, for many, to disentangle. Prior to the pandemic, behavior could be assessed via teacher- and parent-report ratings, evaluated in concert with neuropsychologist’s own qualitative observations. Currently, our ability to make such multi-faceted judgements is quite limited, as children are now educated in their home, teachers are viewing them in a non-traditional context, and neuropsychologists are unable to assess the child’s reaction to a novel testing environment. Cases will be reviewed to evaluate the barriers to adequate behavioral observation during TeleNP. Three cases will be reviewed which compare data from children tested in an outpatient office setting to subsequent evaluations completed during the pandemic via TeleNP.

**Participants and Methods:** Three children (aged 6, 12 and 13 years old) were tested in person prior to the COVID-19 pandemic and completed comprehensive neuropsychological re-evaluations via an online platform.

**Results:** Comparison of these pediatric cases illustrated the differential utility of behavioral observations in children with suspected Attention-Deficit/Hyperactivity Disorder (ADHD) and Autism Spectrum Disorders (ASD).

**Conclusions:** Taken together, evidence from case studies support the differential diagnostic utility of behavioral observations made during remote assessment, dependent on presenting disorders. It can be difficult to parse out secondary effects of the remote testing environment versus true symptom presentation. However, there may also be incremental utility in observing children in their home environment. Supplemental information, such as clinical interview and parent/teacher questionnaires, when possible, is essential to inform diagnosis in “two or more settings,” consistent with DSM 5 criterion. Future studies should empirically assess the comparative impact of age, diagnosis, and acclimatization to online usage in children receiving assessments both in-office and via TeleNP.

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**Keywords:** attention deficit hyperactivity disorder, autism spectrum disorder, learning disabilities

**M. PHILLIPS, K. DELL'ANGELA. Standardized Pragmatic Language Abilities in Children Diagnosed with Autism Spectrum Disorder: Comparing Sex Differences in Performance Using the Comprehensive Assessment of Spoken Language, 2nd Edition.**

**Objective:** Autism Spectrum Disorder (ASD) is disproportionately diagnosed in boys at a rate of 4:1 (Fombonne, 2005). Research has found that girls may present their symptoms in different, albeit subtle ways, that include use of gestures (Rynkiewicz, et. al., 2016) and increased

prosocial behaviors (i.e., staying in close proximity to peers) that help girls to navigate social situations (Dean, Harwood, & Kasari, 2017). Girls with ASD are more likely to apply subtle nuances to language such as “um,” or “uh” (Parish-Morris, et. al., 2017). Pragmatic language is the use of appropriate communication in social situations and deficits in pragmatic language, in part, are required for a diagnosis of ASD. Differences in presentation of pragmatic language skills may affect diagnosis and treatment. This study analyzed pragmatic language assessments to further explore these findings.

**Participants and Methods:** Standard scores from the pragmatic judgment subtest of the Comprehensive Assessment of Spoken Language, 2<sup>nd</sup> Edition (CASL-2) were analyzed. In order to also assess higher order language skills (i.e., recognizing more than basic lexical/semantic elements within language), the nonliteral language subtest of the CASL-2 was included. Retrospective data was acquired from the National Database for Autism Research (NDAR), a national repository containing hundreds of ASD studies. 152 children diagnosed with ASD (F = 51, M = 101) and 207 typically developing (TD) children (F = 90, M = 117) between the ages of 7-18 were included in the study sample. Independent-samples T-test were performed to compare mean differences in performance between: 1) children diagnosed with ASD and TD children and 2) girls and boys diagnosed with ASD.

**Results:** Children diagnosed with ASD demonstrated significantly lower performance than TD children on both subtests. Pragmatic judgment: Standard scores for children diagnosed with ASD (M = 91.00, SD = 18.28) compared to TD children (M = 102.88, SD = 16.62) were significantly lower,  $t(306.97) = -6.32, p = .000$ . Nonliteral language: Standard scores for children diagnosed with ASD (M = 96.09, SD = 16.38) compared to TD children (M = 107.46, SD = 16.25) were also significantly lower,  $t(357) = -6.53, p = .000$ .

Comparing girls and boys diagnosed with ASD revealed the following: On the pragmatic judgment subtest, girls diagnosed with ASD (M = 96.53, SD = 18.78) compared to boys diagnosed with ASD (M = 88.21, SD = 17.46) demonstrated significantly better performance,  $t(150) = 2.71, p = .010$ . On the nonliteral language subtest, girls diagnosed with ASD (99.16, SD = 16.55) compared with boys diagnosed with ASD (94.54, SD = 16.15) demonstrated similar performances,  $t(150) = 1.65, p = .105$ .

**Conclusion:** These preliminary results reveal that girls diagnosed with ASD demonstrate greater performance on the pragmatic judgment subtest of the CASL-2. Interestingly, despite these differences, boys and girls diagnosed with ASD scored similarly on the nonliteral language subtest. These findings support past research that subtle differences exist between ASD presentation between boys and girls. Better understanding of these differences, as well as the mechanisms of this greater skill in pragmatic communication may help to inform diagnosis and treatment.

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**Keywords:** language, social cognition

### **E. BONDA. Neurocognitive Enhancement of categorization abilities in Autism Spectrum Disorder.**

**Objective:** Two clinical cases with Autism Spectrum Disorder/ASD, and within the range of symptoms of High Functioning Autism and Asperger Syndrome, have been thoroughly assessed by neuropsychological examination and followed up through neurocognitive enhancement coupled with enriched or modified cognitive behavioral therapy.

**Participants and Methods:** The children have been assessed at chronological ages from 5 to 8 years old as having Wechsler Intelligence Scales for Children IQ profiles characteristic of High Functioning Autism Spectrum disorders or Asperger syndrome, that is particular strengths in ‘Similarities’ and ‘Matrix Reasoning’, and serious weaknesses in graphomotor and speed processing skills. Both children presented idiosyncrasies in conceptual categorization processes and abstraction semantics operations. Autism Diagnostic measures (ADI-R, ADOS), Attention-deficit Hyperactivity Disorders rating scales as well as Memory and Adaptive Behavioral measures have been used to assess behavioral and cognitive specificities, and establish individual differences to guide a personalized therapy protocol.

**Results:** Sessions of intensive recurrent neurocognitive training, coupled with modified cognitive behavioral therapy, resulted in important improvement in social communication and categorical abstraction disabilities in clinical assessment measures and in school performance. Additionally, reduction in anxiety or depression scores have been obtained in post-treatment evaluations.

**Conclusions:** The results support significant improvement of severe disturbances in semantic abstraction in ASD through neurotechnological training of selected cognitive and emotional processing sub-components, enabling ASD children not just to learn the superficial meaning of a stimulus but an enriched meaning, generalizable to novel stimuli. Neuroimaging and neurophysiological evidence supports the idea that the Temporal Pole and the Amygdala are convergence substrates for unimodal representations into a multimodal semantic abstract representation.

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**Keywords:** autism spectrum disorder, neuropsychological assessment, cognitive rehabilitation

**R. P. THOMAS, S. MILAN, L. NAIGLES, D. ROBINS, M. BARTON, L. ADAMSON, D. FEIN. Symptoms of ASD and Global Developmental Delay in Children with Low Mental Age.**

**Objective:** Early, significant developmental delays often lead to a diagnosed intellectual disability. The large literature on the early signs of ASD has not yet shown a clear picture of how a severe developmental delay impacts the presentation of ASD symptoms in toddlers. Cognitive impairment in toddlers can make it hard to distinguish children with Autism Spectrum Disorder (ASD) from those with other neurodevelopmental disorders, such as global developmental delay (GDD). This study elucidates symptoms related to cognitive delays and to ASD by describing differences in how children with ASD and cognitive impairment (ASD-low-MA) perform on the ADOS-2 Toddler Module compared to children with GDD and to children with ASD and a higher mental age.

**Participants and Methods:** The sample includes 30 children between 15 and 26 months with ASD-low-MA who met criteria for ASD and had no Mullen age equivalents above a 12-month level. Subsets of children with GDD ( $n=30$ ), and ASD-higher-MA ( $n=30$ ) were selected to match the ASD-low-MA group. The ASD-low-MA group was matched to the ASD-higher-MA group on chronological age with both groups around 20 months old ( $t(58)=-.13, p = .910$ ). There were more boys in the ASD-low-MA group ( $n=26$ ) than the ASD-higher-MA group ( $n=19$ ) ( $\chi^2(1, N = 60) = 4.36, p = .037$ ). The ASD-low-MA group and GDD group were matched in pairs on one verbal and one nonverbal measure of cognitive functioning. The GDD group had significantly higher Mullen Visual Reception age equivalents ( $M=10.5$  months,  $SD = 2.3$ ) compared to the

ASD-low-MA group ( $M=9.3$  months,  $SD=2.1$ ;  $t(58)=2.04$ ,  $p=.046$ ). The groups also differed on race ( $\chi^2(1, N=54)=6.03$ ,  $p=.014$ ) with more families identifying as White in the ASD-low-MA group.

**Results:** Item level data from the ADOS-2 Toddler Module were analyzed using chi-square or Fisher's exact test. Three of the 41 ADOS-2 items differed between the ASD-low-MA and ASD-higher-MA groups after controlling for sex. ASD-low-MA children were significantly less likely than ASD-higher-MA children to respond to joint attention (AOR 31.68, 95% CI: 3.65-275.40), initiate joint attention (AOR 15.21, 95% CI: 1.74-132.82), or respond during a socially ambiguous toy play situation (AOR 9.71, 95% CI: 2.25-41.93). Eighteen items differed between the ASD-low-MA and GDD groups after controlling for race and visual reception age equivalents. These significant differences (AOR range 9.31-35.55) can be grouped into the following domains: communication, social responsiveness, unusual sensory interests, repetitive body movements and stereotyped interests.

**Conclusions:** The ADOS-2 Toddler Module successfully captured ASD symptomatology even in children with mental ages below 12 months. Symptomatology in the ASD-low-MA and ASD-higher-MA groups was strikingly similar; developmental level affected the clinical presentation of ASD less than was expected. In contrast, many behaviors distinguished children with ASD-low-MA from children with GDD. The finding that repetitive behaviors and interests strongly differentiated the GDD and ASD-low-MA groups suggests that clinicians may find them useful diagnostic markers of ASD when evaluating globally delayed toddlers who present with ASD features.

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**Keywords:** autism spectrum disorder, intellectual functioning

### **Z. MYSZKO, A. BOTTICELLO, B. MARONNA, L. MURPHY, M. SMITH, K. SHERWOOD, H. M. GENOVA. Parental Perspectives of the Effects of the COVID-19 Pandemic on Young Adults with Autism: A Pilot Study.**

**Objective:** The COVID-19 pandemic has disrupted the lives of many worldwide; however, the effects of the pandemic on transition-age youth with Autism Spectrum Disorder (ASD) are not well understood. As individuals with ASD thrive on consistency, the breakdown of predictability caused by the COVID-19 pandemic may be associated with elevated levels of stress, anxiety, and social isolation, as well as disruptions in the delivery essential therapy and services. The current study examines how the COVID-19 pandemic has affected the lives of transition-age youth with ASD from a parental perspective.

**Participants and Methods:** Thirty-nine parents of transition-age youth with ASD participated in an online survey via REDCap. The youth with ASD were between the ages of 16-20 years old. Parental perspectives were collected using a parental stress survey to identify specific stressors experienced by their children with ASD.

**Results:** Parents reported their children with ASD were experiencing difficulty in meeting their therapeutic goals (both privately and in-school). The majority of parents of children receiving private or in-home therapy reported the goals of that therapy were 'very slightly or not at all' met since March 13, 2020. Other stressors included disruption to routine, increased stimming behaviors, and increased electronics use. Parents concerns also included more social isolation following the pandemic compared to prior to the approximate onset of the COVID-19 pandemic. Overall, participants reported that their children with ASD experienced a marked change in

routine due to the COVID-19 pandemic that has resulted in behavioral and treatment-related setbacks.

**Conclusions:** Our results indicate that the COVID-19 pandemic has had a markedly negative impact on transition-age youth with ASD, including disruptions to routines, reduction in meeting therapy goals, increased electronics use and social isolation. Future directions include examining how these negative changes are impacted by a return to “normalcy” in returning to in-person schooling, stable employment, and increased socialization with peers. The data gathered as a result of this study can be used to prioritize the development of new services and treatments to address the negative changes that are affecting the majority of young adults with ASD as a result of the COVID-19 pandemic.

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**Keywords:** adolescence

### **M. E. BECKERSON, N. LOOMBA, C. AMMONS, R. KANA. Corpus Callosum Morphology and Homotopic Functional Connectivity in Autism Spectrum Disorder.**

**Objective:** Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder characterized by impairments in social communication and repetitive, restricted patterns of behaviors and interests (American Psychological Association, 2013). Using neuroimaging to discover reliable biomarkers of ASD is an avenue of ongoing research that may promote earlier diagnosis and identify targets of intervention. Smaller corpus callosum size (Anderson et al., 2011) and disruptions in functional connectivity (Kana, Libero, Moore, 2011) are some of the consistently reported neural impairments in ASD. However, few studies have examined the relationship between structural and functional connectivity in ASD. The goal of the current study was to examine the relationship between corpus callosum (cc) volume and resting interhemispheric (homotopic) connectivity in ASD.

**Participants and Methods:** Structural MRI and resting state fMRI data from 39 individuals with ASD ( $16.5 \pm 7.0$  years) and 55 typically-developing (TD) controls ( $16.7 \pm 6.2$  years) matched on age ( $t(92) = .097, p = .92$ ) were obtained from the Autism Brain Imaging Data Exchange (ABIDE I) database. The cc was divided into five subdivisions (anterior, mid-anterior, central, mid-posterior, and posterior corpus callosum) using FreeSurfer 6.0 software (Fischl, 2012). Volumes were calculated for each segment, as well as summed together to yield a total cc volume for each subject. Homotopic functional connectivity was calculated between a voxel in one hemisphere and its mirror voxel in the opposite hemisphere using the Resting-State fMRI Data Analysis Toolkit (REST) in MATLAB. Total cc volumes were also correlated with z-scores of interhemispheric correlation values to establish structure-function relationship.

**Results:** The ASD group had significantly smaller volumes in the central section ( $M = 486.23\text{cm}^3, SD = 84.50, F(93) = 7.69, p = .007$ ) of the cc. However, a one-tailed t-test revealed no differences in total cc volume between ASD and TD ( $t(93) = .802, p = .373$ ). Further, the ASD group showed stronger interhemispheric connectivity in the superior frontal gyrus (SFG) than the TD group ( $t = 1.988, p = .05$ ). There was no significant correlation between these structural and functional variables in the ASD group ( $r = -.137, p = .413$ ), nor the TD group ( $r = -.027, p = .844$ ).

**Conclusions:** These findings suggest that individuals with ASD have morphological differences in the cc that may be sub-region specific. The relationship between total cc volume and resting-state interhemispheric functional connectivity may not be directly related, supporting previous

findings (Anderson et al., 2011). Targeted comparisons between specific subregions and corresponding homotopic region connectivity may reveal subtle differences in structure-function relationship. Future research should examine this in different contexts, such as task-based connectivity, age, and in symptom severity levels.

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**Keywords:** corpus callosum, neuroimaging: functional connectivity, neuroimaging: structural connectivity

### **R. NG. Associations Between Parent Factors and Externalizing and Internalizing Symptomatology Among Children with ADHD, ASD, Comorbid Diagnosis, and Communication Disorder.**

**Objective:** ADHD, autism spectrum disorder (ASD), and communication disorders (CD) are highly comorbid and commonly share increased risk for developmental psychopathology, including internalizing and externalizing problems. Although developmental research with at-risk youth has highlighted the deleterious effects of negative parenting practices on mental health, the differential effects of parenting styles and parent-child relationship on internalizing and externalizing symptomatology across these clinical groups remain understudied. Accordingly, the goal of this study was to examine the associations between parenting practices and caregiver-child relationship with psychosocial functioning across children with ASD, ADHD, ASD+ADHD, or communication disorders while controlling for intellectual functioning, attention problems and social dysfunction.

**Participants and Methods:** This study included data from 1113 children who were evaluated through the Healthy Brain Network of the Child Mind Institute. Of these, 158 were neurotypical youth, 692 with ADHD, 43 with ASD, 178 with ASD+ADHD and 42 with communication disorder. Diagnosis was made based on clinician consensus. Caregivers completed the Child Behavior Checklist (CBCL) as an index of their child's day-to-day attention problems, social problems, internalizing behaviors, and externalizing symptoms. The Alabama Parenting Questionnaire and the Parenting Stress Index were also administered to caregivers to assess parenting practices (involvement, positive parenting, poor monitoring, inconsistent discipline, corporal punishment) and parent-child relationship difficulties. Higher scores obtained across inventories reflect greater intensity of the construct represented by the subscale. Child participants were administered a Wechsler test (WAIS-IV, WISC-IV/V, WASI-II) or Kaufman Brief Intelligence Test 2<sup>nd</sup> Edition (KBIT-2) to estimate intellectual functioning.

**Results:** After controlling for age, intellectual functioning, and attention and social problems, parenting styles and caregiver-child relations accounted for an additional 9%, 15% and 19% of variance in externalizing behaviors across ADHD, ASD+ADHD and CD groups respectively; but no associations were found among youth with ASD. Broadly, greater ratings in dysfunctional parent-child interactions was related to more severe externalizing problems across these clinical samples. Inconsistent discipline was associated with more of these problem behaviors among those with CD. Similarly, for the ADHD group, the use of corporal punishment and inconsistent discipline were both related to greater externalizing symptomatology. In regard to internalizing behaviors, parent factors collectively explained an extra 4%, 15% and 23% of variance in symptoms among those with ADHD, CD, and ASD, but were not significant correlates among those with comorbid ASD+ADHD. Poor monitoring was a significant predictor of internalizing behaviors among children with ASD, whereas both poor monitoring and

inconsistent discipline were strong determinants for the CD group. Finally, across ADHD, CD and ASD groups, elevated ratings in dysfunctional parent-child relations were associated with greater internalizing symptomatology reported by caregivers.

**Conclusions:** Negative parenting styles (use of corporal punishment, inconsistent disciplining, poor monitoring), and most notably dysfunctional parent-child interactions, are associated with greater risk for psychosocial functioning problems across children with ADHD, ASD, ASD+ADHD and communication disorders. Results implicate the need for more extensive developmental research on the transactional effects between caregiving practices, family climate and developmental psychopathology among youth with these neurodevelopmental disorders.

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**Keywords:** autism spectrum disorder, attention deficit hyperactivity disorder, neuropsychiatry

### **J. CHANG-TRAN, R. GOIN-KOCHEL. Cross-Cultural Examination of Vaccine Hesitancy and Attributions for Autism Spectrum Disorder (ASD) in Parents of Children with ASD.**

**Objective:** Emerging research suggests that vaccine-hesitant parents (VHPs) of children with autism spectrum disorder (ASD) are more likely to be people of color than White. In a recent study (2020;  $N=225$ ), while 29% of the sample were VHPs ( $n=65$ ), significantly higher proportions of parents of color (collectively, Asian, Black, Hispanic, Other, or Bi-/Multi-Racial; 49%) were vaccine hesitant compared to White parents (22%;  $p<.001$ ). However, the study was limited by small sample sizes for individual races, which resulted in the accumulation of samples of color into one group, thereby likely concealing valuable differences across specific racial/ethnic groups. The current study's objectives were to (a) calculate the prevalence of VHPs across specific racial/ethnic groups, (b) compare beliefs about causes of ASD between hesitant and non-hesitant parents and across racial and ethnic groups, and (c) examine other cultural/demographic factors that may contribute to vaccine hesitancy.

**Participants and Methods:** 8,854 parents of children with ASD completed the following questionnaires in English: *Parent Attitudes about Childhood Vaccines* questionnaire (PACV; measure of vaccine hesitance) and the *Revised Illness Perception Questionnaire-ASD* (IPQ-R-ASD; measure of attributions for child's ASD). Demographic information was also collected through the PACV. Participants were able to identify with one or more of the following racial and ethnic categories: American Indian, Asian, Black, Middle Eastern, Other, Pacific Islander, South Asian, White; Hispanic/Latinx or Not Hispanic, respectively. Descriptive statistics were used to determine the prevalence of VHPs and characterize the sample. Chi-square analyses compared proportions of VHPs and agreement with various causes of ASD across racial/ethnic groups.

**Results:** Overall, 22.2% of parents were vaccine hesitant. Regarding racial/ethnic group(s) endorsed, VHPs were less likely to be White (20.8%;  $p<.0001$ ) and more likely to be American Indian (29.8%), Black (34.8%), Other (38.7%), or Latinx (31.5%). Among other demographic factors, VHPs were more likely to have a lower household income ( $\leq \$30,000$ ) and educational level (e.g., attaining some high school vs. completing high school, college, or more than a 4-year college degree). Within the collective sample, VHPs were more likely to attribute accident/injury, alcohol consumption, deterioration of child's immunity, diet, environmental pollution, worries about ASD, general stress, germ/virus, in utero stress/accident, negative attitudes, own decisions, own emotional state, poor medical care, stress at birth, and toxins in vaccines as causes of their child's ASD. VHPs were also less likely to endorse known causes of

ASD (e.g., age, brain structure, genetics) as causes of their child's ASD. When examining race/ethnicity, regardless of hesitancy status, White parents were more likely to endorse brain structure, chance, and genetics as causes of ASD; conversely, parents of other specific races/ethnicities (including Black, Latinx, Other) were less likely to endorse these factors. Parents of color, including American Indian, Asian, Black, South Asian, Latinx, Other, were more likely to endorse factors, such as vaccines, poor medical care, environment, and diet, as causes.

**Conclusions:** Results are consistent with recent studies showing that proportions of VHPs differ significantly across racial/ethnic groups among parents of children with ASD. Likewise, beliefs about causes of ASD differ significantly between VHPs and non-VHPs, as well as across racial/ethnic groups. This information may inform the design of targeted, preemptive educational information about vaccine safety that could be tailored to culturally diverse communities.

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**Keywords:** autism spectrum disorder, multiculturalism, cross-cultural issues

### **C. ROSENSWEIG, E. CHESSEN, O. PULLARA, J. P. O'GRADY, B. GORDON, K. DAVIS. A Case Study of Peer-To-Peer Learning in Two Adults with Developmental Disorders.**

**Objective:** Social situations are extremely powerful catalysts for learning (Wenger 1998), so much so that some have even argued that they trigger specialized learning mechanisms (Schultz & Dunbar 2012). This potentiation might conceivably be great enough to overcome, at least to some degree, the severe learning deficits found in individuals with developmental disabilities. Two social situations that are known to be particularly potent stimulants for learning are instruction by an authority figure and peer-to-peer learning. In this small pilot study, we tested the efficacy of these two approaches in two individuals with severe intellectual impairments, but very different degrees of social awareness. The outcomes were completely contrary to our expectations.

**Participants and Methods:** Subjects were two young adult men: S1, in his early 30s, with severe intellectual impairment and profound autism (ASD-3); S2, in his late 20s, with severe intellectual disability associated with 13Q 21-23 deletion, but relatively preserved social skills. A skilled instructor trained them in a fitness program (Chessen 2018). S1 had a 16 year history of fitness training with this instructor; S2 was new to the program. Sessions included exercises performed in pairs and independently. The instructor used a range of teaching strategies for fitness skills, including physical prompting, modeling, and verbal instructions; there was no explicit instruction in social skills. There were 7 weekly 60-minute sessions of the program. Each session was video-recorded. Consent and assent were obtained for the research aspects of this program in accordance with procedures approved by the Hopkins IRB. Video data were interval-coded around four major themes: patterns of social engagement, task format, participant behavior toward instructor, and task performance. Hierarchical cluster analysis of the codes was conducted using the Unweighted Pair-Group Method using Arithmetic averages (UPGMA) approach (Sokal & Michener, 1958) using the MaxQDA 2020 software package (VERBI Software, 2019), contrasting in particular the sessions at the beginning (sessions 1-2), middle (3-5), and end (6-7) of the program. Trends over time in clusters of the codes were identified visually, as is standard with this method (Seo & Schneiderman 2002).

**Results:** S1 was found to benefit from peer-to-peer learning more than learning from the instructor. Over time, he increased his engagement with S2 and decreased his need for support (i.e. repetitive or clarifying instruction) from the instructor during tasks performed with S2. He did not show improvement in tasks performed independently. S2 showed no clear improvements over time regardless of whether activities were performed in pairs with S1 or independently.

**Conclusions:** Peer-to-peer interactions may be able to stimulate as much learning, if not more, than do instructor-led activities, even in individuals with profound social deficits (autism). Given the profound needs for such individuals to be taught, and the paucity of proven effective methods for teaching them (Davis et al., 2019), attempts to foster learning by creating peer-to-peer social situations may be a fruitful approach to pursue.

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**Keywords:** autism spectrum disorder, social processes, learning disabilities

### **H. M. GENOVA, A. BOTTICELLO. The Impact of the COVID-19 Pandemic on School Aged Children with Autism: Parental Report.**

**Objective:** In order to curb the spread of COVID-19, school closures were enacted across the USA in the spring of 2020. While this shut-down led to disruptions to the education, socialization and health for all children, children with autism were likely to have experienced unique challenges and stressors relative to neurotypical peers. In particular, given social differences and preferences for consistency in children with autism, we predicted that they would experience more overall negative effects of the pandemic compared to neurotypical peers. Specifically, we predicted that children with autism would experience more stress related to disruptions in daily routines, and less stress related to social isolation. In comparison, we expected neurotypical peers to report more stress associated with social isolation. We also predicted that parents of children with autism would report that their children needed more parental assistance in order to complete academic work, compared to neurotypical peers.

**Participants and Methods:** A sample of 321 parents of school aged children, ages of 4-15 years old, participated in an online survey via REDCap. The majority of the respondents (62%) were from the Northeast region of the United States and 65% were parents of children with autism and 35% were parents of neurotypical children. The children were 69% male, and 74.6% were non-Hispanic white. Parental perspectives were collected using the Covid-19 Adolescent Symptom and Psychological Experience Questionnaire (CASPE).

**Results:** Parents of children with autism reported more overall disruptions on average compared to neurotypical peers ( $t=4.38$ ,  $df=286$ ,  $p = 0.000$ ). The top three stressors reported by parents of children with autism were not attending school, schedule disruption, and having to stay at home. In comparison, the top three stressors reported by parents of neurotypical children were not seeing friends, not attending school, and having to stay home. Parents of children with autism reported that they spent more time assisting their child with academic work compared to parents of neurotypical children ( $t=3.81$ ,  $df=286$ ,  $p = 0.000$ ).

**Conclusions:** The effects of the COVID-19 pandemic and prolonged school closures have disrupted the lives of children, but these circumstances may be affecting children with autism differently compared to their neurotypical peers. Although both parental groups reported stress related to having to stay home and not attend school, parents of neurotypical peers were more likely to report stress related to not seeing friends, whereas parents of children with autism were

more likely to report stress related to disrupted schedules. Furthermore, parents of children with autism reported more stress overall, and that greater parental assistance was required for children with autism to complete school work. These results indicate children with autism are an at-risk group for negative changes due to the pandemic. Clinicians are advised to consider these risks when treating this vulnerable population.

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**Keywords:** autism spectrum disorder

**D. WEXLER, N. LUDWIG, A. E. PRITCHARD. More Alike than Different: Comparing Children with Low Average Intellectual Abilities to Their Lower Functioning Peers.**

**Objective:** Children with low average intellectual functioning are generally not diagnosed with intellectual disability (ID); however, difficulties with functional skills like learning and adaptive functioning may be present. Given limited research examining functional skills in children with low average intellectual abilities, this study aimed to 1) characterize adaptive and academic functioning in children with low average intellectual abilities (i.e., Full Scale Intellectual Quotient [FSIQ] between 80-89) and 2) determine whether adaptive and academic functioning differs between children with low average intellectual abilities and those with average (FSIQ between 90-109), below average (FSIQ between 70-79), and exceptionally low (FSIQ <70) intellectual abilities.

**Participants and Methods:** A dataset was constructed from a clinical database of a neuropsychology outpatient clinic at a large academic medical center. Patients were between 6-13 years ( $m = 9.71$ ) and had valid measures of intellectual functioning (i.e., FSIQ on Wechsler Intelligence Scale for Children, Fourth/Fifth Edition [WISC-4/-5]), adaptive functioning (i.e., General Adaptive Composite [GAC] and Conceptual, Social, and Practical Composites on Adaptive Behavior Assessment System, Second/Third Edition [ABAS-2/-3]), and academic achievement (i.e., word reading and math computation tasks from **Kaufman Test of Educational Achievement, Third Edition [KTEA-3]**, Woodcock-Johnson, Third Edition Tests of Achievement [WJ-III], or Wechsler Individual Achievement Test, Third Edition [WIAT-III]). The final sample included 2,612 participants with a range of FSIQ scores: Average ( $n = 1,013$ ), Low Average ( $n = 662$ ), Below Average ( $n = 544$ ), and Exceptionally Low ( $n = 393$ ). Group differences in adaptive functioning and academic achievement were examined using one-way MANCOVAs with age included as a covariate due to significant group differences ( $p < .001$ ;  $\eta^2 = 0.04$ ).

**Results:** Significant differences emerged in adaptive functioning,  $F(12, 7818) = 38.36$ ,  $p < .001$ ,  $\eta^2 = 0.06$ , and academic achievement,  $F(6, 5214) = 241.68$ ,  $p < .001$ ,  $\eta^2 = 0.22$ . Post-hoc analyses revealed that the Low Average group did not significantly differ from the Below Average group on the GAC ( $p > .05$ ;  $d = 0.11$ ), Social Composite ( $p > .05$ ;  $d = 0.11$ ), and Practical Composite ( $p > .05$ ;  $d = 0.02$ ) on the ABAS-2/-3. All groups were significantly different across all other dependent variables (i.e., word reading, math computation, ABAS-2/3 Conceptual Composite) on post-hoc analyses; means increased with FSIQ.

**Conclusions:** Children with low average FSIQ did not differ significantly from children with below average FSIQ in overall adaptive functioning and in specific areas of adaptive functioning, including social (i.e., social awareness, communication, and judgment) and practical functioning (i.e., learning and self-management). Thus, even though children with low average IQ generally do not meet criteria for ID, they may demonstrate adaptive functioning consistent with those who

are likely to meet criteria for ID. These findings suggest that children with low average IQ may benefit from adaptive supports similar to those received by children with ID.

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**Keywords:** adaptive functioning, intellectual functioning, child development disorders

**H. M. GENOVA, A. EDWARDS, R. E. MCGRATH, M. SMITH. What are Your Strengths? How Youth with Autism Differ in the Expression of Personal Strengths during the Job Interview.**

**Objective:** Youth with autism are at high risk of unemployment, yet the reasons underlying this risk remain unclear. One important step towards obtaining employment is the job interview, during which an individual is expected to express their personal strengths to a potential employer. The process of the job interview may represent a challenge for individuals with autism, given difficulties in social communication. Additionally, research shows that individuals with autism can have decreased self-esteem and self-awareness, and subsequently may lack the ability to express personal strengths on a job interview. The purpose of the current pilot study was to examine the possible differences in the expression of personal strengths within the context of the job interview between adolescents with autism and neurotypical peers.

**Participants and Methods:** Twenty-three adolescents participated in the current pilot study (14 youth with autism and 9 neurotypical peers). During the study, participants participated in a video-recorded mock job interview during which they were asked to express their personal strengths. The videos were then rated by 2 independent reviewers blinded to participant diagnosis (autism vs. neurotypical). Interviews were rated on a number of variables including strength expression, describing oneself in a positive way, and appearing “hire-able” (using standardized rating methods). These ratings were compared between groups using t-tests.

**Results:** The autism group had significantly reduced ability to express their personal strengths,  $p = .015$ , compared to the neurotypical group according to the blinded raters. In addition to reduced strength expression, the autism group was rated as significantly less hire-able than the neurotypical group,  $p = .003$ . We also examined whether strength expression was predictive of overall impressions of hire-ability using regression analyses across the entire sample ( $n=23$ ). Strength expression significantly predicted ratings of hire-ability,  $F(1,21) = 20.9$ ,  $p < .0005$  and accounted for 49.9% of the variability in hire-ability ratings (adjusted  $R^2 = .475$ ).

**Conclusions:** The present findings indicate that youth with autism have difficulty in expressing personal strengths within the context of the job interview. Additionally, difficulty in expressing strengths may contribute to an overall reduced sense of hire-ability to potential employers. This pilot study indicates that improving self-awareness and expression of personal strengths is an important potential treatment target in adolescents with autism. Further, improvement of these skills may influence the ability to impress future employers.

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**Keywords:** autism spectrum disorder

**L. NICHOLS, S. SONI, A. T. WIECKOWSKI, M. F. SKAPEK, Y. G. DAI, T. DUMONT-MATHIEU, M. BARTON, D. FEIN, D. ROBINS. Provider and Child Characteristics Impacting ASD Surveillance.**

**Objective:** While research supports early diagnosis and intervention for children with autism spectrum disorder (ASD), characteristics of pediatric providers and children may influence the likelihood of surveillance and screening for ASD and contribute to disparities in diagnosis. Practice characteristics (e.g., location) may impact detection of ASD and the referral process (Daniels & Mandell, 2014; Mandell et al., 2007). Both provider and child characteristics may affect surveillance accuracy. The current study examined how provider beliefs (i.e., confidence in discussing ASD and making appropriate referrals, screening resources, and use of formal autism screening), practice and provider characteristics (i.e., location, patient demographic, years in practice, race/ethnicity, and sex), and child characteristics (i.e., race/ethnicity, sex, and maternal education) relate to the agreement between the provider's autism surveillance and screening result.

**Participants and Methods:** Toddlers ( $n = 5738$ ) aged 12-21 months were screened by 132 pediatric providers; practices were randomly assigned to begin screening at 12, 15, or 18 month visits across three states (Connecticut, Pennsylvania, and Georgia). Children were screened using the Infant Toddler Checklist (ITC; Wetherby & Prizant, 2002), the First Year Inventory Lite (FYI-L; Baranek et al., 2009), and/or the Modified Checklist for Autism in Toddlers, Revised, with Follow-Up (M-CHAT-R/F; Robins, Fein, & Barton, 2009) depending on the child's age at screening. During each well-child care visit, surveillance was conducted and providers indicated whether or not they had ASD concerns. Providers completed a questionnaire about their screening beliefs and practices. Practice and provider characteristics were also collected. Agreement between provider concern and screening result was modeled by entering provider and child characteristics into logistic regression models.

**Results:** Provider beliefs significantly predicted surveillance-screening agreement with higher provider confidence ( $\beta = 0.57, p < .001$ ) and use of formal autism screening ( $\beta = 0.61, p < .001$ ) predicting greater accuracy of provider concern. Provider and practice characteristics also significantly predicted surveillance-screening agreement, with practice location ( $\beta = -0.83, p < .001$ ), the racial/ethnic demographic of a practice's patients ( $\beta = 0.27, p = .008$ ), providers' years in practice ( $\beta = 0.05, p < .001$ ), sex ( $\beta = 0.81, p = .03$ ), and race/ethnicity ( $\beta = 2.05, p < .001$ ) all significantly predicting surveillance-screening agreement. Some child characteristics, such as the child's race/ethnicity and sex, significantly predicted accuracy. Specifically, concerns about female ( $\beta = 0.40, p = .009$ ) and Black children ( $\beta = 0.48, p = .007$ ) were more likely to be consistent with screening outcomes.

**Conclusions:** Providers with more diverse patient populations and practices with more racial/ethnic diversity in provider staff demonstrate surveillance that is more likely to agree with screening results. More years in practice, confidence in discussing ASD and appropriate referrals, and use of formal ASD screening also predicted higher surveillance-screening agreement. Female children, Black children, and children in practices with a higher number of male providers demonstrated higher surveillance-screening agreement. Overall, increased provider experience, especially with diverse patient populations, may result in ASD surveillance that aligns with screening outcomes in primary care. Further research is required to determine the mechanisms through which individual characteristics of providers and children influence surveillance.

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**Keywords:** autism spectrum disorder, child development disorders, cross-cultural issues

**J. A. TRAPANI, R. KANA, T. LEVINE. Autism Symptomatology and Neuropsychological Mechanisms Underlying Deception Detection.**

**Objective:** Despite extensive research on social cognition in autism spectrum disorder (ASD), examining the vulnerability of this population to deception has received rather limited attention. The role of executive function (EF) skills in detecting deception is even less understood in both typically developing (TD) and ASD populations. The social implications of poor lie-detection along with the dearth of research on deception in ASD exemplify the need to understand the mechanisms that underlie this nuanced form of social interaction. The current study aims to investigate the neuropsychological mechanisms of detecting deception and the extent to which autism symptomatology impacts lie-detection in adults with and without ASD.

**Participants and Methods:** Thirty adults ages 18-28 years with varying levels of transdiagnostic autism symptomatology (mean AQ Total Score = 21.03, range = 7-46; mean FSIQ = 107) completed a short battery of tests to assess EF skills (WASI-II, selected D-KEFS subtests) and questionnaires to assess self-report ratings of autism symptomatology (SRS-2, AQ, EQ, and RMET) and EF (BRIEF-A). They also completed a well-documented deception detection task that required participants to make judgements about whether subjects in the videotaped vignettes were telling the truth or telling a lie (Levine et al., 2011). These videos spanned across veracity *matched* (sincere truth-tellers and insincere liars) and veracity *mismatched* (insincere truth-tellers and sincere liars) conditions. A series of hierarchical multiple regressions were conducted, with age, gender, and IQ entered as covariates of noninterest, measures of autism symptomatology and EF as predictors, and percent accuracy scores across conditions of deception detection (matched and mismatched) as outcome variables.

**Results:** Results indicate that while controlling for age, gender, and FSIQ, both self-rated autism symptomatology (AQ Total Score) and measures of EF skills (D-KEFS Tower Total Achievement Scaled Score and BRIEF-A GEC T-Score) uniquely impacted deception detection ability across different demeanor-based conditions. Increased ratings of autism symptoms predicted higher accuracy rates in the mismatched condition ( $R^2 = .562$ ,  $F(7,29) = 4.04$ ,  $p = 0.005$ , adjusted  $R^2 = 0.424$ ), while EF skills were most important for accurately detecting lies in the matched condition ( $R^2 = 0.497$ ,  $F(6,28) = 3.62$ ,  $p = 0.012$ , adjusted  $R^2 = 0.360$ ). Theory of mind (RMET) and truth-bias (the tendency to believe others are telling the truth) were not related to task performance.

**Conclusions:** Overall, these findings suggest that increased autism symptoms may place individuals with ASD at an advantage in some aspects of lie-detection, as they may be less likely to be manipulated by misleading social cues (Levine, 2014). Meanwhile, executive skills appear to be most important for lie-detection when the accompanying social cues are consistent with the individual's veracity. These results provide insights into the mechanisms underlying deception detection in autism and related weaknesses in social communication.

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**Keywords:** autism spectrum disorder, executive functions, social cognition

**B. H. BRUKILACCHIO, K. MEGHANI, M. BRINSTER. A Matched Pairs Analysis of Sex-Based Social Communication Differences in Young Children with Autism .**

**Objective:** Females are diagnosed with autism much less frequently than males with a current male:female ratio of 4:1. One theory for this discrepancy is that the current diagnostic criteria are male-centric and do not adequately capture autism symptoms in females. Previous research has

also suggested that females with autism are more likely to spontaneously engage in social camouflaging behaviors to mimic what they observe in typically-developing peers. This study was designed to explore 1) whether a commonly used diagnostic rating scale is sensitive to sex-based social/emotional differences in children with autism, and 2) whether these differences persist after controlling for cognitive delays.

**Participants and Methods:** Clinical data were analyzed for a sample of children (N=103), aged 2 to 5, evaluated for autism in a specialty outpatient clinic/academic medical center. Matched pairs were generated and independent t-tests were conducted to assess for differences in total T-Score on the Childhood Autism Rating Scale, Second Edition (CARS-2) and raw scores for Imitation, Relating to People, Emotional Response, and Nonverbal Communication.

**Results:** Male and female matched pairs were based on age and autism severity level, corresponding to severity levels specified in the DSM-5. When matched on these criteria, 22 pairs had significant differences in the areas of total score ( $t = -2.21$ ,  $p = 0.03$ ); Males ( $M = 49.81$ ,  $SD = 4.27$ ); Females ( $M = 47.5$ ,  $SD = 4.85$ ). Additionally, females were rated nearly 0.3 points lower than males on both Relating to People ( $t = -2.16$ ,  $p = 0.04$ ) and Nonverbal Communication ( $t = -2.22$ ,  $p = 0.04$ ). When a dichotomous cognitive ability variable was introduced to the original matching criteria, 19 pairs were generated and no significant sex-based differences were observed in total T-score ( $t = -1.19$ ,  $p = 0.25$ ), Imitation ( $t = -0.87$ ,  $p = 0.40$ ), Relating to People ( $t = -0.89$ ,  $p = 0.39$ ), Emotional Response ( $t = -0.27$ ,  $p$ -value = 0.79), or Nonverbal Communication ( $t = -1.19$ ,  $p = 0.25$ ).

**Conclusions:** Findings indicate that the CARS-2 is sufficiently sensitive to individual differences in social/emotional behavior exhibited by young children with autism. Sex-based differences were identified in CARS2-ST Total Scores and social-communication subscales (Nonverbal Communication, Relating to People) in same-aged patients with comparable symptom severity. However, these differences were no longer significant when accounting for comorbid cognitive delays.

While significant sampling biases remain in the autism literature, this sample includes children with lower cognitive functioning, racial/ethnic diversity, and socioeconomic diversity, all of which theoretically shape the development of social communication skills in early childhood. Methodologically, this study also contributes to the field by using matched pairs to account for some of the substantial heterogeneity in autism. Further analyses using psychometrically and demographically matched pairs in a larger sample may provide additional insights into sex-based differences associated with autism during early childhood, which may explain some of the underdetection of autism in young girls.

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**Keywords:** autism spectrum disorder, test validity, intellectual functioning

**A. FAERMAN, A. SAKALLAH, S. KANSARA, B. KOPALD, J. D. LEWINE, C. DEMOPOULOS. Language Ability Predicts Both Verbal and Nonverbal Intelligence in Children with Autism Spectrum Disorder.**

**Objective:** Intellectual ability is often used to describe level of functioning in individuals with Autism Spectrum Disorder (ASD). Language deficits are highly prevalent among individuals with ASD and may impact performance on measures of general intellectual ability. As such, nonverbal IQ is often used to classify intelligence of those with language impairment and ASD; however, the relationship between expressive and receptive language abilities and performance

on verbal and nonverbal measures of intellectual abilities is not well characterized. Thus, we tested the relationship between language abilities and intellectual functioning in children and adolescents with ASD and neurotypical peers.

**Participants and Methods:** Participants were 77 children and adolescents, ages 5-18, who underwent a neuropsychological evaluation as part of a study examining language functioning in ASD. Autism diagnosis was made according to DSM-IV-TR criteria for autistic disorder, Asperger's syndrome, or pervasive developmental disorder not otherwise specified, supported by data from the ADI-R and ADOS. Language abilities were assessed on the Clinical Evaluation of Language Fundamentals-4<sup>th</sup> Edition (CELF-4). General intellectual abilities were assessed via the Wechsler Intelligence Scale for Children-4<sup>th</sup> Edition (WISC-IV) and nonverbal intelligence was assessed via the Leiter International Performance Scale-Revised (Leiter-R). Linear regression analyses were performed to examine relationships between CELF-4 Expressive and Receptive Language Index scores as predictors and each of the age-scaled Full Scale Intelligence Quotients (FSIQ) on WISC-IV and Leiter-R as dependent variables.

**Results:** Receptive and Expressive language indices significantly predicted WISC-IV FSIQ score in the ASD group ( $R^2 = .806$ ,  $F(2, 53)$   $F(2,53) = 110.261$ ,  $p < .001$ ; see Figure 2), with both CELF scores as significant predictors (Receptive:  $\beta = .599$ ,  $t(53)$   $t(53) = 4.575$ ,  $p < .001$ ; Expressive:  $\beta = .323$ ,  $t(53)$   $t(53) = 2.465$ ,  $p = .017$ ). The model also predicted the Leiter FSIQ score ( $R^2 = .483$ ,  $F(2, 23)$   $F(2,23) = 10.756$ ,  $p = .001$ ), with CELF Receptive Language Index score as the sole significant predictor (Receptive:  $\beta = .837$ ,  $t(23)$   $t(23) = 2.709$ ,  $p = .013$ ; Expressive:  $\beta = -.167$ ,  $t(23)$   $t(23) = -.541$ ,  $p = .594$ ). In controls, similarly to the ASD group, the regression model significantly predicted, although explained a smaller portion of the variance in the WISC-IV FSIQ score ( $R^2 = .569$ ,  $F(2, 14)$   $F(2,14) = 9.235$ ,  $p = .003$ ) with Receptive language score as the sole significant predictor (Receptive:  $\beta = .494$ ,  $t(14)$   $t(14) = 2.343$ ,  $p = .034$ ; Expressive:  $\beta = .359$ ,  $t(14)$   $t(14) = 1.705$ ,  $p = .110$ ). Receptive and expressive language did not significantly predict the Leiter FSIQ score significantly in the control group ( $p = .136$ ).

**Conclusions:** These findings indicate that assessment of both verbal and nonverbal intelligence testing may be strongly impacted by language abilities in children and adolescents with ASD, suggesting that assessment of language abilities is important in interpreting results of intelligence testing in this population and potentially other populations at risk for language impairment.

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**Keywords:** autism spectrum disorder, intelligence, language

## R. NG. Distress Tolerance and Behavioral Functioning in Youth with ADHD, ASD, ADHD+ASD and Intellectual Disability: Mediating Role of Family Stress.

**Objective:** Low distress tolerance has been associated with elevated autism spectrum disorder (ASD) symptomatology, including sensory sensitivity, sensory motor behaviors, and restricted/repetitive behaviors, and self injurious behaviors. Prior studies have also implicated elevated parenting stress and reduced distress tolerance among caregivers of children with ASD, ADHD and intellectual disability (ID). However, it remains unclear the role caregiver burden and family dysfunction plays in the relationship between affective-regulation skills and behavioral functioning among youth with these neurodevelopmental disorders. Notably, these

populations are associated with higher rate of sensory processing problems and psychopathology, thus, identifying the mechanisms in which family and individual factors elevate risk for dysregulated behaviors will be important for targeted interventions. As such, this study aimed to provide a preliminary assessment of the associations between caregiving stress, distress tolerance, and internalizing and externalizing behaviors among youth with ASD, ADHD, ASD+ADHD, and intellectual disability, while controlling for intellectual functioning and age.

**Participants and Methods:** Data from a total of 944 children evaluated through the Healthy Brain Network were included. Of these, 698 were youth with ADHD, 45 with ASD, 182 with ASD+ADHD and 19 with intellectual disability alone. Caregivers completed the Child Behavior Checklist (CBCL) and Parenting Stress Index. Child participants completed the Distress Tolerance Scale to assess their perceived ability to manage stress, and a Wechsler test (WAIS-IV, WISC-IV/V, WASI-II) or Kaufman Brief Intelligence Test 2<sup>nd</sup> Edition (KBIT-2) to estimate intellectual functioning. Caregiver and self-report inventories were scored such that higher scores reflected greater problems within the domain.

**Results:** Multiple regression analyses were conducted to assess associations between parenting stress, distress tolerance, and behavioral functioning across groups. Greater caregiving stress, but not distress intolerance, was associated with elevated internalizing and externalizing behaviors among those with ASD. In contrast, caregiver stress generally demonstrated a mediating effect between the tolerance for distress and behavioral functioning in the ADHD group. Among the comorbid ASD+ADHD group, caregiving stress similarly mediated distress tolerance and internalizing problems; however, caregiving burden, but not distress tolerance, was associated with externalizing behaviors. Finally, those with ID showed differing correlates for internalizing as opposed to externalizing behaviors, with caregiving stress as the primary determinant for the former variable and distress tolerance as the main predictor for the latter outcome factor.

**Conclusions:** Distress intolerance and caregiving stress are associated with psychosocial functioning problems across youth with ADHD, ASD, ASD+ADHD and intellectual disability, albeit in different patterns. Findings highlight the importance of integrating family- and individual-focused interventions to reduce risk for developmental psychopathology and behavior dysregulation across youth with these neurodevelopmental disorders.

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**Keywords:** autism spectrum disorder, attention deficit hyperactivity disorder, intellectual disability

**J. SMITH, R. C. HANDSMAN, A. VERBALIS, A. C. ARMOUR, E. BURLINSON, A. RATO, K. K. HARDY, B. ANTHONY, L. ANTHONY, L. KENWORTHY. Caregiver Strain & Profiles of Executive Functioning (EF) in ASD and ADHD.**

**Objective:** ADHD and ASD are both neurodevelopmental disorders that include deficits in executive functioning (EF). Both have been associated with increased caregiver strain/stress, which may be related to EF deficits. The present study aims to better understand the relationship between specific EF profiles and strain in caregivers of children with ADHD and ASD.

**Participants and Methods:** Participants included caregivers ( $N = 169$ ) of children with ASD ( $n = 120$ ) and ADHD ( $n = 49$ ) from two intervention studies. Only baseline data was used for this study. Caregivers were majority female (90.5%); caregiver age, race and ethnicity were not available. Caregivers' children were between the ages of 8 and 12 ( $M = 9.77$ ) with FSIQ  $\geq 70$ , had a research diagnosis of either ADHD or ASD, and had teacher/caregiver-reported flexibility

problems. Caregiver strain was assessed through the Caregiver Strain Questionnaire-Short Form 7, a 7-item questionnaire assessing child-related caregiver strain through a 6-point Likert scale; higher composite scores indicate greater strain (CSQ-SF7; Brannan, Athay, & de Andrade, 2012). Caregivers reported their child's observed EF through the Behavior Rating Inventory of Executive Function (BRIEF-2; Gioia et al., 2015), which includes three indexes (behavioral (BRI), emotional (ERI), cognitive (CRI) regulation). Pearson Correlations were used to evaluate the relationship between caregiver strain and indexes of EF, followed by linear regression to further understand this relationship, controlling for child's age, IQ and diagnosis, as well as family income.

**Results:** Results indicated that parent-reported child EF problems across all three BRIEF-2 indexes (behavioral, emotional, cognitive) were significantly correlated with parent-reported caregiver strain (all  $r$ 's between .387-.543, all  $p$ 's < .01). None of the EF indices nor caregiver strain were correlated with child IQ. To test whether specific EF profiles predicted strain, a regression analysis was used. Caregiver income was trending towards significance in the regression model, ( $B = .109$ ,  $t(169) = 1.659$ ,  $p < .1$ ). In addition, after controlling for child age, IQ, and diagnosis, results indicated that ERI, but not BRI and CRI, was a significant predictor of caregiver strain ( $B = .463$ ,  $t(169) = 5.371$ ,  $p < .001$ ).

**Conclusions:** We found caregiver-reported emotion regulation problems in their children related to caregiver strain, even after controlling for family income, child age, diagnosis, and IQ. This relationship was specific, as parent-reported behavior and cognitive regulation problems did not predict parent strain after controlling for the demographic variables and accounting for the influence of ERI. The ERI taps a child's ability to regulate their emotional response and their flexibility, or adjust to changes in environment/demands. These findings suggest that interventions focusing on child emotion dysregulation and inflexibility may also effectively reduce caregiver strain. Our study only used parent-report measures, so future research should investigate this relationship with two different types of measure. Future studies should also look further into the relationship between specific EF profiles and caregiver strain in a larger sample of caregivers with children who have ADHD and/or ASD, as well as further explore the result of caregiver strain following child EF treatment.

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**Keywords:** executive functions, autism spectrum disorder, caregiver burden

**A. SRIDHAR, A. LINKE, R. MÜLLER, R. J. KEEHN, K. ALEMU, M. WILKINSON, M. A. OLSON, K. MARINKOVIC. Changes in Neural Network Connectivity Across Brain States in ASD.**

**Objective:** Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder associated with impaired sociocommunicative functioning. Although no longer a diagnostic criterion, language delay is a common first symptom in ASD, with >30% of individuals remaining minimally verbal. While some studies have investigated brain activation or functional connectivity (FC) of language networks in ASD, it remains unknown how atypical language processing relates to changes in network connectivity from resting state to task state, referred to as FC reconfiguration. Reconfiguration reflects changes in resting FC (intrinsic network architecture) required during domain-specific processing. Lower reconfiguration may therefore be an index of optimized intrinsic network architecture. Thus, FC reconfiguration may serve as a measure to investigate inefficient network organization in clinical disorders.

**Participants and Methods:** We used functional magnetic resonance imaging (fMRI) to examine FC reconfiguration between resting state and a lexical decision task in 30 adolescents with ASD (mean age 15.8 years, 8 female, 2 left-handed) and 23 typically developing (TD) peers (mean age 15.2 years, 8 female, 3 left-handed). Groups did not differ on age, motion in the scanner and non-verbal IQ. The lexical decision task involved differentiating between frequent (non-animal) standard words, animal words, and pseudowords. Brain areas supporting sensory (visual), language, and executive processing were selected as regions of interest (ROIs), based on previous studies using similar lexical decision tasks in independent samples. Non-parametric Ranksum tests were used to identify differences between ASD and TD groups in the distributions of resting and task state FCs (across all ROI pairings). In addition, FC patterns across ROIs were compared between participants within each group to assess FC variability. Lastly, groups were compared with respect to the distribution of correlations between absolute reconfiguration FC and behavioral measures using Ranksum tests.

**Results:** While distributions of resting FCs did not differ between groups, distributions of task FC were more positive in the ASD group. FC patterns were less similar between ASD participants, compared to TD participants, during rest but not during the task. In addition, correlations of reconfiguration FC with task performance and language skills showed differences in overall distribution, being more positive in the ASD compared to the TD group.

**Conclusions:** Broadly stronger task (but not resting) state FC in ASD compared to TD participants may reflect greater neural effort needed to perform the lexical decision task. Furthermore, reduced similarity at rest in ASD indicates greater variability of intrinsic network architecture, with some ASD participants showing 'idiosyncratic' resting FC patterns (i.e., patterns that are not only atypical, but also highly different from those seen in other ASD participants). Finally, links between reconfiguration FC and language abilities (including task performance) were more positive in the ASD compared with the TD group, indicating that greater reconfiguration may be associated with better language abilities in ASD. Overall, the findings are compatible with the hypothesis that intrinsic network architecture is less optimized in ASD than in TD peers, with enhanced neural effort required to adapt quickly and efficiently to new cognitively-demanding tasks.

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**Keywords:** autism spectrum disorder, neuroimaging: functional connectivity, language

**R. C. HANDSMAN, J. SMITH, A. VERBALIS, A. C. ARMOUR, E. BURLINSON, D. CHILDRESS, L. ANTHONY, L. KENWORTHY. Improvement in Executive Functioning & Reduced Caregiver Strain in Autistic Children.**

**Objectives:** Executive function (EF) is broadly impaired in autistic children. Caregivers of autistic children also have reported higher levels of stress. Research has shown that this increased stress is related to greater EF deficits in autistic children. In this study we aimed to investigate the relationship of EF and child-related caregiver strain (CS) in the context of a caregiver-training intervention trial.

**Participants and Methods:** Participants included 96 caregivers of autistic children. 93% of caregivers were female, they had between 12 and 21 years of education ( $M=16.9$ ,  $SD=2.1$ ), and 21% identified as non-white. All participants had a child between 8 and 12 years old ( $M=9.8$ ,  $SD=1.5$ ) with FSIQ  $\geq 70$  ( $M=104.4$ ,  $SD=17.1$ ), who met DSM-5 criteria for autism, supported by the ADOS/ADOS-2. Caregiver strain was assessed through the use of the Caregiver Strain

Questionnaire-Short Form 7 (CSQ-SF7; Brannan, Athay, & de Andrade, 2012). The CSQ-SF7 is a 7-item questionnaire assessing child-related caregiver strain measured on a Likert scale ranging from “not at all” to “very much”, 0-5 respectively. Caregivers reported on their child’s EF problems with the Behavior Rating Inventory of Executive Function (BRIEF-2), which provides a standardized score measuring global EF impairments (Global Executive Composite - GEC). Caregiver-trainings utilized concepts from *Unstuck and On Target!*, a cognitive-behavioral intervention aimed at improving EF skills in autistic children and were delivered either in person (n=50) or through an online platform (n=46). ANCOVAs determined if there were any differences in outcomes between caregivers trained in person and those trained online. Multiple regressions identified baseline relationships between parent CS and child EF problems. Next, a paired-samples t-test examined the change in CS and EF as a result of the caregiver trainings. Finally, multiple regressions were calculated to examine the relationship between change in CS and change in EF.

**Results:** No significant differences were found between caregivers trained in person and those trained online either in change in child EF ( $F_{(1,82)}=.079, p>.05$ ) or change in caregiver strain ( $F_{(1,82)}=.342, p>.05$ ) when controlling for child IQ and caregiver education. Baseline EF scores were significant predictors of CS at baseline ( $B=.461, P<.01$ ) above and beyond child IQ and caregiver education. As a result of the caregiver-training sessions child EF skills improved ( $t(84)=3.88, p<.01$ ) and CS was reduced ( $t(86)=6.15, p<.01$ ). Finally, following caregiver training, improvement in EF skills was a significant predictor of reduction in caregiver CS ( $B=.322, p<.01$ ) above and beyond child IQ and caregiver education.

**Conclusions:** Caregiver strain has been shown to be correlated with their children’s EF problems. We extended this relationship by showing that as caregivers receive training on how to improve their child’s EF skills, both reported EF skills improve and strain declines. Additionally, it was found that improvement in child’s EF is a strong predictor of reductions in CS, after controlling for caregiver education and child IQ. This highlights the idea that EF skills may be a key intervention target to help reduce child-related strain in caregivers of autistic children. Future research should investigate this relationship using objective laboratory-based tasks.

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**Keywords:** autism spectrum disorder, executive functions, neuropsychological outcome

### **A. CAMODECA, K. WALCOTT. Intact Emotion Fluency Abilities in Children with Autism Spectrum Disorders.**

**Objective.** This study investigated performance on the Emotion Word Fluency Test (EWFT) in children with Autism Spectrum Disorders (ASD). Executive function, particularly verbal fluency, is frequently investigated in ASD. However, these studies have typically included only the “animals” category cue (Animal Fluency Test; AFT). There is evidence that performance for particular verbal fluency categories (e.g., action words) is impaired in some disorders (i.e., Parkinsons Disease). As children with ASD consistently demonstrate weaknesses in emotional understanding and interpretation, it is possible that the fluency category of “emotions” would be associated with poorer performance in those with ASD vis-à-vis controls, children with other disabilities, and/or their own performance compared to the animals cue.

**Participants & Methods.** Participants included a sample of 113 community controls recruited from a university summer camp population ( $X_{age}=10.43$  years;  $SD=2.50$ ) and a clinical group of 115 outpatient child referrals. The clinical group was classified as ASD ( $n=38, X_{age}=11.11$

years;  $SD=3.82$ ); ADHD ( $n=86$ ,  $X_{age}=9.90$  years;  $SD=3.00$ ), and Other Diagnoses ( $n=31$ ,  $X_{age}=9.16$  years;  $SD=3.36$ ) based on results of a comprehensive assessment that included the Autism Diagnostic Observation Schedule 2<sup>nd</sup> Edition when ASD diagnosis was under investigation. Children with ADHD were classified as a separate comparison group due to their social deficits that exist without the core symptoms of ASD. The community controls were administered the EWFT only during a break in their summer camp program. The clinical group was administered both the EWFT and AFT by the examiner as part of their assessment. The EWFT and AFT were randomly counterbalanced to avoid order effects. Total correct words were the variables of interest on each of these tests.

**Results.** In the clinical group, a repeated measures ANCOVA (controlling for age) indicated a main effect of semantic category, wherein all children generated more correct words for the AFT compared to the EWFT,  $F(1, 151)=295.24$ ,  $p<.001$ . However, there was no main effect of diagnostic group,  $F(2, 151)=0.65$ ,  $p=.52$ , and there was no interaction between semantic category and diagnostic group performance  $F(2, 151)=.527$ ,  $p=.59$ . Comparison of all diagnostic groups with community controls regarding the EWFT also indicated no between-group differences,  $F(3, 263)=1.92$ ,  $p=.13$ .

**Conclusions.** Children with ASD did not demonstrate comparative weaknesses regarding their EWFT performance compared to other clinical groups and controls. They also did not demonstrate worse performance on the EWFT vs the AFT in ipsative comparisons. These findings suggest intact emotion lexicon access within a time limit for those with ASD. Research suggests high-functioning children with ASD demonstrate intact emotion recognition skills but have difficulty with interpretation of others' intentions. It is likely the EWFT does not draw upon the higher-level social-cognitive weaknesses observed in ASD. Further research regarding qualitative aspects of performance, such as strategy use, may be beneficial.

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**Keywords:** autism spectrum disorder, emotional processes, verbal abilities

### **W. HUANG, N. GUO. Mind-PEACE Neuropsychological Intervention for Autism Spectrum Disorder: A Case Report.**

**Objective:** The 2019 coronavirus disease (COVID-19) can result in higher levels of psychological distress, especially children and adolescents with Autism Spectrum Disorder (ASD), because they have deficits in executive function (EF), it is difficult for ASD to adapt to unexpected and complicated changes. Because to prevent COVID-19, we make many adjustments in our daily lives, therefore we must develop a program with new routines to help ASD understand this issue. This report aims to discuss the Mind-PEACE with ASD patients and develop effective intervention programs for clinical application.

**Participants and Methods:** Mind-PEACE is a 5-steps neuropsychological strategies, includes play game, enhance the safety, accept emotion, change the behavior and engage in life. Mind-PEACE intervention targets at ecological, cognitive, emotional, behavioral, flexibility and interact cold and hot executive function (EF). Two ASD patients were 9 and 10-year-old male, they had different cognition ability, one's intelligence quotient (IQ) was low- average, the other was very superior, all of them had basic language expression. They referred to clinical psychologist were poor social skills, parent-child conflict impulsive, restricted behavior, and high anxiety. The 9-year-old ASD, pre-intervention results showed high anxiety, more restricted behavior such as drawing a street map and poor daily life. The 10-year-old ASD, his pre-

intervention results showed his advantage is hand-made and computer operation, but he had high anxiety, low emotional regulation, frustration tolerance and cognitive flexibility. According to their self-evaluate, they were anxiety about the COVID-19 and family's health. Because their severity of symptoms and cognition ability were different, therefore the Mind-Peace interventions applications were different. For low-average IQ ASD, he needed to gradually assist him in understanding this strategies and establishing of conceptual, and followed the five-steps operation can help him build a new routines. For very-superior IQ ASD, used the step-by-step strategies, he felt boring and difficult to change his behavior. And he need to familiarize strategies, learned conceptualize, and then generalized it into life.

**Results:** After 2 sessions of Mind-PEACE intervention, the patient's anxiety about the COVID-19 were decreased. Two weeks follow-up, the low-average IQ ASD whose parents reported his restricted behaviors decreased and daily life functions improved. The other whose parents reported his cognitive flexibility and problem-solving skills increased. In addition, the very-superior IQ ASD used the computer to produce health education propaganda for COVID-19.

**Conclusion:** The impact of the COVID-19 on ASD individuals, may make them feel scared and worried, and affected their inability to properly regulate their emotions and daily life adaptation. Even if the same Mind-PEACE intervention is operated, a step by step intervention program is effective for patients with high and low functions, but the clinical application is different. ASD with low-average IQ used new strategies to increase the face of COVID-19, so that he could build a sense of security, while ASD with very-superior IQ reached him to apply and generalize Mind-PEACE to life, increased his self-efficacy.

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**Keywords:** cognitive rehabilitation, self-monitoring, generalization

### **E. RIGGALL, R. SEVCIK, L. BRANUM-MARTIN, V. DOTSON, R. D. MORRIS. Verbal Learning and Memory Factor Structure and Text Reading in Children with Developmental Dyslexia.**

**Objective:** Verbal learning and memory abilities support development of core language and academic skills, particularly reading (e.g., Kibby, 2009; Perez, Majerus, & Poncelet, 2012; Pham & Hasson, 2014; Roch, Florit, & Levorato, 2012). The California Verbal Learning Test, Children's Version (CVLT-C) is one of the most commonly used measures of verbal learning and memory among children (Delis, Kramer, Kaplan, & Ober, 1994). The CVLT-C's internal latent structure has been confirmed in the standardization sample and in many clinical groups (e.g., Carlew et al., 2018; Dejong & Donders, 2009; Griffiths et al., 2006), but remains unexamined among children with Developmental Dyslexia (DD). This is despite a well-documented pattern of verbal learning and memory deficits in this population (Kramer, Knee, & Delis, 2000; Oyler, Obrzut, & Asbjornsen, 2012).

**Participants and Methods:** This study investigated the internal structure of the CVLT-C in a sample of 155 elementary school children with DD (age 8-11 years,  $M=9.23$ ,  $SD=0.67$ ) using confirmatory and exploratory factor analyses (CFA and EFA). It also explored the relationship between verbal learning and memory abilities and functional reading outcomes as measured by the Standardized Reading Inventory, Second Edition (SRI-2) in these children with DD.

**Results:** Results did not confirm any of the previously proposed models of CVLT-C factor structure. While EFA did not reveal an adequate alternative model, discrepancies between the best-fitting 3-factor model from the EFA and the previously proposed models provide insights into potential differences in verbal learning and memory strategies and performance patterns within this population. Correlational analyses highlighted a significant relationship between aspects of verbal learning and memory performance on the CVLT-C and SRI-2 passage comprehension, while SRI-2 word reading accuracy was not significantly related.

**Conclusions:** Present findings underscore the importance of understanding the internal structure of the CVLT-C within this vulnerable and prevalent population. This is particularly important given the functional implications for interpreting the CVLT-C results and understanding the academic impacts of a child's verbal learning and memory profile.

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**Keywords:** reading disorders, memory: normal, neuropsychological assessment

### **T. I. THOMAS, M. V. PERDUE, F. HOEFT, N. LANDI. Semaphorin 6D and Reading: An Imaging Genetics Study.**

**Objective:** Specific reading disability (SRD) has diverse genetic and environmental causes that are not fully understood. Using integrative imaging genetics methodology to investigate the relationships between genetic influences, brain structure, and reading measures can help to increase our understanding of SRD risk and improve early identification. One candidate gene that has not been previously investigated in relation to SRD, but is on SRD risk locus DYX1, is *Semaphorin 6D (SEMA6D)*, involved in axon guidance, synapse formation, and regulation of dendrite development and associated with language impairment and autism spectrum disorder.

**Participants and Methods:** *SEMA6D*'s associations with brain structure and reading were investigated in a sample of typically developing children collected from two different sites, in Connecticut (n=67, 6-13 years, mean age=9.07) and San Francisco (n=28, 5-8 years, mean age = 6.5). Multiple regression analyses were used to determine associations between SNPs in *SEMA6D* and measures of cortical thickness, gyrification, and white matter volume, which were in turn associated with measures of reading. **Results:** Significant associations were found between SNPs and neural measures, including rs16959669 and cortical thickness in the fusiform gyrus and rs4270119 and gyrification in the supramarginal gyrus in the Connecticut sample, but this was not replicated in the San Francisco sample and not significantly associated with reading. Across the entire sample collected from both sites, white matter volume in the left transverse temporal gyrus was significantly associated with reading, and nominally related to rs1817178, rs12050859, and rs1898110 in *SEMA6D*, and rs1817178 was significantly related to reading.

**Conclusions:** As the sample was young, structure in the transverse temporal gyrus, involved in auditory perception, may be more strongly involved in reading because phonological processing is still being learned and used (as opposed to more fluent reading). Overall, results suggest *SEMA6D* likely has an impact on neural structures involved in reading, but more research should be done with additional brain measures and using an older age range to better understand effects.

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**Keywords:** neuroimaging: structural, genetics, reading disorders

**A. FARRELL, A. GIOIA, A. MILLER, M. BARNES, G. ROBERTS, P. CAPPELLI, P. T. CIRINO. Mind Wandering and Reading in Middle School.**

**Objective:** Mind wandering (MW), or shifting focus from a task to internal information unrelated to the task (Smallwood & Schooler, 2006), is particularly relevant to understanding academic achievement and has recently become an interest of scientific investigation (Murray, Krasich, & Seli, 2020). However, most existing research on MW focuses on older student populations and it is unclear how findings may generalize to younger students. The aim of this study is to evaluate MW measured in three ways and determine its relation to reading in middle school students. We expect that task-based retrospective reporting (TBRR) and probe-caught MW (PCMW) will relate to reading to a greater degree than trait MW (TMW).

**Participants and Methods:** Fifty-one 6<sup>th</sup> grade students with a mean age of 12.1 (0.39) participated in this study. The majority were male ( $n=31$ , 60.78%) and classified as economically disadvantaged ( $n=50$ , 98.04%). Nearly all of the sample identified as Hispanic ( $n=47$ ) and 64.71% ( $n=33$ ) were currently or previously classified as having limited English proficiency. Students were administered a TMW questionnaire, questions probing for MW administered during the reading measures (PCMW), and a TBRR questionnaire administered immediately following the reading measures. Student were also administered reading measures: Letter Word Recognition, Word Recognition Fluency, and Reading Comprehension from the Kaufman-Tests of Educational Achievement-3 (KTEA-3; Kaufman & Kaufman, 2014) and a separate passage-based reading comprehension measure. Hypotheses were addressed via correlations and multiple regression.

**Results:** The three MW measures were related to reading measures to varying degrees. PCMW exhibited the highest correlation across all measures (Letter Word Recognition:  $r = 0.54$ ,  $p < 0.001$ ; Word Recognition Fluency:  $r = 0.56$ ,  $p < 0.001$ ; KTEA-3 Reading Comprehension:  $r = 0.46$ ,  $p < 0.001$ ; passage-based reading comprehension:  $r = 0.32$ ,  $p = 0.02$ ). Correlations of TBRR with reading were somewhat lower (median  $r = .31$ , all  $p < .05$ ), and TMW exhibited the weakest correlation to reading (median  $r = .13$ , all  $p > .05$ ). Together, the MW measures, phonological awareness, and gender (the latter two as covariates) accounted for a substantial portion of variance across reading outcomes ( $R^2 = 36\%$  to  $61\%$ ). PCMW, but not TMW or TBRR, was a unique predictor for both single word reading ( $p = .029$ ) and reading fluency ( $p = .015$ ). However, the MW measures were not uniquely predictive of reading comprehension ( $p > .05$ ), likely due to shared variance with the covariates.

**Conclusions:** These results generally support our hypotheses, refine our understanding of the role of MW in reading, and extend patterns found in adults to younger students. Results also provide direction for informing intervention targets to ameliorate the impact of MW on reading. Future work can be expanded to inform other achievement outcomes, such as math.

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**Keywords:** academic achievement, reading (normal), attention

**H. WAKEMAN, D. R. LEOPOLD, L. M. MCGRATH, R. K. OLSON, E. G. WILLCUTT. Modeling the Speeded Determinants of Adolescents' Academic and Attentional Functioning.**

**Objective.** Reading disability (RD), math disability (MD), and attention-deficit/hyperactivity disorder (ADHD) are common neurodevelopmental disorders with high rates of co-occurrence. However, despite the well-documented comorbidity between RD, MD, and ADHD, there are still

relatively few studies examining shared cognitive risk factors. Although several studies have identified processing speed (PS) as a potential shared cognitive predictor, the literature is sparse and results have varied by study. Further, the field still lacks a strong consensus around the measurement of PS, with previous studies using both verbal and non-verbal measures that varied from little or no executive component to a large working memory load. Thus, more work is needed to better understand PS as a construct and its role in the comorbidity between learning disorders. This study uses Structural Equation Modeling (SEM) to examine the relationship between PS, rapid naming (RN), reading, math, and symptom dimensions of ADHD (inattention and hyperactivity/impulsivity). The current findings extend the literature by clarifying the relation between the constructs of PS and RN, and by examining the relationship between PS and RN and multiple aspects of academic skills (e.g., basic, complex, and fluency measures) as well as multiple symptom dimensions of ADHD (i.e., inattention vs. hyperactivity/impulsivity).

**Participants and Methods.** Participants were 930 adolescents ( $M_{age}=15.5$  years) who were assessed as part of a larger twin study. Participants completed a battery of standardized measures of different components of academic achievement (e.g., single word reading, reading comprehension, and reading fluency), as well as multiple measures of PS and RN. ADHD symptoms were measured by parent or caregiver report. SEM was used to perform exploratory and confirmatory factor analyses (EFAs and CFAs) of both the endogenous and exogenous latent traits. Once the best-fitting overall measurement model was identified, a full structural model was then estimated in which latent reading, math, fluency, inattention, and hyperactivity/impulsivity were simultaneously regressed onto latent PS and RN.

**Results.** Results indicated that the best fitting model included correlated but distinguishable latent measures of PS, RN, reading, math, inattention, hyperactivity/impulsivity, as well as an additional latent factor representing “fluency,” perhaps more aptly thought of as “haste/rushing” on academic tasks. Additionally, results indicated that PS was a shared cognitive predictor across all the outcome measures, while RN was uniquely associated with reading and fluency (and weakly with math).

**Conclusions.** Results provide further evidence that PS is a key shared cognitive weakness across dimensions of reading, math, inattention, and hyperactivity. Further, this association is similar for multiple aspects of academic skills (e.g., basic, complex, and fluency measures). Future studies will be critical to examine the overlap between these academic and symptom domains in models that include additional cognitive predictors, as well as study designs that allow more insight into potential causality and neural correlates.

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**Keywords:** learning disabilities, attention deficit hyperactivity disorder, cognitive processing

### **A. GIOIA, Y. AHMED, S. P. WOODS, P. T. CIRINO. The Assessment of Writing, Self-Monitoring, and Reading (AWSM Reader) and its Relationship with Executive Function.**

**Objective:** Extant literature measuring academic outcomes in school-aged children indicates a significant overlap in the domains of writing and reading. Evaluating similarities and differences in the cognitive predictors of both domains simultaneously can help inform the way each are addressed, particularly for struggling students. Executive function (EF) has been implicated at both empirical and theoretical levels for both domains, though less is known regarding its joint relation to reading and writing. In this study, we focus on a novel measure that directly evaluates both reading comprehension and writing. We expect sufficient psychometric properties, and

expect the reading and writing portions to relate to one another and more established measures, with EF accounting for substantial variance between the two domains.

**Participants and Methods:** Participants consisted of 377 3<sup>rd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> graders who enrolled in this study and were categorized as struggling readers. The Assessment of Writing, Self-Monitoring, and Reading (AWSMR) was created for this study to more efficiently measure reading comprehension (RC) and writing (Key Words [KW] and Ideas Expressed [IE]) within the same topics. The Gates MacGinitie Reading Test (MacGinitie et al., 2000) and Test of Written Language (TOWL; Hammill & Larsen, 2009) were included for convergent validity purposes. The NIH Examiner (Kramer et al., 2014) was used to measure EF. Age, gender, race, socioeconomic status (SES), and language (Verbal Knowledge of the KBIT-2; Kaufman & Kaufman, 2004) were included as covariates. Hypotheses were addressed through computations of Cronbach's alpha, correlations, multiple regression, and partial correlation analyses.

**Results:** Reliability was  $\alpha=0.58$  for the AWSMR RC,  $\alpha=0.80$  for the AWSMR KW, and  $\alpha=0.75$  for the AWSMR IE. The AWSMR validity for reading (against the Gates MacGinitie) was  $r = 0.48$ ,  $p < .001$ , and for writing (against the TOWL) was  $r = 0.52$ ,  $p < .001$ . Correlation between the AWSMR RC with the AWSMR KW and AWSMR IE were  $r = 0.56$  and  $r = 0.51$  (both  $p < .001$ ), respectively. EF was a unique predictor of AWSMR RC ( $R^2\Delta = 2.4\%$ ,  $p = .004$ ), as well as AWSMR KW ( $R^2\Delta = 2.1\%$ ,  $p = .007$ ) and AWSMR IE ( $R^2\Delta = 1.2\%$ ,  $p = .047$ ), over covariates. However, partialing both language and EF, the AWSMR RC still had significant correlations with both AWSMR KW and AWSMR IE,  $r = 0.51$  and  $r = 0.46$  (both  $p < .001$ ), respectively.

**Conclusions:** Results were mixed. The AWSMR RC had lower than desirable reliability, although AWSMR writing portions were higher, and most correlations within and across domains were as hypothesized, in direction if not always to the extent expected. While EF (and language) each related to all aspects of the AWSMR, even together, they did not account for the relation between the domains. The results stress the difficulty in constructing combined reading and writing measures, but give direction for how this might be accomplished. Results also highlight the need to consider additional sources for the overlap among reading and writing, beyond EF.

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**Keywords:** academic achievement, executive functions

### **A. WARD, P. VUIJK, G. FORCHELLI, A. DEWS, A. DOYLE, E. BRAATEN. The Impact of Slow Processing on Reading Skills Among Child Psychiatric Outpatients.**

**Objective:** Slow processing speed (PS) is well-documented in ADHD, and our group recently showed that PS is relevant to other psychiatric disorders and academic achievement in children. The relationship between academics and PS has been attributed to poorer academic fluency and deficits in foundational reading skills, but less is known about the relationship with higher order skills that are important for ultimate academic success such as reading comprehension (RC). We aimed to better understand the relationship between PS and RC using SEM to determine their association while accounting for potential mediating variables (i.e., working memory and word reading) and controlling for intellectual ability. Given prior literature, we hypothesized a direct effect of PS on RC, as well as an indirect effect through mediators. Finally, we also determined whether models linking slow PS and RC differ between youth with and without ADHD.

**Participants and Methods:** Participants were from the Longitudinal Study of Genetic Influences on Cognition (LOGIC), which recruits youth referred for neuropsychiatric evaluations. Subjects were outpatients ( $n = 703$ ) ages 7 to 17.

The Processing Speed Index (PSI), Working Memory Index (WMI) and General Ability Index (GAI) were from the WISC-IV/V or WAIS-IV. Measures of Reading Comprehension and Word Reading were from the WIAT-III.

SEM was used to investigate whether and how PS impacts RC by examining direct and indirect effects mediated by word reading and WM. This model was followed-up by examining differences in youth with and without ADHD. All models controlled for age, sex, psychotropic medication and GAI. Stata 14 and a critical value of .05 was used for all analyses.

**Results:** The SEM in the whole sample yielded significant direct effects for word reading ( $\beta=.45$ ,  $z=15.24$ ,  $p < .001$ ), WM ( $\beta=.22$ ,  $z=6.39$ ,  $p < .001$ ) on RC and a significant indirect effect of PS ( $\beta=.12$ ,  $z=5.02$ ,  $p < .001$ ) mediated by word reading and WM. In youth diagnosed with ADHD direct effects for word reading ( $\beta=.46$ ,  $z=11.40$ ,  $p < .001$ ), WM ( $\beta=.24$ ,  $z=5.48$ ,  $p < .001$ ) and a significant indirect effect of PS ( $\beta=.12$ ,  $z=3.91$ ,  $p < .001$ ) on RC. In youth without ADHD as partial mediation effect was found with a direct effect ( $\beta=.13$ ,  $z=2.37$ ,  $p = .018$ ) and an indirect effect ( $\beta=.13$ ,  $z=3.29$ ,  $p = .001$ ) of PS on RC.

**Conclusions:** Slow PS places youth at greater risk for negative outcomes and academic difficulties. While the literature demonstrates that weaknesses in foundational reading skills contribute to poor comprehension, studies have not modeled this relationship with other variables known to impact RC (particularly word reading, WM and GAI). After accounting for those variables, we found that slower PS contributes to weaknesses in RC. However, while a relationship between PS and RC emerged through mediators for all children and in children with ADHD, PS additionally had a direct impact on RC for those without ADHD. Although RC is not a timed task, our data suggest that RC may be negatively impacted in youth with slow PS, although the mechanism of the impact may vary by diagnostic status.

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**Keywords:** academic skills, attention deficit hyperactivity disorder, neuropsychological assessment

**S. BAJAJ, K. S. BLAIR, J. BASHFORD-LARGO, R. ZHANG, A. SCHWARTZ, M. DOBBERTIN, J. ELOWSKY, A. MATHUR, J. R. BLAIR. Association between Network-wise Morphometry and Irritability in Adolescents.**

**Objective.** Cortical function and structure of emotion-specific brain regions are associated with irritability and its associated emotions. A body of work has focused on the pathophysiology of irritability via task-based functional MRI. Rather less work has focused on the association between region-specific cortical structural alterations and irritability. Moreover, no previous work has examined potential alterations of pre-specified networks with respect to irritability in adolescents. The current study aims to determine the extent to which network-wise cortical volume (CV) of irritable adolescents differs from typically healthy adolescents and investigate the association between CV of identifiable networks and irritability. As an exploratory analysis, the current study will also explore whether general intelligence (IQ) plays a protective role against altered network-wise cortical structure and greater levels of irritability.

**Participants and Methods.** High-resolution structural MRI and IQ data were collected from 130 adolescents (mean age =  $15.46 \pm 2.23$  years, 58 females) with clinically significant levels of

irritability and 166 healthy adolescents (HCs; mean age = 13.97±2.45 years, 61 females). Subject specific network-wise CV was estimated after parcellating the whole-brain into 17 standard networks.

**Results.** The multivariate analysis showed significant group differences ( $p_{adjusted} < 0.05$ ) in CV of the control B network (CBN), default D network (DDN), and default B network (DBN); the irritable sample showed significantly lower CV than HCs. Networks mainly constituted the posterior cingulate cortex, inferior parietal cortex, and large proportion of the frontal and temporal cortices. Correlation analyses showed significant negative associations between CV of all the networks (CBN, DDN, and DBN) and irritability, and interestingly, the associations were moderated by IQ.

**Conclusions.** Findings suggest that, first, the networks involving regions responsible for emotional regulation may structurally differ between irritable and healthy adolescents, and identifiable differences are associated with irritability. Second, higher IQ may provide a protective influence against altered cortical volume and greater levels of irritability. The current findings enhance our fundamental understanding of cortical structure and irritability at the whole brain level with 17 brain networks as networks of interest as well as at varying levels of IQ. Further research is required to identify and quantify more factors which contribute to strengthen the association between cortical structure and irritability.

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**Keywords:** adolescence, child development disorders, brain structure

### **C. WHITFIELD, M. LOBERMEIER, R. MAAS, A. LUKOMSKI, J. BROOKS, R. LAJINESS-O'NEILL. Maternal Alcohol and Nicotine Consumption as Environmental Moderators in the Relationship Between Gestational Age and Social-Emotional/Communication/Cognitive Development in Infancy.**

**Objective:** During fetal development, the rapidly growing fetus is exposed to a multitude of environmental and biological risk factors. Teratogens, agents that may harm the development of a fetus, including alcohol and/or nicotine, may result in deficits in social, communication, and cognitive development (SCG) (Alwan & Chambers, 2015). Even with minimal consumption, in utero teratogen exposure may negatively impact the development of both term and pre-term infants and may pose a greater risk to pre-term infants (Georgieff, 2018). The present study examines how caregiver reported alcohol and nicotine consumption affects caregiver reported SCG development using a novel tool that allows for earlier identification of resulting developmental deficits, potentially leading to earlier intervention. We expect that alcohol and nicotine consumption will negatively impact all infants with a greater impact on pre-term infants.

**Participants and Methods:** This study assessed the effects of prenatal alcohol and nicotine consumption on caregiver reported SCG development in 531 pre-term (< 37 weeks gestation,  $M=32.85$ ,  $SD=3.14$ ;  $n=236$ ) and term ( $\geq 37$  weeks gestation,  $M=39.07$ ,  $SD=1.16$ ;  $n=295$ ) caregiver/infant dyads via PediaTrac™ v3.0, a web-based survey tool designed to track infant/toddler development (Lajiness-O'Neill et al., 2018). Data were collected longitudinally at newborn (NB), 2-, 4-, and 6-month time periods (age corrected for pre-term). Predictor (gestational age), moderator (reported nicotine and alcohol consumption), and outcome (SCG) variables were examined via the demographic, general medical, and SCG domains. Correlations were computed between alcohol/nicotine consumption, SCG development, and multiple

demographic variables. Moderation analyses were conducted to determine if alcohol or nicotine consumption were moderators in the relationship between gestational age and SCG development. **Results:** Caregiver reported alcohol consumption in the entire sample was negatively related to the SCG score at NB, 4, and 6 months ( $r = -.10, -.12, \text{ and } -.15$ , respectively,  $p < .05$ ), whereas nicotine consumption was positively related to the SCG score at 2-, 4- and 6-months ( $r = .10, .18, .11$ , respectively  $p < .05$ ). Maternal alcohol consumption was found to moderate the relationship between preterm/term status and SCG scores only at the NB ( $p < .001$ ) and 2-month periods ( $p < .001$ ), but in the opposite direction anticipated. At both periods, maternal alcohol consumption had a greater negative impact on SCG development in term infants compared to pre-term infants. Nicotine consumption did not moderate this relationship at any time period.

**Conclusions:** Prenatal maternal alcohol and nicotine consumption was shown to affect SCG development at certain periods based on caregiver report. Alcohol consumption differentially affected term infants, resulting in lower reported SCG development compared to pre-term infants. This finding in pre-term infants may be due to pre-existing health conditions having greater negative impacts on health resulting in teratogen consumption having minimal additional impact. Term infants may experience less negative health conditions, thus making the negative impacts of alcohol and nicotine consumption easier to detect. Caregiver expectations for infant development based on term/pre-term status may influence their reporting of the infant's SCG development. Education of the potential effects of prenatal teratogen consumption on development is important to potentially reduce consumption, thus reducing the likelihood of negative impacts on development.

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**Keywords:** in utero teratogen exposure, cognitive functioning, social cognition

### **B. C. BONDI, D. J. PEPLER, M. MOTZ, N. C. ANDREWS. Cumulative Risk, Protection, and Early Intervention: Neurodevelopment in Sibling Groups Exposed Prenatally to Substances.**

**Objective:** Prenatal substance exposure is associated with neurodevelopmental deficits that are exacerbated by cumulative risks, yet attenuated by cumulative protective factors. Risk that spans different domains presents heightened neurodevelopmental challenges. Early intervention is vital for optimal neurodevelopment as it capitalizes on neuroplasticity and can alter developmental trajectories; however, there has been minimal investigation into the effects of early intervention on neurodevelopment in substance-exposed infants and young children. We endeavored to 1) outline the longitudinal neurodevelopmental profile of substance-exposed sibling groups, 2) explore the balance between total and cross-domain cumulative risk and protection, and the impact on neurodevelopment, and 3) highlight the importance of early intervention on neurodevelopment.

**Participants and Methods:** This study was conducted at Mothercraft's Breaking the Cycle (BTC), an early intervention program for substance-exposed infants and young children. The study included three pediatric (aged 0-6 years) sibling groups with prenatal substance exposure: two sibling dyads and one sibling quadrad ( $N=8$ ). All sibling groups participated in programming at BTC for a minimum of 2.5 years, with neurodevelopmental assessments at multiple time points. We used cumulative risk and protection measures that were previously established at BTC, alongside mixed-method descriptions of cross-domain cumulative risk and protection to understand the context of risk and protection for the three sibling groups.

Neurodevelopmental data were obtained from annual BTC neurodevelopmental assessments. Social-emotional development was assessed using the Infant-Toddler Social Emotional Assessment or the Child Behavior Checklist (depending on child age). Cognitive development was assessed using the Bayley Scales of Infant and Toddler Development-Third Edition or the Wechsler Preschool and Primary Scale of Intelligence-Fourth Edition. The impact of early intervention was explored by examining age at entry into programming and proportion of lifetime in programming within and between sibling groups.

**Results:** Children demonstrated improvements in neurodevelopment across their time receiving services at BTC. Children with lower levels of clinically significant cumulative risk, alongside higher levels of clinically significant cumulative protection, showed fewer neurodevelopmental concerns. Certain domains of risk (i.e., birth/postnatal, child, parent-child interaction) and protection (i.e., family, parent-child interaction) had the greatest impact on neurodevelopment. Children who entered programming at a younger age (i.e., earlier intervention), thus spending a larger proportion of their life in programming, showed better neurodevelopment relative to those who entered programming at an older age.

**Conclusions:** The results suggest that the neurodevelopment of infants and young children prenatally exposed to substances is dependent on the balance between levels of cumulative risk and protection. This research indicates that domains of risk, specifically in the postnatal period, may pose the greatest harm to neurodevelopment. It also shows that domains of protection, specifically in relational environments, may pose the greatest benefit to neurodevelopment. Examining the variability within and between sibling groups highlighted the importance of early intervention 1) as soon as possible postnatally and 2) before age 3 years. This research has practice and policy implications for very early interventions for substance-exposed children. Early, individualized, and relationship-based interventions may improve neurodevelopment and developmental trajectories, thus reducing social and economic costs for society.

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**Keywords:** perinatal factors, substance abuse

### **C. DANDAR, A. M. MATTES, J. PIERCY, A. HEITZER, B. PETERS PAUL, C. LEE, J. KLARR, S. RAZ. Executive Functioning in Preterm-Born Preschoolers: Associations with Cognitive and Motor Skills.**

**Objective:** In typically developing children, language and motor abilities are associated with executive functions (EFs). Whereas language abilities may facilitate executive performance that requires verbal response, motor abilities likely facilitate executive performance that requires motor response. Nonetheless, discrete EFs have also been shown to share substantial common variance, though they are clearly separable. Preterm-born (PT) children are more likely to exhibit cognitive and motor deficits compared to term-born children. Thus, examination of the relationships between language, motor, and discrete executive skills in this high-risk population may provide an opportunity to gain further insight into the development and degree of interdependence between these fundamental abilities. We tested the hypothesis that in PT preschoolers, executive task performance is more closely linked to skills underlying the required response modality (language vs. motor output) than to executive skills that require a different output modality for task performance.

**Participants and Methods:** Motor inhibition and verbal fluency, two different executive functions, were assessed in 82 (41 boys, 41 girls) and 85 (43 boys, 42 girls) PT (< 34 weeks

gestation), singleton, preschoolers (3-4 years of age), respectively. Our outcome measures of motor inhibition and verbal fluency were the Statue and Word Generation (WG) subtest scores from the NEPSY-II, respectively. Expressive language skills were also assessed, using the Expressive Language Index (ELI) from the Clinical Evaluation of Language Fundamentals – Preschool – 2. Gross motor skills were assessed as well, using the Gross Motor Quotient (GMQ) from the Peabody Developmental Motor Scales – Second Edition. Children with a history of moderate to severe intracranial pathology or cerebral palsy were excluded.

**Results:** We conducted separate multiple regression analyses using either Statue or WG standard scores as the predicted variable. Our predictors of interest were either the GMQ and WG scores, or the ELI and Statue scores, respectively. Gestational age, sex, and socioeconomic status were used as covariates. The GMQ accounted for a significant portion of the variance in Statue scores ( $\Delta R^2 = .114, p = .001$ ), whereas performance on WG, an EF task, did not ( $\Delta R^2 = .01, p = .31$ ). The ELI ( $\Delta R^2 = .166, p < .001$ ) and Statue ( $\Delta R^2 = .036, p = .05$ ) scores each accounted for a significant portion of the variance in WG performance. Nonetheless, ELI explained a greater portion of the variance in WG performance compared to Statue, an EF task.

**Conclusion:** In a sample of PT preschoolers, gross motor ability explained a greater portion of the variance in motor inhibition than verbal fluency, a different EF. Similarly, expressive language accounted for a greater share of the variance in verbal fluency than motor inhibition. We conclude that at least in the PT population, poorer performance on EF tasks may not be due to EF deficits alone, but perhaps primarily to underdeveloped fundamental skills underlying proper execution of task response.

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**Keywords:** executive functions, language: development, intelligence

### **L. D. POTH, S. MATTSON. Language and Communication Abilities in Adolescents with Fetal Alcohol Spectrum Disorders.**

**Objective:** Language and communication are two areas of functioning that are largely understudied among youth with fetal alcohol spectrum disorders (FASD). To date, findings on language and communication abilities have been mixed, and have generally focused on more severely affected (i.e., children with FAS rather than the broader spectrum of FASD) or younger children. The current study aimed to elucidate the profile of language (i.e., receptive, expressive, parent-report) and communication (i.e., functional, social) abilities in adolescents with FASD. Further, we aimed to investigate the relationship between language and communication among this population.

**Participants and Methods:** Participants aged 12-17 years with (alcohol-exposed [AE] = 31) and without (control [CON] = 29) prenatal alcohol exposure were included. Receptive and expressive language were measured by the Clinical Evaluation of Language Fundamentals – Fifth Edition (CELF-5). Parents or caregivers completed the Children’s Communication Checklist – Second Edition (CCC-2) as a subjective measure of general language skills. Functional communication was measured by the Student Functional Assessment of Verbal Reasoning and Executive Strategies (S-FAVRES) and parents or caregivers completed the Social Skills Improvement System (SSIS) Rating Scales as a measure of social communication. Cognitive data (inhibition, working memory, attention) were available as part of a larger study. Multivariate analysis of variance determined the overall profile of language (receptive, expressive, parent-report) and communication (functional, social) and whether it differed between groups. Next, multiple regression analyses examined the relationship of cognitive domains (inhibition, working

memory, attention) to receptive and expressive language. Finally, multigroup path analysis determined if the proposed mediated effects of language (receptive, expressive) on communication (functional, social) via cognitive domains (inhibition, working memory, attention) differed between groups. An alpha level of  $p < .05$  was used to determine statistical significance and effect sizes were examined.

**Results:** The AE group performed significantly lower than the CON group on receptive language and parent-report of general language while groups did not significantly differ on expressive language. Groups did not significantly differ on functional communication while social communication was rated as significantly lower in the AE group. All cognitive domains were significantly related to receptive language while only attention related to expressive language across groups. Expressive language significantly related to both functional and social communication while receptive language significantly related to functional communication only. Overall, no indirect relations via cognitive domains were significant.

**Conclusions:** The results of this study provide important information regarding the relations between basic language abilities and higher-level communication skills of adolescents with FASD. Interventions targeting working memory, inhibition, and attention may improve language abilities, which in turn may improve communication skills. Ultimately, improving communication skills of youth with FASD may translate to better overall functioning in social, academic, and occupational settings.

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**Keywords:** language

**C. LEE, C. DANDAR, A. HEITZER, J. PIERCY, B. PETERS PAUL, J. KLARR, S. RAZ.**  
**The Relationships Between Anemia of Prematurity, Intellectual, and Language Functioning in Preterm-Born Preschoolers.**

**Objective:** Anemia of Prematurity (AOP) is a well-documented complication in preterm children served in the Neonatal Intensive Care Unit. The risk for developing AOP and the subsequent need for packed red blood cell transfusions are inversely related to gestational age and birth weight. The primary cause of AOP is impaired ability to increase serum erythropoietin appropriately in the setting of anemia and decreased tissue availability of oxygen. Anemia may lead to tachycardia, hypotension, and poor perfusion and oxygen delivery to the tissues. Though some literature is available on the neurocognitive outcome of neonates treated at various transfusion thresholds, little data exist about long-term outcome differences between preterm infants with low and normal hematocrit levels at birth. Our main objective was to explore the cognitive and language functioning of preterm-born preschoolers whose hematocrit levels on their first newborn blood count fell either above or below threshold for anemia classification.

**Participants and Methods:** Intellectual and language abilities were assessed in a cohort of preterm-born (< 34 weeks' gestation), singleton, preschoolers (3-4 years of age). Intelligence, receptive, and expressive language measures were available for 107, 98, and 93 children, respectively. Nineteen, fifteen, and fourteen of these children were classified with AOP at birth, respectively, using hematocrit < 40% as a cutoff. Intellectual abilities were assessed with the Full Scale Intelligence Quotient (FSIQ) from the Wechsler Preschool and Primary Scale of Intelligence (Third or Fourth Edition). Receptive and expressive language abilities were assessed with the Receptive Language Index (RLI) and Expressive Language Index (ELI) from the

Clinical Evaluation of Language Fundamentals-Preschool-2. Children with history of moderate to severe intracranial pathology or cerebral palsy were excluded.

**Results:** Three separate general linear model analyses were conducted using anemia classification as the predictor of interest. Outcome measures were the FSIQ, RLI, and ELI scores. Gestational age, socioeconomic status, and sex were used as covariates and interactions between predictors were examined. The total sum of perinatal complications and birth weight were not used as a predictor to reduce multicollinearity. AOP classification was found to be significantly associated with lower FSIQ scores,  $F(1, 101) = 6.647, p = .011$  and with lower RLI scores,  $F(1, 92) = 4.496, p = .037$ . However, AOP classification was not significantly associated with ELI scores,  $F(1, 87) = 1.749, p = .189$ . The adjusted means ( $\pm SE$ ) for preschoolers classified with AOP vs. those with normal hematocrit levels were  $95.74 \pm 4.22$  vs.  $107.75 \pm 1.86$  for the FSIQ,  $95.78 \pm 3.77$  vs.  $104.42 \pm 1.51$  for the RLI, and  $99.03 \pm 4.20$  vs.  $105.01 \pm 1.59$  for the ELI.

**Conclusion:** In a sample of preterm-born preschoolers, AOP determined by initial blood count was associated with lower intellectual abilities and receptive language skills, but not expressive language skills. Group differences corresponding to a medium-large effect size were observed even after adjustment for perinatal risk and sociodemographic variables. Further exploration of the role of low initial hematocrit level as a potential precursor of intellectual and language deficits in preterm-born preschoolers is needed.

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**Keywords:** intellectual functioning, language: development, neuropsychological outcome

**K. SHADA, S. GEORGOPOULOS, C. LIPMAN, D. BOTHE, T. DRAGGA, R. TANGEN.**  
**Understanding the Impact of Sleep on Anxiety and Behavioral Functioning in Children with Fetal Alcohol Spectrum Disorder.**

**Objective:** Sleep problems are commonly reported for children with Fetal Alcohol Spectrums Disorder (FASD); however, there are few studies that explore the functional impact of sleep difficulties in this population. Children with FASD are also known to have a high rate of anxiety and behavioral problems. The impact of sleep on emotional and behavioral functioning has not been well studied in this population. In children with FASD, it is predicted that there will be positive relationship between sleep problems and parent reported anxiety symptoms, attentional problems, and oppositional behaviors.

**Participants and Methods:** Data from 49 children (ages 3-14) diagnosed with an Alcohol Related Neurodevelopmental Disorder using the 4 Digit Diagnostic Code (Astley, 2004) was analyzed. Parents completed the Sleep Disturbance Scale for Children (SDSQ) and Child Behavior Checklist (CBCL) as part of a larger neuropsychological battery. Regression analysis was used to test associations between parent reported sleep problems (DBRS Total Score) and parent reported emotional and behavioral functioning (CBCL - DSM Oriented Scales).

**Results:** In the FASD clinical sample, parents rated more sleep ( $t(49) = 6.15, p < .001$ ), anxiety ( $t(49) = 6.66, p < .001$ ), attention ( $t(49) = 12.03, p < .001$ ), and oppositional behavior ( $t(49) = 10.07, p < .001$ ) problems than the normative sample. There were significant sleep problems in 41 percent of the sample. Anxiety and oppositional behavioral scores were not at a clinically significant level overall, but 31 percent of the group had a clinically significant anxiety score and 43 percent of the group had a clinically significant oppositional behavior score. ADHD scores were at a clinically significant level overall and 57 percent of the group had clinically significant

ADHD scores. The model of sleep problems to predict anxiety was statistically significant,  $R^2 = .088$ ,  $F(1, 47) = 4.59$ ,  $p = .037$ , adjusted  $R^2 = .0695$ , with 8.8 percent of the variance explained by sleep difficulties in our sample. The model of sleep problems to predict attentional problems was also statistically significant,  $R^2 = .107$ ,  $F(1, 47) = 5.65$ ,  $p = .021$ , adjusted  $R^2 = .088$ , with 10.7 percent of the variance explained by sleep difficulties in our sample. The model of sleep problems to predict oppositional behavior was not statistically significant,  $R^2 = .013$ ,  $F(1, 47) = .661$ ,  $p = .420$ .

**Conclusions:** Consistent with previous studies, these results suggests that children with FASD have more sleep attentional, oppositional, and anxiety problems than average. In our clinical sample, sleep was found to account for a significant, yet small proportion of anxiety and attentional problems, but not oppositional behavior. This study was limited due to small sample size and use of a broad band emotional and behavioral scale. Further delineation of anxiety and behavioral symptoms with narrow band measures would be helpful. Future models should also consider other contributions to anxiety and behavior symptoms including trauma exposure, changes in caregiver, and family genetic history. Since emotional and behavioral concerns are often a clinic priority for parents, a focus on interventions for sleep may lead to positive emotional and behavioral changes in this population.

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**Keywords:** sleep, anxiety, attention

**T. A. BUSCH, A. DE SILVA, M. L. NEEL, G. MOOTS, N. MAITRE, H. TAYLOR. Executive Functioning Predicts Academic Readiness in Very Preterm Children.**

**Objective:** Very preterm (VPT) children (GA of <30 weeks) are at high risk for deficits in executive function (EF). These deficits include problems in self-regulatory abilities, such as selective attention and inhibition of inappropriate behaviors, that can adversely affect children's everyday functioning. EF skills are also an important basis for successful school entry, and VPT children who lack these abilities can have difficulties in acquiring academic skills. Academic readiness is typically defined by meeting five major milestones: motor, play, motivation and self-control, communication, and cognition, including knowledge of letters and math concepts. However, we know little about the how deficits in EF in VPT children contribute to academic readiness. This study tested two hypotheses: 1) Preschool-aged VPT children would perform more poorly than an age-matched group of full-term (FT) children on an EF task measuring inhibition and attention, as well as on measures of academic readiness; and 2) EF scores in the VPT group would be associated with more difficulties on formal assessments of academic readiness and parent report of these skills.

**Participants and Methods:** 52 preschool-aged VPT children were compared to 39 FT peers on a measure of inhibition and attention, as measured by the mean accuracy score on a Go/No-Go task called the Zoo Game. Children's academic readiness was assessed by tests of global cognitive ability, knowledge of letters, and math concepts, as well as by parents' ratings of children's progress in meeting behavior and academic milestones.

**Results:** Compared to FT group, VPT children exhibited deficits in EF skills as measured by Go/No-Go mean accuracy ( $t(75) = 3.32$ ,  $p = .001$ ), as well as lower scores in areas of academic readiness, such as global cognitive ability ( $t(87) = 6.41$ ,  $p = .001$ ), knowledge of letters ( $ps < .001$ ), and math concepts ( $t(81) = 5.53$ ,  $p = .001$ ). VPT children's lower scores on the Go/No-Go

task were associated with lower scores on most measures of academic readiness ( $r_s = .32 - .45$ ,  $p_s < .04$ ), and with parent report of how well children are meeting behavior and academic milestones ( $r_s = .33 - .43$ ,  $p_s < .03$ ). Findings suggest that VPT children's lack of self-regulatory skills is associated with poor performance in critical areas of academic readiness such as literacy, numeracy, and cognition.

Conclusion: EF skills, such as inhibition and attention, may critical skills to target in designing interventions to help VPT children prepare for the transition to school.

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**Keywords:** neuropsychological assessment, prematurity, executive functions

**E. OZTURK, S. E. AARON, D. L. HUNT, R. DANIELS, W. P. MEEHAN III, D. R. HOWELL, J. W. HAMNER, C. O. TAN. Cerebrovascular Function during Adolescent Development.**

**Objective:** Cerebral blood flow declines throughout adolescent development as executive function improves. Cerebrovascular function may adapt to compensate in support of the maturation of neural function in the face of apparently diminished resource availability.

**Participants Methods:** Thirty-eight healthy adolescents and young adults between 14 – 21 years old completed cerebrovascular function testing. We assessed age- and sex-related changes in cerebral blood flow velocity (CBFv), vasoreactivity, autoregulation, and the vascular response to a working memory task (neurovascular coupling).

**Results:** Females had higher resting CBFv ( $p=0.02$ ) and lower systolic arterial blood pressure ( $p<0.01$ ) than males. There was a relationship between age and CBFv across individuals, with an interaction between age and sex (overall adjusted  $R^2=0.26$ , Age Effect  $p=0.02$ , Age x Sex  $p<0.01$ ). Resting CBFv was negatively related to age in females (adjusted  $R^2=0.34$ ,  $p<0.01$ ) but not in males ( $R^2=0.04$ ,  $p=0.45$ ). Cerebral vasoreactivity and two components of autoregulation explained almost two-thirds of the variation in CBFv (adjusted  $R^2=0.62$ ,  $p<0.01$ ). We also found a significant relationship between age and executive function performance (adjusted  $R^2=0.16$ ,  $p=0.01$ ). Autoregulation and neurovascular coupling together explained one-third of the variation in executive function responses (adjusted  $R^2=0.26$ ,  $p=0.02$ ).

**Conclusion:** Age- and sex-related changes in resting CBFv are related to changes in cerebral vasoreactivity and autoregulation, while changes in executive function during adolescence are related to changes in neurovascular coupling and cerebral autoregulation. As the brain develops structurally and energetically, key mechanisms of cerebrovascular function also develop to meet the new demands of higher functioning.

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**Keywords:** cerebral blood flow, adolescence, working memory

**S. FOSS, D. P. WABER, R. J. WRIGHT, M. B. ENLOW. Associations Among Maternal Lifetime Trauma, Psychiatric Symptoms in Pregnancy, and Infant Stress Reactivity and Regulation.**

**Objective:** Exposures to adversity and trauma pose well-documented risks to individual and public health, leading to worse physical and mental health outcomes in individuals and across generations. For example, maternal adversity has been linked to worse birth outcomes, altered newborn brain morphology, and poorer child mental health. Research is more limited regarding

effects of maternal adversity on infant reactivity to and regulation of stress, which have been associated with neurobehavioral and cognitive challenges in later childhood. Indirect evidence suggests that maternal mental health may contribute to associations between maternal adversity and poor infant outcomes, as psychopathology is a documented sequela of trauma exposure and a predictor of altered self-regulatory capacity in offspring of affected mothers. The goal of the present study was to assess associations among maternal lifetime trauma history, psychiatric symptoms in pregnancy, and infant reactivity and regulation; specifically, this study aimed to test the hypothesis that maternal psychiatric symptoms in pregnancy mediate associations between maternal trauma history and infant reactivity and regulation.

**Participants and Methods:** Participants were 677 mothers recruited into a sociodemographically diverse longitudinal cohort during pregnancy and their infants. During pregnancy, mothers were assessed for lifetime trauma history via the Life Stressor Checklist-Revised. They also completed the Edinburgh Postnatal Depression Scale and the Spielberger State-Trait Anxiety Inventory to assess current depressive and anxiety symptoms, respectively. When infants were 6 months of age, mothers completed the Infant Behavior Questionnaire-Revised, which provided measures of infant reactivity (intensity of distress in response to daily life stressors) and regulation (rate of recovery from peak arousal). Primary hypotheses were tested using mediation models with PROCESS (SPSS 24). Maternal (age, education, race/ethnicity) and child (age, sex) sociodemographic variables were included as covariates in all models.

**Results:** Greater maternal lifetime trauma exposure and maternal depressive and anxiety symptoms in pregnancy were each associated with increased reactivity and poorer regulation in infants ( $p < .01$ ). Maternal depressive symptoms during pregnancy fully mediated the association between maternal trauma history and infant reactivity (Standardized Indirect Effect [IE]=.04). Maternal anxiety symptoms fully mediated the association between maternal trauma history and infant regulation (IE=-.05), and partially mediated the association between maternal trauma history and infant reactivity (IE=.03).

**Conclusions:** Consideration of both maternal lifetime trauma history and psychiatric symptoms in pregnancy is important for identifying infants at risk for increased stress reactivity and impaired regulation. In this sample, both prior maternal trauma exposure and heightened anxiety and depressive symptoms in pregnancy were associated with increased infant stress reactivity and poorer regulation. Moreover, maternal anxiety and depressive symptoms partially to fully mediated links between maternal trauma history and infant reactivity and regulation. The current findings highlight potential contributory mechanisms in the development of maladaptive infant reactivity and regulation abilities, which have been associated with increased risk of internalizing, externalizing, and conduct problems, ADHD, and poorer cognitive and academic outcomes in childhood. Better understanding of familial risk factors and mechanisms for development of these cognitive and behavioral outcomes may result in earlier identification of at-risk children, allowing for earlier implementation of interventions.

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**Keywords:** chronic stress, perinatal factors, transdisciplinary research

**M. CLIFFORD, K. KING. Neuropsychological Profile of an Adolescent Diagnosed with Dissociative Identity Disorder (DID).**

**Objective:** It is well documented that individuals who have a history of early stressors and adverse childhood experiences are more likely to develop dissociative behaviors. Yet, misdiagnosis in clinical settings is common and it typically takes an average of 6 to 12 years for an individual to be diagnosed with DID. Further, the neuropsychological profiles of these individuals, particularly as children and adolescents, are largely underrepresented in the available literature.

**Participants and Methods:** A comprehensive neuropsychological evaluation was conducted with an adolescent who was ultimately diagnosed with dissociative identity disorder (DID) as a result of that evaluation. Areas assessed include: intelligence, executive functions, social language and responsiveness, affect recognition, validity, personality, dissociative experiences, and emotional and behavioral functioning.

**Results:** Results of validity testing provided evidence of effortful participation. The adolescent's intellectual functioning was average to above average. Parent ratings of attention were not indicative of significant problems. While structured tasks of executive functioning were average, problems with initiation were evident on a parent questionnaire. Social concerns, including feeling disconnected from others, and sensory sensitivities were noted during interview. However, a standardized questionnaire and direct testing indicated appropriate social skills, with the presence of repetitive behaviors. Affect recognition was broadly intact, though errors interpreting sadness, anger, and disgust were evident. Self-report measures indicated dissociative experiences similar to other individuals with DID and were indicative of emotional symptoms consistent with posttraumatic stress disorder (PTSD) including anxiety and depression. Clinical interview and behavioral observations also provided support for the evidence of dissociative experiences. For example, physiological and communication changes were observed as the adolescent completed certain tasks and/or felt the presence of a neurodissociative part.

**Conclusions:** Despite diagnoses of DID and PTSD, this individual's overall cognitive functioning was average to above average on direct testing, consistent with prior research conducted on adults. Executive functioning (working memory and inhibition in particular) and attention deficits were also not of notable concern. Despite strong abilities, significant difficulties with school and social functioning were reported. Assessment tools of dissociative symptoms were important components to this neuropsychological battery and provided helpful information to further guide clinical interviewing. Despite having received prior psychological evaluations and participating in therapy for multiple years, this adolescent's dissociative disorder had not been previously recognized and treated. Differential diagnoses of autism spectrum disorder, psychotic disorder, and attention deficit hyperactivity disorder were ultimately ruled out. Recommendations included a referral for a medical doctor with experience treating individuals with dissociative abilities and trauma histories for follow-up regarding medical and sleep concerns, a referral for a therapist trained in the Adaptive Internal Relational (AIR) Network Model (treatment model designed for working with individuals with dissociative abilities), and formalized supports for school. This case study provides one example of a neuropsychological profile of an adolescent with DID. Results are consistent with research suggesting the possibility of dissociation being a protective factor in terms of cognitive functioning in individuals with histories of early adverse experiences.

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**Keywords:** neuropsychological assessment, childhood maltreatment, chronic stress

**M. LOBERMEIER, J. CANO, A. LUKOMSKI, R. LAJINESS-O'NEILL. Association Between Obstetric Mode of Delivery and Social, Communication, and Cognitive Development in Infancy.**

**Objective:** Research indicates that children born via cesarean delivery are at greater risk of developing autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) than children born via vaginal delivery (Zhang et al., 2019). Although these relationships have been studied in toddlers and young children, it is unclear whether the same neurodevelopmental outcomes are observable in infancy. The current study aims to address this gap by examining early indicators of difficulty in social, communication, and cognitive (SCG) development in children born via cesarean compared to vaginal delivery. We expect that children born via cesarean delivery will have lower scores on parent-reported development than children born vaginally. Earlier identification of SCG delays may lead to earlier and more targeted ASD and ADHD intervention.

**Participants and Methods:** A sample of 402 caregiver/infant dyads from a longitudinal, multi-site study (site 1: N = 48; site 2: N = 153; site 3: N = 201) were included to examine the effect of delivery type on caregiver-reported infant SCG development at 6 and 9 months. SCG development was assessed using the social communication scale of the Communication and Symbolic Behavior Scales-Developmental Profile (CSBS-DP) Infant-Toddler Checklist, and the SCG domain of PediaTrac™ v3.0 (PT), an experimental tool for measuring infant and toddler development (Lajiness-O'Neill et al., 2018). To examine differences in CSBS-DP and PT scores by delivery type, t-tests and Mann-Whitney U tests were computed. Sites 1 and 2 were combined (N = 201) in all analyses due to similar demographic characteristics (lower socioeconomic status [SES]), while site 3 remained its own group (higher SES). Repeated measures analysis of covariance (ANCOVA) was performed to determine longitudinal associations of SCG development and delivery type, while controlling for pregnancy complications, site, and demographic factors (maternal age, maternal education, and household income).

**Results:** Children born via cesarean delivery had higher CSBS-DP scores than those born vaginally at 6 months ( $p = 0.04$ ), but not at 9 months ( $p = 0.65$ ). PT scores did not differ by delivery type at 6 or 9 months ( $p \geq 0.65$ ). There was no association over time between CSBS-DP and PT scores with delivery type, while controlling for pregnancy complications and site ( $p \geq 0.17$ ). CSBS-DP and PT scores were higher over time at sites 1 and 2 compared to site 3, while controlling for delivery type and pregnancy complications ( $p \leq 0.01$ ). Site differences disappeared after also controlling for demographic factors ( $p \geq 0.14$ ). While controlling for all covariates, pregnancy complications were positively associated with PT scores ( $p < 0.003$ ).

**Conclusions:** SCG development in infancy may be an early indicator of ASD and ADHD, which previous literature suggests is affected by delivery type. The absence of association between SCG development and delivery type in this study suggests these differences may not be identifiable until SCG development becomes more complex. Conversely, differences may exist, but caregivers may be unable to accurately report their child's development. Site differences within our sample appear to be driven by a combination of demographic factors. Differential expectations for and knowledge of child development may partially explain why lower SES parents report increased child SCG development and why a positive association between pregnancy complications and PT scores was present.

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**Keywords:** child development disorders, perinatal factors

**E. A. STINSON, K. N. LECLAIRE, K. V. MONTOTO, K. LISDAHL. Self-Reported Antioxidant Diet Levels are not Associated With Cognitive Performance in Healthy Adolescents and Young Adults.**

**Objective:** Antioxidants are nutritional compounds that research suggests reduce oxidative stress and contribute to brain health. Research has found that high antioxidant (e.g., vitamin E and beta-carotene) intake is associated with superior performance on verbal learning tasks and related to global cognitive improvements in older adults (Beydoun et al., 2015; McEvoy et al., 2017). In younger age groups, limited research has shown that adherence to the Mediterranean diet, a diet high in antioxidants, is associated with higher academic scores during early adolescence (Adelantado-Renau et al., 2019). However, little is known about whether antioxidant intake is associated with cognitive performance in physically healthy adolescents and young adults. The current study aims to investigate how self-reported recent consumption of foods rich in antioxidants (foods containing vitamin C and E, carotenes, antioxidant minerals) relates to verbal learning, visual spatial, working memory, and psychomotor speed performance in adolescents and young adults without metabolic conditions.

**Participants and Methods:** The current sample included 72 participants aged 16-25 (50% female, 69.4% white) who were physically healthy (exclusion criteria included diagnosis of diabetes, hypertension, hyperlipidemia, neurologic and psychiatric disorders). All participants completed the Automated Self-Administered 24-Hour Dietary Assessment Tool (Subar et al., 2012) to assess their food intake within the last 24 hours. Composite variables were created when individual antioxidants were correlated  $>.70$  to reduce multicollinearity; variables included: minerals (zinc and selenium), carotenes (beta carotene, alpha carotene, lutein, vitamin A), vitamin C, vitamin E, and lycopene. Participants were administered the California Verbal Learning Test-II, Rey Complex Figure Task, Weschler Adult Intelligence Scale-III Letter-Number Sequencing subtest, and Delis-Kaplan Executive Functioning Scale Trail Making Tests. Analysis of variances (ANOVAs) were used to examine gender differences in antioxidant intake. Separate stepwise regressions were conducted to evaluate whether levels of antioxidant intake, after controlling for gender, significantly predicted performance on verbal learning, visual spatial, working memory, and psychomotor speed tasks.

**Results:** Antioxidant variables were not significantly related to any of the neuropsychological outcomes. Gender was significantly associated with working memory performance ( $p=.01$ ).

**Conclusions:** Our results suggest that levels of recent antioxidant intake were not significantly associated with cognitive performance on verbal learning, visual spatial, working memory, and psychomotor speed tasks in healthy adolescents and young adults without metabolic disease. Administration of an antioxidant rich diet may result in differential outcomes; this was not directly studied. Further, age-related benefits to high antioxidant intake on cognitive performance may exist in samples with metabolic conditions. Future longitudinal research should examine how nutrition may impact cognitive and academic performance during particularly sensitive periods of development (e.g., childhood and early adolescence).

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**Keywords:** adolescence, cognitive functioning

**N. DESIRE, M. ANDRES, C. HAY, T. WILLIAMS. Examining the Feasibility and Client Satisfaction of a Tiered Approach to Delivering Videoconference-Based Screening Assessments to Youth and Families During COVID: Preliminary Findings.**

**Objective:** The current COVID-19 crisis calls for consideration of additional innovative teleneuropsychological practices in providing complementary service delivery options to traditional in-person assessments, particularly as concerns for a potential second wave arise around the world, suggesting that physical distancing regulations may be maintained for months to come.

In response to this crisis, we examined the feasibility and client satisfaction of a novel tiered teleneuropsychological screening process for children referred for neuropsychological assessment at a large Canadian tertiary pediatric hospital. This approach aims to increase service delivery and provide informed and time-conscious direction to patients and families based on needs identified in the screening assessment. We describe here preliminary findings of implementing this approach in a Neonatal Neurology program to meet families' needs during COVID.

**Participants and Methods:** Twenty-one children (8 female;  $M = 7.42$  years;  $SD = 2.94$ ; Range 4 to 14 years) referred for neuropsychological assessments from a Neonatal Neurology program were contacted between May and August 2020 and offered a three-part screening assessment which included: 1) completion of online intake and psychosocial questionnaires; 2) an intake interview with a neuropsychologist via the hospital's Zoom platform (HIPAA-compliant professional version); and 3) completion of remote testing when eligible. Neurological conditions included, but were not limited to, perinatal stroke, hypoxic-ischemic encephalopathy, prematurity and associated complications, and epilepsy. Feasibility measures included the number of participants who completed each tier of the evaluation and post-assessment surveys were sent to document client satisfaction. Reasons for incompleteness at each step were documented.

Remote testing comprised of an abbreviated testing battery (1-to-2 hours) that included: standardized measures of estimated intellectual functioning, language, reasoning, verbal memory, and basic academic skills. Tests were administered remotely using a combination of Zoom screen-sharing methods and Pearson's Q-interactive.

**Results:** Of the 21 participants contacted, 20 families completed online questionnaires, 20 were provided parent interview and consultation, and 12 children (57 % of our sample) participated in remote testing. One parent declined consultation and was booked for an in-person evaluation post-hospital reopening. Of the 8 children (38%) who did not participate in remote testing, consultation was sufficient for 3 families with recommendations for follow-up in 1-to-2 years; 3 children had marked behavioral or developmental limitations, and 2 families had technological limitations. Of the 12 children who participated in remote testing, 2 required a more in-depth follow-up in-person assessment. In post-assessment surveys, parent and children reported minimal to no technological difficulties and many described advantages of the virtual approach, such as schedule flexibility, reduction in travel time of up to 3 hours, as well as the child and parent's comfort in their home-setting.

**Conclusions:** Preliminary results suggest that this tiered approach to providing clinical care is feasible, can be used to screen for cognitive difficulties in children with complex neurological conditions, provide appropriate parent consultation, and help identify children who require more in-depth in-person evaluations or direct later follow-up. More globally, this novel approach has the potential to increase service delivery to families, particularly in contexts where physical

distancing regulations arise or where access to specialized tertiary pediatric hospital services is limited.

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**Keywords:** pediatric neuropsychology, neuropsychological assessment, cognitive screening

**S. V. CLARK, T. Z. KING, T. D. SATTERTHWAITE, R. D. MORRIS, J. A. TURNER.**  
**Relationships Between Cerebello-Cortical Functional Connectivity and Executive Functioning Across Childhood and Adolescence.**

**Objective:** The cerebellum is a modulator of both motor and cognitive functions, helping to make these behaviors coordinated and efficient. It is structurally and functionally connected to the prefrontal cortex (PFC) through multisynaptic, closed-loop circuits. Neuroimaging studies have established that the posterior lobules of the cerebellum are active during executive function (EF) tasks and are functionally connected to cortical regions of EF-associated networks such as the fronto-parietal network (FPN) and cingulo-opercular network (CON). Despite much evidence that the developmental timecourses of EF and cerebello-cortical connectivity are similar, and early damage to the cerebellum can cause numerous cognitive deficits, relationships between executive functions and cerebello-cortical functional connectivity during childhood and adolescence have not yet been investigated. We therefore aimed to elucidate relationships between cerebello-cortical connectivity and EFs in a typically developing sample. We predicted that cerebello-cortical connectivity would mediate the relationship between FPN/CON connectivity and EF efficiency, and that these relationships would be stronger in older participants.

**Participants and Methods:** Participants included typically developing youths ages 8 – 21 ( $N = 554$ ), from the publicly available Philadelphia Neurodevelopmental Cohort. Participants performed three EF tasks completed outside the scanner: attention (Penn Continuous Performance Task), working memory (Letter N-Back), and flexibility (Penn Conditional Exclusion Task); efficiency on each task was computed by standardizing accuracy and speed and subtracting speed from accuracy. Independent components analysis (ICA) was utilized to compute resting-state functional connectivity between nodes of the FPN and CON, and between posterior cerebellum and PFC nodes of the executive networks. Connectivity values were extracted and entered into multiple linear regression and conditional processes models predicting EF efficiency.

**Results:** First, we observed positive linear relationships between age and posterior cerebellum - PFC connectivity. In addition, left posterior cerebellum – anterior cingulate cortex (ACC) connectivity predicted attention efficiency and attention and working memory accuracy. Further, left posterior cerebellum – ACC connectivity mediated the relationship between CON connectivity and both attention efficiency and working memory accuracy. However, age was a stronger predictor of EF efficiency than connectivity was, and mediation was not present when age was included in statistical models. Significant age x connectivity interactions were present in conditional process models, as well: cerebellum – CON connectivity became stronger with age, as predicted, but the relationship between cerebellum – ACC connectivity and attention efficiency was only significant in younger children.

**Conclusions:** Results suggest that posterior cerebellum – PFC connectivity increases with age and the posterior cerebellum integrates with the CON across development. With regard to EF, we speculate that during childhood, the posterior cerebellum and ACC create and update internal

models to facilitate sustained attention and conflict and error monitoring (i.e. executive attention) on attention and working memory tasks. However, cerebello-cortical connectivity did not predict attention or working memory as strongly as age did, and connectivity did not predict flexibility. Findings shed light on relationships among age, cerebello-cortical connectivity, and executive functioning during typical neurodevelopment and can help to guide future clinical research questions.

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**Keywords:** cerebellum, neuroimaging: functional connectivity, executive abilities - normal

**P. THOMAS, S. H. CROWELL, G. KIM, B. LANEY, W. I. MATTSON, E. NELSON, K. HOSKINSON. Responses to Stress Correlate with Cortical Thickness Across Adolescence in Healthy Neurodevelopment.**

**Objective:** Changes in cortical thickness occur throughout healthy brain development, with the most significant decreases occurring during puberty and adolescence. Cortical thinning reflects pruning of excess neuronal synapses to refine brain networks. Research suggests environmental variables such as home environment and socioeconomic status may impact cortical thickness. However, maturational changes in coping with stress across development have not been investigated as a coinciding factor, whether as a predictor or result, of synaptic pruning. The current study utilizes structural MRI and the Responses to Stress Questionnaire (RSQ) to examine how coping and involuntary stress response relate to brain structure in children and adolescents. The RSQ includes three dimensions of stress response: primary vs. secondary control, voluntary vs. involuntary, and engagement vs. disengagement. Primary control involves engaging directly with the stressor through methods such as problem solving and emotional regulation, whereas secondary control is adapting to the situation with methods such as positive thinking or acceptance. Voluntary control coping includes both primary and secondary control, which represent more adaptive coping with environmental stressors. The other categories of stress response involve disengagement with the stressor (through denial, avoidance, etc.) and involuntary reactions. Involuntary responses can either cause engagement (through rumination, emotional/physiological arousal, impulsive action, etc.) or disengagement with the stressor (by inaction, emotional numbing, involuntary avoidance, etc.). We predict that a more mature prefrontal cortex, evidenced by more pruning and quantified by lower cortical thickness, will correlate with higher measures of adaptive, voluntary coping on the RSQ.

**Participants and Methods:** 44 healthy participants ages 8-20 ( $14.06 \pm 3.28$ ) were recruited from the greater Columbus area. Participants and their parents rated the child's coping and stress response using the RSQ. Participants underwent 3T structural MRI. The 5 factors of the RSQ were scored: primary and secondary control engagement coping, disengagement coping, and involuntary engagement and disengagement. Regional cortical thickness was quantified using FreeSurfer 7.1.0 and data were integrated using SPSS.

**Results:** Correlation models revealed little to no correlation between parent reports on the RSQ and cortical thickness. However, self-reports on the RSQ revealed several significant correlations between cortical thickness and coping, including negative associations among cortical thickness and both primary and secondary control engagement coping. These correlations are largely in anterior, prefrontal brain regions (including superior frontal, orbitofrontal, and anterior cingulate). In contrast, there were positive associations found among cortical thickness and disengagement, involuntary engagement, and involuntary disengagement.

**Conclusions:** Parent-reports and self-reports of the RSQ were significantly different for 3 of 5 factors, indicating some discrepancy between parental observation and internal perception of stress response. Correlations between cortical thickness and self-reports on the RSQ suggest a dynamic relationship between response to environmental stress and changes in cortical thickness. More synaptic pruning and maturation within anterior and prefrontal regions occur with increased use of adaptive coping strategies such as primary and secondary control engagement, whereas higher involuntary or disengagement responses correlated with higher cortical thickness and less maturation. These results indicate a strong association of cognitive maturation and adaptive coping with cortical maturation.

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**Keywords:** child development (normal), brain plasticity

### **A. M. MATTES. Postnatal Growth Change Scores and Executive Functioning in Preterm Preschoolers.**

**Objective:** Intrauterine Growth Restriction (IUGR), or failure to meet expected growth rate, is associated with suboptimal birth weight (BW) and frontal lobe abnormalities. Prematurity and IUGR combined represent unique risk for poorer neuropsychological outcome. The current study aims to add to the limited research regarding relationships between postnatal growth and executive function (EF) in preterm (PT) preschoolers.

**Participants and Methods:** PT children (N = 217) were assessed at 3-4 years. Weight, length/height, and head circumference (HC) were collected retrospectively from birth medical records, and measured at testing. Nested, mixed model multiple regression was used. Predictors of interest were postnatal change scores (birth to preschool age), SES, sex, and gestational age (GA). Dependent variables included direct EF measures (verbal working memory [WM], verbal fluency, and inhibition), and parent ratings (BRIEF-P).

**Results:** Smaller HC change z-scores were significantly associated with elevated parent ratings of behavioral dysregulation ( $t[86.82] = -2.19, p = .028$ ), and trended toward significant prediction of poorer behavioral inhibition ( $t[202.64] = 1.90, p = .061$ ). After exclusion of cases with neurological deficit, postnatal height change z-score was significantly associated with verbal working memory ( $t[194.96] = 1.99, p = .046$ ).

**Conclusions:** Despite a focus on prenatal growth or measurement of postnatal growth at a discrete time point, change scores representing postnatal growth over time show significant associations with executive outcome and overall school readiness.

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**Keywords:** executive functions, pediatric neuropsychology, perinatal factors

### **J. GULER, A. MCGUIRE, R. GRIFFITH, A. JACKSON, E. HAMBRICK. A Systematic Review of the Influence of Childhood Trauma Exposure on Executive Functioning.**

**Objective:** Childhood trauma exposure has been associated with negative cognitive outcomes over the life course. Previous research has demonstrated youth whom experience exposure to trauma during childhood may be at a greater risk for executive functioning deficits compared to their non-exposed peers. Despite this evidence, the previous literature has been limited in its summative examination of the breadth of adversity which may be encountered during childhood and has largely neglected evaluation of the significant variance which exists in the extant

literature regarding construct measurement. The purpose of this study was to systematically review the research on the association between childhood trauma exposure and executive functioning among children and adolescents to inform our understanding of the breadth of childhood adversity and improve the measurement of salient constructs in future research.

**Participants and Methods:** The databases PsycINFO, Web of Science, PubMed, ProQuest Dissertations and Theses, and ERIC were searched for articles published in English in May 2020 using search terms such as “executive functioning”, “executive control”, “adversity”, “trauma”, “child”, and “adolescent”. Approximately 14,055 abstracts were systematically screened by a team of reviewers, with two independent reviewers screening each individual abstract. Abstract screening determined 11,838 abstracts did not meet required study inclusion criteria. A secondary review of full texts was conducted, resulting in the inclusion of 152 articles in the final data set. Data was extracted from these articles to produce a summative systematic review, and evidence will be synthesized and reported using PRISMA guidelines.

**Results:** Childhood trauma exposure has been associated with executive functioning deficits in youth including difficulties with memory, inhibitory control, and cognitive flexibility. There was variance in the type of executive functioning measurement utilized across studies, with many studies examining more than one type of executive function. The types of adversity examined across study samples also varied, including samples of youth exposed to maltreatment and abuse, neglect, natural disasters, injury, war and political conflict, homelessness, and refugee forced migration. A proportion of articles were also identified which examined broadband trauma exposure in community or school-based samples of youth. There was significant variance in the rigor and type of trauma measurement utilized across studies.

**Conclusions:** The integration of empirical foci between the areas of child traumatic stress and pediatric neuropsychology is of great value to both respective fields through the incorporation of rigorous trauma and executive functioning measurement in samples of youth exposed to adversity and hardship. Future directions will be discussed regarding gaps in the extant literature regarding samples of at-risk youth which warrant additional empirical study regarding their executive functioning after trauma exposure. Recommendations will also be provided related to the integration of rigorous measurement techniques related to the construct of trauma exposure in youth to inform neuropsychological research and clinical practice.

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**Keywords:** childhood maltreatment, post-traumatic stress disorder, executive functions

## **B. GIMBEL, T. LAFAVOR. Neuropsychological correlates of psychopathology in a homeless youth sample: Understanding aggressive behaviors in the context of extreme adversity.**

**Objective:** Homeless youth experience disproportionate trauma and adversity compared to their stably housed peers. Accurate diagnosis of behavioral problems presents unique challenges in this population given the symptom overlap between trauma-based psychopathology and behavioral disorders (e.g., ADHD, conduct disorder [CD]) in children, particularly in the context of extreme adversity. In a previous study (Gimbel, Olsen, Travis & Laffavor, 2020) we found neuropsychological testing was useful in differentiating PTSD from ADHD symptoms in homeless youth. The current study extends that model to better understand CD symptoms in this population.

**Participants and Methods:** 86 children living in emergency homeless shelters completed measures of intelligence (WASI-II) and executive function (EF; Stroop). Caregivers rated internalizing, externalizing, and CD behaviors (Conner's 3, CBCL), EF (BRIEF), and adverse childhood experiences (ACEs; Life Time Events Questionnaire). Hierarchical regression analyses were used to examine variables most associated with symptoms of psychopathology.

**Results:** Total ACEs robustly predicted PTSD and ADHD symptomology in hierarchical regressions ( $\Delta R^2 = .23$  in both models) over and above age, gender, and IQ. Internalizing and CD behaviors predicted PTSD symptoms ( $\Delta R^2 = .22$ ), while externalizing and CD behaviors predicted ADHD symptoms ( $\Delta R^2 = .48$ ), over and above age, gender, IQ, and total ACEs. Task-based EF measures accounted for minimal variance, while caregiver-ratings showed broad EF impairment in ADHD, but specific emotional/behavioral EF dysregulation in PTSD.

**Conclusions:** Consistent with our previous research, homeless youth with PTSD and ADHD symptoms showed differing patterns of behavioral symptoms and EF dysfunction that may aid in accurate diagnosis. Novel to this study, CD behaviors were strongly predictive of both PTSD and ADHD symptoms. In the context of extreme adversity and homelessness, these findings suggest a reactive (as opposed to proactive) form of aggression in response to environmental threat—an important consideration for conceptualizing and diagnosing aggressive behaviors in this population.

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**Keywords:** chronic stress, aggression, conduct disorder

### **E. MAUER, E. MAK, Y. UCHIKOSHI, R. LUO, Q. ZHOU. Book-Sharing Complexity and Executive Function Among Low-Income, Preschool-Aged Dual Language Learners.**

**Objective:** Parental language usage is theorized to support children's executive function (EF) development (e.g., Carlson, 2003). Congruent with theory, parental language complexity during parent-child book-sharing tasks has been observed as positively associated with child EF outcomes (e.g., Baptista et al., 2017). Though substantial evidence shows differences in parental language input based on socioeconomic status (e.g., Hart & Risley, 1995), few investigators have explored parental language – child EF relations among low-income samples specifically. Furthermore, previous research is characterized by the use of simple, global indicators of language complexity (e.g., number of words). And the extant literature broadly suffers from overreliance on ethnically and linguistically homogenous samples, limiting the generalizability of previous findings. The present study aimed to help fill this gap by drawing upon data collected from a sample of low-income Chinese American (CA) and Mexican American (MA) preschool-aged dual language learners (DLLs) and their parents. The study aimed to examine the relationship between the cognitive demand of parental book-sharing language and child EF, specifically inhibitory control (IC) and cognitive flexibility (CF).

**Participants and Methods:** Participants were 88 preschool children (45 MA and 43 CA, 58% girls, age = 38-68 months,  $M_{age} = 54.27$ ,  $SD_{age} = 7.08$ ) and their parents ( $M_{per\ capita\ income} = \$5,226$ ,  $SD_{per\ capita\ income} = \$3,676$ ) drawn from a larger study ( $N = 90$ ). Two participants were excluded in the present study due to behavioral issues and procedural error. Parents were instructed to tell stories to their children using *Frog, Where are You?* (Mayer, 1969), a wordless picture book previously utilized by other researchers, in their typical home language (English, Cantonese, Mandarin, or Spanish). Transcripts of book-sharing interactions were coded using an adapted version of Luo & Tamis-LeMonda's (2017) coding scheme. Each parent utterance was

coded as referential (low cognitive demand, referencing visible features of pictured objects), behavioral (moderate cognitive demand, referencing character actions), or inferential (high cognitive demand, involving abstract thought relating to but not observable in pictured material) and was classified as either a question or statement (Cohen's kappa = 0.75). Child IC and CF were assessed using the Silly Sounds Stroop task and Something's the Same task respectively (Willoughby et al., 2010).

**Results:** The final  $N$  for main analyses was 78 due to missing data. A general linear model analysis revealed a unique, positive association between the number of parent behavioral questions and child CF controlling for relevant demographic covariates ( $F(5,72) = 9.32, p < 0.01$ ).

**Conclusions:** Findings suggest utterance-level indicators of parent language complexity based on cognitive demand are positively associated with child EF among low-income, preschool DLLs. Results are consistent with previous research incorporating alternative language complexity measures. The present study has the potential to inform clinical intervention and parenting practices due to EF's association with a broad range of functional outcomes in children. Given the cross-sectional and correlational study design, more work is needed to test whether complex parental language use prompts child EF development, children's EF abilities prompt parents to complicate/simplify their language use, or both.

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**Keywords:** executive functions, language, child development (normal)

### **J. NIELSEN, R. MENNIES, T. OLINO. Impacts of Socioeconomic Status on Executive Functioning and Cortical Structure in Early Adolescence.**

**Objective.** Socioeconomic status (SES) is associated with a multitude of health and cognitive outcomes, including executive functioning (EF). The impact of SES on neurodevelopment may account for adverse outcomes; low SES is associated with global reductions in cortical thickness (CT) and surface area (SA), as well as in regions specifically involved in EF. The current study examines CT/SA as mediators of the associations between SES and EF in youth.

**Participants and Methods.** 161 youth (58.4%F,  $M_{age}=11.5, SD=1.5$ ) participated in a prospective longitudinal study of mood disorders. SES was assessed at baseline via parent report (household) and geocoding of census data (neighborhood). Youth completed an MRI 5 months ( $SD=2$ ) following baseline. CT and SA were estimated using FreeSurfer. Mothers rated EF on the Behavior Rating Inventory of Executive Function, Short Form (BRIEF-SF) 9 months ( $SD = 2$ ) following baseline. Subscales included the Behavior Regulation Index (BRI), Metacognition Index (MCI) and General Executive Composite (GEC). Bivariate correlations explored relationships between study variables. Regression analyses examined direct associations between SES and EF (controlling for age/sex). Mediation models were estimated using maximum likelihood estimation and bootstrapping (1000 samples) was used to examine indirect effects.

**Results.** Bivariate correlations identified **positive** associations between *neighborhood*, but not household, SES and cortical structure including CT (right:  $r=.18, p=.02$ ; left:  $r=.17, p=.03$ ) and SA (right:  $r=.17, p=.03$ ; left:  $r=.15, p=.06$ ). There were no significant bivariate associations between EF and brain structure or SES and EF. However, regression analyses found that *neighborhood* SES was **positively** associated with BRI ( $b=.93, p=.04$ ), but not MCI or GEC. There were no associations between household SES and EF or CT/SA. Mediation models found no indirect effects between SES and EF via CT or SA.

**Conclusions.** Unexpectedly, youth living in low SES neighborhoods had fewer behavioral regulation problems. Low neighborhood SES was also associated with reduced CT and SA. However, associations between SES and EF were *not* mediated by cortical structure. Continued study of relationships between SES, EF, and brain development are needed to inform targeted prevention/intervention efforts and promote neurocognitive development in socioeconomically disadvantaged youth.

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**Keywords:** child development (normal), neuroimaging: structural, executive functions

**E. HOLDING, J. AMATO, E. POLLOCK, K. GRODNER, J. LICHTENSTEIN. Executive Functioning and Working Memory: Exploring the Associations among Parent Report and Individual Performance Measures.**

**Objective:** Executive Functioning (EF) is an umbrella term utilized to capture a set of neurocognitive skills involved in goal-directed behavioral responses to novel or difficult situations. Working Memory/Updating has been identified as a neurocognitive skill that makes a distinct contribution to EF. While aspects of executive functions can be examined using traditional neuropsychological assessments, parent-report measures provide unique data about how children respond in a more ecologically valid setting (e.g., decision-making, planning, prioritizing in emotionally charged or motivationally significant situations). Therefore, the current study aimed to understand the association between performance-based measures of working memory and parent-report of working memory in everyday life.

**Participants and Methods:** The study is a retrospective cohort analysis of parent reported and direct individual performance EF outcomes. Participants (n=1,113) were individuals seen for outpatient neuropsychological assessment in a tertiary care medical center. Ages ranged between 5-20 years-old (M=11.88 years; 41% female) and primary diagnoses include Neurodevelopmental Disorders (n=369), Other Medical/Neurological Condition (n=135), Epilepsy (n=114), TBI (n=95), Anxiety (n=76), Genetic/Metabolic Disorders (n=32), Mood Disorders (n=31), Behavioral Disorder (n=15), Headache/Migraine (n=11), and Other (n=235). Working Memory outcomes were assessed using the Behavior Rating Inventory of Executive Function (BRIEF) Working Memory scale, Wechsler Intelligence Scale for Children, Fourth Edition and Fifth Edition (WISC-IV, WISC-V) Digit Span and Coding subtests, Delis-Kaplan Executive Function System (D-KEFS) Trail Making Test and Color-Word Inhibition, Rey Complex Figure Test, and California Verbal Learning Test-Children's and Second Edition (CVLT-C, CVLT-II). Bivariate correlations were used to examine associations among parent-report of working memory and performance-based measures of working memory.

**Results:** Analyses demonstrated significant correlations between the BRIEF Working Memory scale and many of our cognitive measures. The effects were small in most variables (WISC-IV, WISC-V, and WAIS-IV Digit Span; WAIS-IV Digit Span Backwards; WISC-IV and WAIS-V Coding; DKEFS Trail Making Test Condition 4; CVLT-C Total Acquisition, Short Delay Cued Recall, Short Delay Free Recall, and Long Delay Free Recall; and CVLT-II Short Delay Cued Recall) with r-values ranging from -.09 to -.26. However, we found moderate correlations on several measures including the WAIS-IV Working Memory Index and CVLT-II Total Acquisition, Short Delay Free Recall, Long Delay Free Recall, and Long Delay Cued Recall, with r-values that ranged from -.27 to -.32. Inverse correlations demonstrate agreement.

**Conclusions:** In a mixed clinical sample, the association between parent-report of working memory on the BRIEF and performance measures were small with the exception of the moderate associations observed between the BRIEF Working Memory scale and the Wechsler Working Memory Index, and scores from the CVLT-II. These measures are utilized in populations age 16 and older, which suggests that the associations between parent-report and performance-based measures become stronger as children age. This may reflect the developmental trajectory of executive functions, which become more developed with age, and therefore deficits in executive functions, specifically working memory, may be more apparent to caregivers of teenagers or young adults.

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**Keywords:** executive functions, working memory, pediatric neuropsychology

**M. I. ROBINSON, I. R. CHRISTIAN, M. E. KRYZA-LACOMBE, T. RIGGINS, E. REDCAY, L. R. DOUGHERTY, J. L. WIGGINS. Cognitive Brain Network Connectivity Changes in Childhood.**

**Objective:** Brain networks are in critical stages of growth in early to middle childhood, as are concurrent changes in executive functioning. Recent literature suggests that across development, interactions between the default mode and fronto-parietal networks, both active during rest, may be related to individual differences in executive functioning. In adolescence, connectivity patterns between the default mode network, the ‘task-negative’ network, and the fronto-parietal network, or ‘executive functioning network’ typically become more anti-correlated in adolescence, while within network connectivity increases. However, the development of functional neural networks is not well understood in early to middle childhood. Examining brain network connectivity changes over time may provide insight into executive control capacity shifts as children transition from preschool- to school-age. To this end, we examined age-related within and between network connectivity changes of networks previously shown to be implicated in executive functioning development (i.e., default mode and fronto-parietal networks) in a cross-sectional and longitudinal sample of children.

**Participants and Methods:** Resting state fMRI data were acquired from children aged 4-9 years old ( $N=176$ , mean age [SD]=6.52[1.50]). Subsamples of 4-year-olds ( $n=34$ , preschool cohort) and 6-year-olds ( $n=29$ , school-age cohort) completed two additional scans, each one year apart. A data-driven approach identified default mode and fronto-parietal networks as well as network nodes using independent component analysis. Within- and between-network connectivity was calculated using network nodes for each individual at each timepoint. Pearson correlations were used to examine the relationship between age and network connectivity in the cross-sectional sample. Repeated measures general linear models examined the main effect of Time in each of the longitudinal samples.

**Results:** Cross-sectionally, within network connectivity of default mode ( $r=.22$ ,  $p=.003$ ) and fronto-parietal ( $r=.19$ ,  $p=.014$ ) networks was positively correlated with age. Longitudinally, within default mode network connectivity significantly increased with age ( $F[2,32]=5.34$ ,  $p=.010$ ) in the preschool cohort but not in the school-age cohort ( $F[2,27]=.94$ ,  $p=.403$ ). Within fronto-parietal network connectivity did not significantly increase in either of the longitudinal cohorts and there were no significant age-related changes in between network connectivity.

**Conclusion:** Increased within default mode network connectivity suggests significant brain growth between early and middle childhood. Furthermore, longitudinally, significant increases in

within default mode network connectivity in the preschool cohort but not the school-age cohort suggest that within network connectivity changes in early childhood may be greater than in later childhood and emphasize the importance of examining neural network changes across the early developmental spectrum. For the fronto-parietal network, contrasting findings between longitudinal and cross-sectional analyses may reflect a potential cohort effect; our results emphasize the importance of longitudinal research along-side cross-sectional work. Although prior work reported between-network anti-correlations in adolescence, the absence of such anti-correlations in our younger sample may indicate underdevelopment of these networks among younger children. Within network maturation may be necessary before relationships between networks can occur. Such changes in within and between network brain connectivity across childhood and adolescence may correspond to concurrent executive functioning development.

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**Keywords:** executive functions, child development (normal), neuroimaging: functional connectivity

### **T. NI, N. GUO. The Effectiveness of Executive Function Training Program of Prader-Willi Syndrome.**

**Objective:** Prader-Willi syndrome (PWS) is a rare neurodevelopmental genetic disorder characterizes mainly by hyperphagia. Individuals with PWS often involved impaired cognitive performance, emotional problems, and behavioral problems. Studies have shown that their maladaptation behaviors, such as disinhibition behavior, rigid thinking, emotion regulation problem may be related to abnormal activity in frontal neural circuits, indicating executive dysfunction. However, there is little study about the executive function training of individuals with PWS, and the training effect remains unclear. Therefore, the purpose of this study was to evaluate the effectiveness of Executive Function Training Program (EFTP) in PWS individuals.

**Participants and Methods:** A total of 7 individuals with PWS (5 males and 2 females) aged from 19 to 31 years old (mean = 25, SD = 4.86) were included. The full IQ assessed by WAIS-III of individuals with PWS ranged from 41 to 72 (mean = 52.29, SD = 11.43), VIQ ranged from 40 to 68 (mean = 51.71, SD = 12.31), and PIQ ranged from 40 to 78 (mean = 52.57, SD = 13.77). EFTP is targeted at inhibition, working memory, and cognitive flexibility. This program was carried out as a group with 8 sessions. Each session lasting 90 minutes and can be divided into two parts: 45 minutes computerize training and 45 minutes contextually-based activities. Individuals with PWS were arranged neuropsychological assessment (NPA) before training, after training, and at a one-month follow-up. The NPA instruments including Comprehensive Nonverbal Attention Test Battery (CNAT), Wisconsin Card Sorting Test (WCST), Knox's Cube Test, Digit Span Subtest of WAIS-III, and Daily Executive Function Scale. All raw data were analyzed with Bootstrap analysis.

**Results:** The results showed that after EFTP, there were two out of seven indexes of WCST and one index of Knox's Cube Test significantly improved ( $p < .05$ ). The indexes of CNAT, Digit Span Subtest of WAIS-III, and Daily Executive Function Scale showed no significant differences after training. At one-month follow-up, results showed that three out of seven indexes of WCST and one index of Knox's Cube Test significantly improved ( $p < .05$ ). The indexes of CNAT, Digit Span Subtest of WAIS-III, and Daily Executive Function Scale showed no significant differences.

**Conclusions:** After this EFTP, there were significant improved in the cognitive flexibility and nonverbal working memory, and its' effect remained to one-month follow-up. While there were no significant changes in inhibition, verbal working memory, and daily executive function performance reported by parent.

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**Keywords:** executive functions

**C. SHEN, N. GUO. Children Born Very Low Birth Weight with Normal Early Development Slowly Catch Up on Cognitive Executive Functions at School-Age.**

**Objective:** Children born with very low birth weight (VLBW) are at high risk of executive functions (EFs) delay. However, the VLBW children with normal early development still had cognitive EFs deficits at 6-year-old (Ni, Huang, & Guo, 2011). Therefore, this study aimed to follow the development of cognitive EFs of this group of children throughout school age.

**Participants and Methods:** The VLBW children, recruited from the Regional Cohort Network for premature infants who were admitted to neonatal intensive care units, had normal scores in Bayley and Wechsler Intelligence systems before 6 years old. A total number of 398 children born VLBW were included. Of 398 VLBW children, 230 at the age of 6, 111 at the age of 8, and 57 at the age of 10. Whereas the full-term born children recruited were 100, 100, and 60, for the age of 6, 8, and 10, respectively, who were born healthy and developed normally, with comparable age, sex, home environment, and social-economic status. Both groups received neuropsychological assessment for cognitive EFs, including Digit Span Subtest of WISC-IV, Knox's Cube Test (KCT), Tower of London (ToL), Wisconsin Card Sorting Test (WCST), and Comprehensive Nonverbal Attention Test Battery (CNAT).

**Results:** It revealed the cognitive EFs of the VLBW group with normal early development at the age of 6 were significantly impaired in working memory, planning, cognitive flexibility, and inhibition ability. Among 25 items in the four cognitive aspects of EFs, the 6-year-old VLBW group indicated 14 items (56%) delayed ( $p < 0.05$ ) and 2 items (8%) suspected delayed ( $0.05 < p < 0.1$ ). Although the 8-year-old VLBW group indicated 2 items (8%) suspected delayed while 2 items showed better average performance compared to the full-term born group. There is no item delayed or suspected delayed for the 10-year-old VLBW group, as well as 2 items, showed better average performance compared to the full-term born group.

**Conclusions:** The four cognitive EFs of the VLBW group are delayed rather than deficits, they would slowly catch up at the age of 8 or 10. Further studies are needed for identifying those who can not catch up.

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**Keywords:** executive functions

**Y. PI, N. GUO, Y. LIAO, P. CHOU, K. LEE. Therapeutic Effectiveness of Neurofeedback-Based Neuropsychotherapy on Impulsivity for Adolescents with IA and ADHD.**

**Objective:** Many therapy approaches have been used for people with Internet Addiction (IA), however, it usually takes a long period to show some improvements. A neuropsychology-based neurofeedback training program (Npsy-NF) has proved its usefulness on children with attention deficit hyperactivity disorder (ADHD) in just 20 hours (Liao et al., 2015). As IA is commonly known to comorbid with ADHD, we applied the Npsy-NF to adolescents with comorbidity of IA

and ADHD (IA & ADHD). Both disorders shared a characteristic of high impulsivity. This study was to present the effectiveness of Npsy-NF and its follow-up outcome on impulsive control.

**Participants and Methods:** Seven IA & ADHD subjects age 10-16, transferred by psychiatric clinics or school counselors, enrolled in a ten-week training program for a total of 20 hours. Detectors were applied on F3 and F4 to collect brainwave data while the subjects worked on different cognitive tasks. The Npsy-NF emphasized autonomy, self-monitoring, and the ability to generalize the skills to everyday life. In that case, the types and difficulties of the tasks were adjustable according to their interests and strengths. The performance on Stroop Test and Comprehensive Nonverbal Attention Test (CNAT) accompanied by EEG recordings were analyzed pre-training (t1), post-training (t2), and follow-up (t3) one-year after Npsy-NF.

**Results:** Improvements are shown at t2 and t3 comparing to t1. Among all indexes, four are significantly better at t2, including Stroop word, color-word and predicted color-word scores, and the ratio of F3 during the behavioral inhibition task of CNAT. Most improvements stay after a year, and the significances even increase to nine indexes, including five new items, that is, better Stroop color performance, less impulsive errors at simple reaction task, and more correct trials with lower theta/beta ratio of F3 at both simple reaction tasks and distract task.

**Conclusions:** The results showed that the effect of neurofeedback technique combined with training under neuropsychological perspective can not only enhance the ability of inhibition in adolescents with ADHD & IA during the time, but also maintain and even continue to improve one year after the training.

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**Keywords:** neurofeedback, inhibitory control, addiction or dependence

**L. MILLER, E. A. WALSH, F. K. WINSTON, D. ROMER. Utility of Behavior Rating Inventory of Executive Function Metacognition Index for Identifying Risky Young Drivers: An Analysis of Subjective and Objective Behavioral Measures.**

**Objective:** Disproportionately high crash rates among younger drivers compared to older, more experienced drivers may be attributed to unsafe driving behavior. One's ability to self-monitor cognition and direct behavior – metacognition – may be an essential mechanism associated with risky driving. Despite the wide usage and clinical utility of the Behavior Rating Inventory of Executive Function survey tool, few studies have analyzed the subscales of this measure. The current study investigated relationships between reported metacognitive ability, unsafe driver behavior, and objective metrics from simulated driving performance.

**Participants and Methods:** 65 young adult drivers aged 18 to 24 years were included in the current study. Participants completed self-report measures of metacognitive ability [Metacognition Index from Behavior Rating Inventory of Executive Function – Adult Version (BRIEF-A), mean t-score=54.2, SD=11.8], driving history, reckless driving [modified Driver Behavior Questionnaire (DBQ)], sensation-seeking [Brief Sensation Seeking Scale 4-item (BSSS-4) and a 6-item acting without thinking measure [from Junior Eysenck Personality Questionnaire (JEPQ) impulsivity scale]. Participants also took part in the Virtual Driving Test (VDT) that measures some risky driving metrics such as driving too fast and running red lights and stop signs.

**Results:** Bivariate Pearson correlations indicated worse metacognition (higher scores on the MI index) was associated with more self-reported motor vehicle crashes ( $r = 0.25$ ,  $p = .049$ ), risky

driving ( $r = 0.40$ ,  $p = .001$ ), and acting without thinking impulsivity ( $r = 0.39$ ,  $p < .0001$ ). In addition, risky driving was related to driving too fast in the VDT ( $r = 0.28$ ,  $p < .05$ ).

**Conclusions:** Metacognitive ability may be important for understanding which unsafe driving behaviors young drivers are likely to commit, and whether this behavior is intentional. Moreover, these findings support the utility of the easy-to-administer BRIEF-A Metacognition Index as tool for identifying young drivers with increased crash risk.

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**Keywords:** metacognition, driving, ecological validity

**A. POLLASTRI, G. FORCHELLI, P. VUIJK, S. STOLL, M. CAPAWANA, E. BRAATEN, A. DOYLE. Convergence of Behavior Ratings of Executive Functions with Psychometric Tests and Psychopathology in Clinically-Referred Youth.**

**Objective:** Executive functions (EFs), including working memory, planning, organizing, shifting,, and monitoring are critical for successful functioning in a range of settings. Both direct assessment and behavior rating scales have been used to measure EF. Prior research indicates that behavior ratings do not consistently converge with psychometric tests of EF in clinical populations ; however, such studies have been constrained in size and scope of psychopathology. We aimed to extend this work using a large, well-characterized sample of consecutively referred child psychiatric outpatients.

**Participants and Methods:** The sample included 650 unrelated participants, ages 8-18 ( $M=12.1 \pm 2.9$ ; 62.8% male) from the Longitudinal Study of Genetic Influences on Cognition (LOGIC). The LOGIC study recruits youth with neuropsychiatric symptoms referred for neuropsychiatric evaluation to a pediatric assessment clinic within Massachusetts General Hospital. Clinical data included diagnosis as well as dimensional psychopathology scores as rated by caregivers on the Child Symptom Inventory-IV; the Child Behavior Checklist; the Social Responsiveness Scale; and the Child Mania Rating Scale. EF data included caregiver reports on the Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al., 2000) and scores from psychometric tests: Working Memory Index scores from Wechsler Intelligence Scales, perseverative errors from the Wisconsin Card Sorting Task and number-letter switching from the Trail Making task in the Delis-Kaplan Executive Function System, and commission errors on the Conners Continuous-Performance Task-2.

Multiple regressions were used to examine the associations between psychometric EF domains and BRIEF domains, as well as between the BRIEF and psychopathology, controlling for age, sex, medication use, and comorbidity.

**Results:** Fifty-two percent of the youth had BRIEF global (GEC) scores in the clinical range ( $t \geq 65$ ). Domains with the greatest impairment were Working Memory and Plan/Organize. BRIEF scores did not correlate significantly with psychometric tests in most areas, with the exception of working memory. Strong associations were found between EF and all diagnoses except psychosis. Domains in the Behavior Regulation Index were most strongly associated with Conduct Disorder and Oppositional Defiant Disorder. Domains in the Metacognition Index were most strongly associated with ADHD. Domains in the Behavior Regulation Index had the strongest associations with aggression. Domains in the Metacognition Index were predominately associated with inattention.

**Conclusions:** This is the first study of the BRIEF, cognition and psychopathology in a large cross-diagnostic outpatient clinical sample. Results support prior evidence that the BRIEF is not

a proxy for children's performance on common EF psychometric tests. Impairment in BRIEF domains was also not limited to particular psychiatric subgroups or types of psychopathology. Rather, impaired scores were associated with a range of psychiatric diagnoses and symptom dimensions, with different patterns found within and across domains. Given evidence from the literature that the BRIEF relates to a range of functional outcomes, our data support further investigation of the contribution of the BRIEF to the assessment of child psychiatric outpatients.

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**Keywords:** executive functions, ecological validity, psychopathy

### **K. MACDONALD, P. T. CIRINO. Characterization of English and Spanish Language Proficiency and Balance among Middle School English Learners.**

**Objective:** Evaluating the ways in which bilingualism may afford cognitive benefits is a growing area of study; however, approaches to characterizing bilingual samples in terms of language proficiency and balanced bilingualism are widely variable. The purpose of this study is to characterize an at-risk sample of middle school English Learners with reading difficulties in terms of language proficiency, balance, and self-reported language usage. Specifically, we examined whether subgroupings of students would emerge that are differentiated by English and Spanish proficiency levels as well as balance through latent profile analysis. Latent profiles were then compared on a self-report measure of language usage.

**Participants and Methods:** Participants were 161 Spanish-speaking middle school students (41% female, mean age = 12.5 years) further designated as English Learners and struggling readers. All students were assessed on nine objective language tests in English and Spanish. A self-report measure was also used to evaluate contextual information about students' usage of English and Spanish across a number of different contexts. Latent profile analysis was used to evaluate whether students could be placed into subgroups based on their performance across the nine language tests, and one-way ANOVA was used to evaluate whether the groups differed on the self-report measure.

**Results:** Students demonstrated low performance relative to age-based norms across all nine language tests, with significant variability noted within the sample. Results from latent profile analysis revealed that a 3-profile model provided the best fit to the data (BIC = 3987.21, ABIC = 3867.03, bootstrapped likelihood ratio test = 92.73,  $p < .001$ , and entropy = .82). Profile 1 was characterized by a high degree of balance between English and Spanish, as well as the highest scores across language tests. Profile 2 was characterized by a moderate degree of imbalance between English and Spanish, with Spanish skills falling somewhat higher than English skills. Profile 3 was characterized by a significant degree of imbalance between English and Spanish, with Spanish skills falling significantly lower than English skills. The profiles were differentiated by scores on the self-report measure ( $F = 12.27$ ,  $p < .001$ ). Specifically, Profile 3 reported significantly higher English usage relative to Spanish usage than Profile 1 ( $p < .001$ ) and Profile 2 ( $p < .001$ ), while Profiles 1 and 2 did not differ significantly from one another ( $p = .841$ ).

**Conclusions:** Results highlight the heterogeneity of this at-risk sample in terms of English proficiency, Spanish proficiency, and balance. Our approach provides one way of classifying a bilingual sample categorically, as well as construct validation of the profiles with an external measure of self-reported language usage. This approach to characterization should be used to evaluate the roles of English proficiency, Spanish proficiency, and balance in important

outcomes for this at-risk population. For instance, results from this study can drive future work that investigates how the latent profiles differ on measures of reading achievement, or domain general cognitive abilities such as executive function tasks. Better understanding how these sources of heterogeneity impact important outcomes can help inform intervention approaches in this at-risk population.

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**Keywords:** bilingualism, language

**M. KANAYA, Z. MESTRE, A. BISCHOFF-GRETHER, C. WIERENGA, K. BOUTELLE. Association Between Food Memory and Hippocampal Dependent Memory in Children with Healthy Weight.**

**Objective:** Obesity is becoming increasingly prevalent among children. Prior research shows that obesity is associated with differences in brain regions involved in memory and satiety perception, thus putting individuals at greater risk for overeating. However, less is known about whether obesity is associated with differences in objective measures of food intake memory, and whether children at risk for obesity will be impacted. This exploratory study examined potential differences in memory measures and food intake memory between healthy weight children at high or low-risk for obesity. We also examined whether hippocampal dependent memory measures are associated with food intake memory.

**Participants and Methods:** The sample included 82 children, ages 8-11, 41 at high-risk for obesity (HR: two overweight parents) and 41 at low-risk for obesity (LR: two healthy weight parents). Each participant completed two subscales of the Child Memory Scales (CMS; dot location and word-pairs), an eating behavioral measure (Eating in the Absence of Hunger (EAH) paradigm), and a food intake memory task (EAH delayed recall). A “learning” score, total score, and delayed recognition score were derived from the CMS subscales. The EAH paradigm included the children consuming dinner with a following free access period. EAH delayed recall assessed how accurately each participant was able to recall the quantity of snack foods they had consumed in the free access and how well they recognized the EAH snack foods. T-tests examined differences in memory and food intake memory between risk groups. Linear regression models then examined potential associations between food intake memory and hippocampal dependent memory (CMS subscales), controlling for age, obesity risk, gender, race/ethnicity, BMIz, and depression (CES-D scores).

**Results:** Although risk groups were well balanced in terms of demographics, HR children, compared to LR children, had higher BMIzs (HR=0.17; LR=-0.19;  $p<0.001$ ), lower depression scores (HR=11.71; LR=14.98;  $p=0.046$ ) and lower total scores on the CMS word-pairs (HR=10.71; LR=12.07;  $p=0.046$ ). There was also a trend toward significance in CMS word-pairs learning score (HR=10.78; LR=12.02;  $p=0.102$ ). There was no significant difference between the HR and LR participants in terms of EAH accuracy ( $p=0.213$ ). Risk groups were combined to examine the relationships between hippocampal dependent memory and food memory. Linear models showed that CMS word-pairs learning score was significantly associated with EAH accuracy ( $T=-2.072$ ,  $p=0.042$ ). We also saw trends between CMS word-pairs delayed recognition score and EAH accuracy ( $T=-1.784$ ,  $p=0.079$ ), and CMS words-pairs total score and EAH accuracy ( $T=-1.877$ ,  $p=0.065$ ). However, there were no associations found between EAH accuracy and CMS dot location learning score or total score.

**Conclusions:** This study suggests that risk for obesity is associated with hippocampal memory,

which is important as these differences were detected in children who are healthy weight. Food memory was not impacted in this study. We also found that scores on the hippocampal dependent memory task were negatively associated with food memory, possibly due to food motivation. Since food memory is associated with overeating, it is important to conduct further studies to explore the role of memory, food intake, and risk for obesity in children.

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**Keywords:** pediatric neuropsychology, hippocampus, learning

**G. N. MINOR, A. GORDON, D. E. HANNULA, J. D. RAGLAND, M. SOLOMON.**  
**Behavioral and Eye-Movement Correlates of Item-Specific and Relational Memory in ASD.**

**Objective:** Traditionally, research has shown that individuals with autism spectrum disorder (ASD) exhibit relational memory impairments relative to typically developing (TD) individuals, but recent work has challenged this assumption. Previous studies relied solely on explicit behavioral responses to assess relational memory, although performance on behavioral tasks is subject to other forms of cognitive dysfunction. Therefore, reported impairments may be a consequence of higher-level cognitive deficits (e.g., executive function) in ASD rather than evidence of a true relational memory deficit. Eye-tracking tasks do not require complex instructions, and previous research has shown that eye movements are automatically attracted to changes in previously studied materials, a phenomenon referred to as the “eye-movement-based memory effect.” Thus, eye-tracking represents a more sensitive approach for investigating memory than standard techniques. The objective of the current study was to determine whether there were differences in item-specific and relational memory in ASD versus TD individuals, using eye-tracking technology and behavioral reports.

**Participants and Methods:** Forty participants (18 ASD, 22 TD; ages 15-24) were recruited from an ongoing cohort-sequential study (CoCoA). Participants viewed computer-generated scenes while eye movements were recorded. Each scene contained a critical object, and three versions of each scene were created: an “original” scene, a scene in which the critical object had changed identity (item change), and a scene in which the critical object had changed locations (relational change). The task was divided into three parts: Study 1, Study 2, and Test. During Study 1, participants were instructed to view and memorize 48 scenes. In Study 2, the same scenes were presented again, accompanied by an orally-presented question. Questions either oriented the participants to features of the critical object or to the spatial relationship between the critical object and another scene element. Participants listened and responded to the question via a button press. During Test, participants viewed 64 scenes (16 original, 16 item change, 16 relational change, and 16 novel). They were prompted to make a button-press response to indicate whether the scene was the “same,” “modified,” or “new” and to indicate how confident they were about their response. Participants were yoked, such that three participants saw the same image (e.g., original) at Test, but the version seen during Study (i.e., original, item change, or relational change) varied.

**Results:** Results yielded no significant group differences in recognition performance or recognition confidence. Standard eye-movement-based memory effects were observed. During Test, all participants spent a disproportionate amount of time viewing regions that contained a new critical item (when an item change occurred) and regions that contained an old critical item

in a new location (when a relational change occurred), relative to analogous regions in original or novel scenes. There were no significant group differences in these viewing patterns.

**Conclusions:** The present study found no evidence for an impairment in relational memory in the explicit behavioral responses or viewing patterns for ASD individuals relative to TD individuals. These results suggest that previously documented deficits may be due to task requirements, developmental effects, and/or the operation of cognitive or other processes.

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**Keywords:** autism spectrum disorder, memory: normal

**L. M. GIL DIAZ, M. CLAPP, M. E. FIELDS, D. WHITE, A. KING, A. HOOD. Neuropsychological Testing in a Pediatric Sickle Cell Disease Sample: A Comparison Between the Wechsler Abbreviated Scale of Intelligence and the NIH Toolbox Cognition Battery.**

**Objective:** Children with sickle cell disease (SCD) experience cognitive deficits that can be exacerbated by silent cerebral infarction (SCI) or overt stroke, but deficits are also present for those without infarction. In most settings, estimated IQ has been used to measure cognition, although children with SCD most often experience executive function deficits. Recently, the NIH Toolbox has been utilized because it can quickly assess general cognition as well as executive function. Given the increased use of the NIH Toolbox, it is critical to know how scores relate to those obtained from other tests. Thus, we assessed the relationship between scores from a widely used IQ test and the NIH Toolbox. Additionally, we assessed whether performance on these tests differed by age.

**Participants and Methods:** Participants were recruited from the SCD Clinic at St. Louis Children's Hospital. Participants completed the 2-subtest Wechsler Abbreviated Scale of Intelligence (WASI) and the NIH Toolbox Cognition Battery during the same testing session.

**Results:** Our sample included 40 children with SCD ( $M = 11.02$ ,  $SD = 4.1$ , range = 5-21 years) who all were taking a disease-modifying treatment (hydroxyurea). Medical chart review indicated that no child had experienced SCI or stroke. Fifty percent of participants were female, all identified as Black or African American, and all had sickle cell anemia (HbSS or HbS/ $\beta$ 0thalassemia genotype).

One-sample t-tests indicated that mean scores on both the WASI ( $M = 90.15$ ,  $SD = 13.24$ , range = 62-121),  $t(38) = -4.64$ ,  $p < .001$ ,  $d = 0.74$  and the NIH Toolbox ( $M = 83.35$ ,  $SD = 16.08$ , range = 56-119)  $t(36) = -6.29$ ,  $p < .001$ ,  $d = 1.03$  were significantly below the normative mean of 100. We found a strong correlation ( $r = .68$ ,  $p < .001$ ) between the overall composite scores on the WASI and the NIH Toolbox, but age was not significantly related to either composite score ( $ps > .05$ ). The composite score on the WASI, however, was significantly higher than the NIH Toolbox,  $t(35) = 3.55$ ,  $p = .001$ ,  $d = 0.59$ . When we assessed specific subtests, we found that the Vocabulary subtest on the WASI was strongly correlated with Picture Vocabulary on the NIH Toolbox ( $r = .63$ ,  $p < .001$ ). In contrast, the Matrix Reasoning subtest was only weakly correlated with all tests of executive function on the NIH Toolbox ( $ps > .05$ ). Age was only predictive of scores of the Flanker-Attention test on the NIH Toolbox ( $r = .54$ ,  $p < .001$ ), with younger children demonstrating better performance.

**Conclusion:** Our findings indicate that although there is a strong correlation between the WASI and the NIH Toolbox, there is a difference between tests related to vocabulary and those that focus on executive function. These data suggest that given the specific challenges related to

executive function that children with SCD experience, time limitations, and the desire to reduce the burden on families, the NIH Toolbox is a screening measure that likely best captures the specific cognitive deficits experienced by children in this population.

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**Keywords:** sickle cell disease, stroke, cognitive

**F. AHMED, T. MCMILLAN, L. LAGERSTROM, J. L. THOMPSON. Waist-to-Hip Ratio in Young Adults: Performance on the Trail Making Test.**

**Objective:** It is well-established that obesity increases risk for dementia, particularly mid-life obesity (Ahmed et al., 2019). However, the cohort of current older adults in these longitudinal studies were likely more physically active in childhood/adolescence than our current generation. According to the Centers for Disease Control from 2015-2016, 18.5% of those ages 2-19 years were obese. The reduced physical activity among children and adolescents is particularly concerning regarding the brain, as this is a time when the more complex cognitive functions are continuing to develop (Luciana, 2005; Salthouse, 2009). Unlike body-mass index, waist-to-hip ratio (WHR) is a better metric for identifying unhealthy weight (Ahmed et al., 2019). Given that executive function is often most easily impacted (Gunstad et al., 2010), our objective was to examine the influence of WHR on Trail Making Test (TMT) performance among healthy young adults.

**Participants and Methods:** This study is part of a larger database project examining the role of various health metrics and their relationship with cognition. In a sample of 151 healthy undergraduate college students (mean age = 19.1, SD=2.021), we examined the correlation and regression of WHR on TMT performance. TMT performance was divided into completion time part A (TMT-A), completion time part B (TMT-B), and the difference between completion between parts A and B (TMT-B-A).

**Results:** The data were non-normally distributed. Age and education were not correlated with TMT performance. A Spearman's rank-order correlation showed that WHR was significantly correlated with TMT-A and TMT-B, but not TMT-B-A. We then ran two simple regression analyses and found that WHR accounted for significant variance for TMT-B ( $\beta=0.25$ ,  $t(137)=3.01$ ,  $p<.05$ ) but not TMT-B-A ( $p>.05$ ).

**Conclusions:** Given the restricted range in our participants, it can be difficult to generalize our findings. We can conclude, however, that WHR is already an important factor in cognitive set shifting. Importantly, these findings support evidence that indices of health, such as WHR, may already impact complex cognitive functions as early as young adulthood.

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**Keywords:** executive functions

**J. BEATTIE, C. A. AUSTIN, B. LEJEUNE, A. BRADLEY, M. GERSTLE, D. W. BEEBE. Examiner Relationships and Concrete Guidance Predict Parent Satisfaction with Pediatric Neuropsychological Evaluations.**

**Objective:** Research has shown that most, but not all, parents are satisfied with pediatric neuropsychological evaluations. There are few known predictors of satisfaction to target for quality improvement efforts.

**Participants and Methods:** In this study, 91 parents rated their satisfaction several months post-evaluation.

**Results:** Overall, parents were highly satisfied, but there was variation. Satisfaction was unrelated to child sex, race, ethnicity, or age ( $p > .05$ ). However, it was related to parents' retrospective report of the examiner's relationship skills and concrete guidance. Parents were most satisfied when they perceived a positive relationship between the evaluator and themselves ( $\rho = .66$ ) and their child ( $\rho = .43$ ), and when they recalled fewer negative feelings during the evaluation (e.g., "I felt blamed for my child's problems";  $\rho = -.30$ ),  $p < .005$ . Parents were also more satisfied when they reported having received more concrete guidance on services ( $\rho = .69$ ) and having learned new information ( $\rho = .68$ ),  $p < .001$ . Prospective parent ratings gathered pre- and post-evaluation showed fewer associations. Satisfaction correlated with pre- to post-evaluation change in child functioning ( $\rho = .25$ ),  $p < .05$ , but not change in severity of child problems or change in parent knowledge/efficacy,  $p > .05$ .

**Conclusions:** By collecting data at multiple time points, this work contributes to a growing literature on parent satisfaction and therapeutic/collaborative assessment concepts in neuropsychological evaluations.

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**Keywords:** neuropsychological assessment, neuropsychological outcome

**A. P. FISHER, L. M. GIES, C. A. AUSTIN, M. NARAD, N. ZHANG, K. YEATES, H. TAYLOR, S. WADE. Parent- and Adolescent-Reported Executive Functioning in the Context of Randomized Controlled Trials of Online Family Problem-Solving Therapy.**

**Objective:** Executive functioning (EF) deficits are one of the most common and persistent sequelae after pediatric traumatic brain injury (TBI), impairing functioning across a multitude of domains. Online Family Problem-Solving Therapy (OFPST) has been developed to mitigate impairments such as deficits in EF. Previous research has identified discrepancies between parent- and adolescent-reported EF behaviors following TBI; however, no studies have investigated differences in OFPST. We also examined parent- and adolescent-reported EF behaviors following pediatric TBI in the context of Online Family Problem-Solving Therapy and moderators of change in EF behaviors.

**Participants and Methods:** 274 adolescents aged 11 to 18 years with complicated mild to severe pediatric TBI and their parents were randomized to OFPST or an internet resource comparison group. Participants completed the Behavior Rating Inventory of Executive Function at four time points. Mixed models were used to examine EF behaviors, assessing the effects of visit, treatment group, rater, TBI severity, age, socioeconomic status (SES), and family functioning.

**Results:** Parents rated their adolescents' EF as poorer ( $F(3,1156) = 220.15$ ,  $p < .001$ ;  $M = 58.11$ ,  $SE = 0.73$ ) than adolescents rated themselves ( $M = 51.81$ ,  $SE = 0.73$ ). Across raters, EF behaviors were poorer for adolescents with lower SES ( $F(3,1156) = 8.60$ ,  $p = .003$ ;  $M = 56.76$ ,  $SE = 0.98$ ) than for those with higher SES ( $M = 53.16$ ,  $SE = 0.88$ ). Age at baseline interacted with visit ( $F(3,1156) = 5.05$ ,  $p = .002$ ), such that families with older adolescents reported improvement in EF behaviors over time. Family functioning also interacted with visit ( $F(3, 1156) = 2.61$ ,  $p = .049$ ), indicating more improvement in EF behaviors over time in higher functioning families. There were no effects of treatment or TBI severity.

**Conclusion:** We identified a discrepancy between parent- and adolescent-reported EF and factors that influenced EF behaviors over time including age, SES, and family functioning. These results, along with previous findings, emphasize both the significance and challenges associated with interventions designed to target EF behaviors in younger individuals. Additionally, this study highlights the importance of family functioning and the need to consider this factor throughout recovery.

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**Keywords:** executive functions, traumatic brain injury, pediatric neuropsychology

### **C. BAUCKE, S. GOLDSTEIN, R. LAJINESS-O'NEILL. Birthweight and Parental Education: Predictors of Communication Development in Infancy.**

**Objective:** Communication skills are essential for meeting social and emotional needs and begin to develop in infancy (Bates, Camaioni, & Volterra, 1975; Iverson, 2010). Literature has identified several predictors of communication development in childhood, including birthweight (Madigan, Wade, Plamondon, Browne, & Jenkins, 2015; Shenkin, Starr, & Deary, 2004) and parental level of education (Graybill et al., 2016; Rowe, Denmark, Harden, & Stapleton, 2016). Lower birthweight and less parental education have negatively impacted outcomes in school-age children (Andreias et al., 2010; Chaudhari et al., 2005). However, limited research has examined the effect of these factors on infant communication development. The present study aims to assess the interaction effects between parental education and birthweight on parent-reported communication development across the first six months of infancy. It is hypothesized that birthweight, parental education, and their interaction will positively predict communication scores at two, four, and six months.

**Participants and Methods:** Participants were term and pre-term infants (N = 470) who were recruited from a larger multi-site study of PediaTrac™ v3.0, a web-based tool for tracking infant development (Lajiness-O'Neill et al., 2018) and were being surveyed longitudinally from birth through 18 months. Participants completed the online PediaTrac™ survey and several reliable and validated developmental, behavioral, and caregiver questionnaires completed via pen-and-paper. For the purposes of this study, only the Ages and Stages Questionnaire (3rd ed.; ASQ-3; Squires & Phillips, 2009) and the Communication and Symbolic Behavior Scales–Developmental Profile (CSBS-DP; Wetherby & Prizant, 2001) were examined. Moderation analyses were conducted to evaluate the differential effects of parental education and birthweight and their interaction on communication scores.

**Results:** Results indicated that neither birthweight nor the interaction between birthweight and parental education significantly predicted communication scores. Parental education accounted for much of the variance in communication scores across all time periods. Parental education significantly predicted ASQ and SCG scores at 2 months (ASQ  $\beta = -.14$ ,  $p = .03$ ,  $R^2$  adjusted = 0.06; SCG  $\beta = -.22$ ,  $p < .001$ ,  $R^2$  adjusted = 0.08) and 4 months (ASQ  $\beta = -.24$ ,  $p = .001$ ,  $R^2$  adjusted = .08; SCG  $\beta = -.28$ ,  $p < .001$ ,  $R^2$  adjusted = 0.08), and SCG scores at 6 months ( $\beta = -.20$ ,  $p = .008$ ,  $R^2$  adjusted = 0.03). Unexpectedly, greater levels of parental education predicted lower communication scores.

**Conclusions:** This study explored the interaction effect between birthweight and parental education on parent-reported infant communication development. No significant interaction effects were found. Birthweight did not significantly predict most communication scores, contrary to the trends of previous literature demonstrating birthweight as a predictor of

communication development (Madigan, Wade, Plamondon, Browne, & Jenkins, 2015; Shenkin, Starr, & Deary, 2004). Contrary to the hypothesis, parental education was negatively associated with parent-reported infant communication scores. This unexpected association may have captured an important effect of parental education on parent reporting of infant skills and development. The relationship between parental education and parent reporting identifies a need for better psychoeducation for parents across education levels regarding developmental milestones and expected communication skills in infancy.

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**Keywords:** language: development, pediatric neuropsychology, demographic effects on test performance

**D. MCCALL, A. KIRSCH, A. HUEBNER, T. BROWN. Hospital Referral Patterns in Pediatric Neuropsychology: An Update after 25 Years.**

**Objective:** The field of Pediatric Neuropsychology has evolved and grown significantly over the last two decades. As more neuropsychologists have devoted their practice exclusively to children and adolescents, the quantity and complexity of caseloads have increased. In 1995 Yeates and colleagues described referral patterns for 1 year at three different Pediatric Neuropsychology practices. This project describes the referral patterns for 8 years at one Pediatric Neuropsychology practice. The goal is to compare and contrast the referral patterns described by Yeates and colleagues (1995) to this recent referral pattern as a measure of the evolution of the field of Pediatric Neuropsychology.

**Participants and Methods:** This project includes all patients evaluated by pediatric neuropsychologists at Mayo Clinic in Rochester, Minnesota from 2010-2018. This includes 2906 unique patients ages 0 – 39 years ( $n = 167$  for patients 18-years-old and above). The practice also completed several re-evaluations such that 604 patients have two or more evaluations and 2 patients have seven evaluations.

**Results:** The Pediatric Neuropsychology practice at Mayo Clinic, Rochester evaluated an average of 370 patients per year from 2010-2018. The majority of these patients had at least one medical diagnosis. The most common medical diagnosis was epilepsy or seizures (over 800 evaluations), followed by a history of traumatic brain injury (over 200 evaluations), a central nervous system tumor (over 200 evaluations), and a genetic condition (over 200 evaluations). The practice also evaluated many patients with a diagnosis of autism spectrum disorder (ASD) or characteristics of ASD (over 450 evaluations) or a craniofacial disorder (over 100 evaluations). These patients were referred from 23 different departments.

**Conclusions:** When compared to similar practices from 25 years ago, the Pediatric Neuropsychology practice at Mayo Clinic, Rochester evaluated approximately 1.5-2.5 times more patients per year. The majority of the most common diagnoses were similar at both time points but the percentage of cases differed. Additionally, there were several diagnostic categories that accounted for a substantial portion of the Mayo Clinic practice that were not among the most frequent diagnoses in 1995 (e.g., ASD, craniofacial anomalies, autoimmune disorders, etc.). Although the referral patterns for Mayo Clinic, Rochester will not generalize to all Pediatric Neuropsychology practices, it is believed to broadly reflect trends of practices within academic medical centers. Importantly, a general comparison between similar practices 25 years apart suggests that pediatric neuropsychologists are evaluating significantly more patients with a wider range of diagnoses than they did 25 years ago.

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**Keywords:** pediatric neuropsychology

**J. J. MANIAK, K. FRENN, M. K. GEORGIEFF, K. LIM, M. M. LUCIANA, J. WOZNIAK, R. I. PIERPONT. Feasibility of Remote Testing Methodology for the Study of Fine Motor Development in Preschool and School-Aged Children.**

**Objective:** Longitudinal monitoring of motor and neurocognitive functioning changes via smartphone and tablet applications is a promising method for detecting subtle changes in individuals with progressive neurologic disease. Validation of this methodology for pediatric populations could facilitate research and clinical care during a pandemic or in situations where direct contact with patients is otherwise challenging (e.g., in the study of rare diseases). We aimed to test the feasibility of a remote method of testing fine motor function in preschool and school-aged children with no direct contact between the research team members and the participating families.

**Participants and Methods:** Our team designed and programmed a Flutter application for iPads and tablets to assess the speed and timing of finger taps on a touchscreen. The application consists of a single-hand and alternating-hand tapping conditions as well as a condition to measure the synchrony of simultaneous taps with both hands. The conditions requiring bimanual coordination were developed to assess functions associated with the interhemispheric white matter tracts of the corpus callosum. Feasibility data were collected from 12 healthy, typically developing preschool and school-aged children (ages 4 to 14) through remote iPad test administration. During the initial pilot phase of the study, a sanitized iPad, as well as study supplies and participant incentives, were delivered through a no-contact curbside drop off with families. Visits were then conducted by a video call from another location. Participants completed our novel fine motor measure along with measures of handedness, alternate measures of finger tapping (NEPSY Finger Tapping), and a vocabulary test (NIH Toolbox).

**Results:** Remote data collection in our local community proved safe and feasible during a pandemic. Performance data from the fine motor application demonstrate expected age-related improvements in finger tapping speed for both single and alternating conditions and were associated with other measures of neurocognitive and fine motor function. Synchrony of bimanual taps was generally quite accurate (i.e., within 20 milliseconds), even among preschool children.

**Conclusions:** Remote test administration via tablet applications are a practical method of collecting pediatric psychometric data both rapidly and safely during the COVID-19 pandemic. When administered longitudinally, these tools may have the potential for capturing subtle neural changes in developing children and seem especially well suited for populations with rare diseases to allow for data collection without the need for long-distance travel. The next steps of this project are to ensure test-retest reliability and to compare the performance of typically developing children to that of children with neurologic disease. Future versions of our application will allow for families to download the application on their personal devices. This adaptation will allow for national recruitment in our study and eliminate the need for curbside drop-off and pickup of iPads from the homes of the research participants.

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**Keywords:** psychometrics, test development, motor function

**S. TAYLOR, P. MARTIN, R. W. SCHROEDER. At What Point is One Trial on the Test of Memory Malingered Enough? A Systematic Review of Pediatric Studies.**

**Objective:** A score of 45 on the Test of Memory Malingered (TOMM) Trial 1 (T1) predicted passing the full TOMM in 100% of cases in a review of 19 adult-focused studies (Denning, 2012). Expanding on these findings, this systematic review examined the utility of T1 in predicting passing subsequent TOMM trials in pediatric samples by aggregating data from previously published studies.

**Participants and Methods:** A systematic review of two research databases (i.e., PubMed and PsycInfo) was performed for full-text articles published in English between 1996 and 2020 that examined TOMM performance in children. Studies were included if they examined the accuracy of T1 performance in predicting passing of the TOMM overall. Of the 13 unique results, only four studies (Brooks, Sherman, & Krol, 2012; Donders & Gardner, 2020; Loughan, Perna, & Le, 2016; Perna & Laughan, 2013) compared T1 performance to subsequent TOMM trials. When available, data were extracted regarding the frequency of children who passed and failed T1 at various cut points and subsequently passed or failed the TOMM based on the adult published cutoff for Trial 2 or the Retention trial (i.e., <45). In two instances, frequency data were not directly reported and were calculated using the reported classification accuracy statistics, and in one instance, neither frequency data nor classification accuracy statistics were reported across cutoffs and the data were received via personal communication with the study's primary author. Frequency values were summed across studies for each T1 cut point. The overall mixed clinical sample included 448 children aged 6-19 ( $M_{age}=12.60$ ,  $SD=3.3$ ; 54.69% boys;  $M_{fsiq}=88.56$ ,  $SD=17.9$ ).

**Results:** The overall failure rate for the TOMM was 8.48% ( $n=38$ ). At a T1 cut score of  $\geq 40$ , 97.5% of children subsequently passed the TOMM. At a T1 cut score of  $\geq 41$ , 98.1% of children subsequently passed the TOMM. At a T1 cut score of  $\geq 42$ , 98.1% of children subsequently passed the TOMM. At a T1 cut score of  $\geq 43$ , 98.0% of children subsequently passed the TOMM. At a T1 cut score of  $\geq 44$ , 98.5% of children subsequently passed the TOMM. At a T1 cut score of  $\geq 45$ , 99.0% of children subsequently passed the TOMM.

**Conclusions:** Consistent with Denning's (2012) review of T1 in adults, T1 predicted passing subsequent trials of the TOMM with a high degree of accuracy in pediatric samples. If a child reaches a score of at least 45 on T1, there is a 99% likelihood that they will go on to pass subsequent trials of the TOMM. Given time pressures in clinical evaluations, particularly, such a score could justify discontinuation of the rest of the TOMM in some instances. Given that this systematic review was comprised of a relatively limited number of studies, ongoing research should further investigate utility of T1 as a performance validity measure, particularly in samples of children with more severe neurologic illness and intellectual impairments.

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**Keywords:** test validity, pediatric neuropsychology, neuropsychological assessment

**I. GONZALEZ, A. MARTIN, G. BERRIOS-SIERVO, R. BOADA. Exploring Bilingualism as a Protective Factor for Executive Functioning Performance in Children with Neurocognitive Disorders.**

The bilingual advantage in executive functioning (EF) has been a matter of significant debate in the literature. Previous studies have inconsistently demonstrated advantages for bilinguals across

specific measures of EF in healthy populations and adult clinical samples. We examined whether bilingualism is a protective factor in the EF performance of children with medical conditions affecting the central nervous system.

This retrospective study sample consisted of 140 children (Mean age=12.64; SD=3.3) with epilepsy (n=72), oncological disease (n=30), congenital heart disease (n=18), or neurofibromatosis (n=20). Half of the patients in each disease population were bilingual (English-Spanish). Children were administered intellectual, language, and EF measures as part of comprehensive clinical evaluations. The bilingual and monolingual groups were matched on relevant disease severity variables. One-sample and independent sample t-tests, as well as multiple regression analyses were conducted to compare and predict EF outcomes.

One-sample t-tests showed that our cohort of patients scored significantly lower on measures of intellectual functioning (Full Scale Intellectual Quotient [FSIQ]), attention, working memory, inhibition, switching, planning, and verbal fluency (all  $p$ -values < .05) when compared to the normative groups. Similar significant discrepancies from the normative mean were found on parent ratings of EF using the BRIEF. While commission errors on a continuous performance test (CPT) were normal in the bilingual group, ( $t(17)=0.28$ ,  $p=.978$ ), there was a trend for poorer performance in monolinguals ( $t(19)=-1.922$ ,  $p=.07$ ).

Independent sample t-tests revealed significantly better performance in monolinguals on FSIQ, verbal working memory, and verbal fluency (FSIQ  $t(133)=4.670$ ,  $p<.01$ ; Digit Span  $t(117)=2.681$ ,  $p<.01$ ; DKEFS VF-CS  $t(81)=2.593$ ,  $p=.05$ ). Bilingual patients performed significantly better than monolinguals on measures of visual inhibition (CPT Commissions  $t(100)=-2.747$ ,  $p<.01$ ). Using ANCOVA, differences in EF performance remained on measures of FSIQ, verbal working memory, visual inhibition, and verbal fluency when controlling for maternal years of education. Visual inhibition was the only one that remained significant when additionally controlling for FSIQ.

Lastly, the difference in receptive vocabulary scores was used as a continuous measure of the extent to which a patient was a balanced bilingual. The latter, along with FSIQ and maternal education, was used to predict EF outcomes using multiple linear regression. Level of bilingualism predicted significant variance in only one EF measure: Digit Span ( $R=.37$ ,  $F(1,38)=5.902$ ,  $p<.02$ ;  $\beta=.45$ ,  $p<.02$ ). However, the direction of effect was contrary to what was predicted; namely, bilingual patients who were less balanced performed better.

Consistent with prior literature, patients from these 4 diagnostic groups, as a whole, showed cognitive and EF impairment relative to typically developing same-age peers. While monolinguals outperformed bilinguals on verbal tasks of EF, bilingual children demonstrated a significant advantage on a task of visual inhibition. Contrary to our hypothesis, balanced bilingualism negatively predicted verbal working memory performance. Although study limitations include a small sample size and use of retrospective clinical data, this study is among the first to examine EF in bilingual children who are neurologically compromised. Furthermore, there is evidence to suggest that bilingualism might serve as a protective factor for some aspects of EF performance (inhibition).

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**Keywords:** bilingualism, executive functions, medical disorders/illness

**A. FOY, R. L. HUDOCK, R. SHANLEY, R. I. PIERPONT. Social Behavior in Children with RASopathies and Idiopathic Autism.**

**Objective:** Children with genetic syndromes that arise from disruptions to the RAS-MAPK cellular signaling pathway (RASopathies) and children with non-syndromic autism spectrum disorder (idiopathic ASD) are both at increased risk of social problems, but few studies have compared social behavior in these conditions. Some literature indicates that children with RASopathies may exhibit relatively strong empathetic or prosocial behaviors. Our study sought to 1) evaluate and compare the presence of empathy and social competence in children and adolescents with RASopathies and idiopathic ASD, and 2) determine which psychological factors predict scores on measures of empathy and social competence for each group.

**Participants and Methods:** In this cross-sectional, survey-based investigation, parents and caregivers of 180 children with RASopathies (neurofibromatosis type 1, Noonan syndrome, cardiofaciocutaneous syndrome, Costello syndrome) and 97 children with non-syndromic (i.e., idiopathic) ASD provided ratings to evaluate the presence of empathetic behavior and social competence as well as symptoms of hyperactivity/inattention, emotional problems, and communication skills. Medical and family history was also ascertained.

**Results:** Despite a notably heightened risk for problems with social competence, parent ratings demonstrated relatively intact empathetic behaviors in children with RASopathies. In contrast, among children with idiopathic ASD, parents reported a similar degree of impairment across these two domains of social behavior. Similarities and differences emerged with regard to which psychological factors predicted social behavior in these two groups. Stronger communication skills were associated with increased empathetic behavior for both groups. For the idiopathic ASD group, communication abilities were also associated with social competence. For the RASopathy group, problems with social competence were more strongly associated with emotional challenges and hyperactive-impulsive behaviors.

**Conclusions:** The development of social behavior among children with RASopathies may involve a distinct pattern of strengths and weaknesses as compared to a behaviorally-defined disorder such as idiopathic ASD. Identification of areas of resilience as well as behavioral and social challenges may support more targeted intervention.

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**Keywords:** genetic disorders, autism spectrum disorder, pediatric neuropsychology

**S. K. PARDEJ, D. M. GLAD, C. L. CASNAR, B. P. KLEIN-TASMAN. Measurement of Attention in Young Children with NF1: Comparison of the K-CPT and K-CPT-2.**

**Objective:** Children with neurofibromatosis type 1 (NF1) demonstrate difficulties with attentional maintenance (Isenberg et al., 2013). There is little research about the measurement of attention in young children with NF1. This study aims to explore whether there are differences between the mean outcome scores on the two editions of the Conners Kiddie Continuous Performance Test (K-CPT), a widely used measure of attentional maintenance, in young children with NF1. The K-CPT has been used in prior research with young children with NF1 (Arnold et al., 2018; Sangster et al., 2011), but there is no published research using the updated K-CPT-2. Performance on these measures is compared in two samples of children with NF1, and relations with parent-reported attention difficulties are explored.

**Participants and Methods:** Participants included children with NF1 ages 4-6 years from two independent samples: 1) K-CPT sample (N = 22; 8 female, 14 male; mean age = 4.95 (SD =

0.66)) and 2) K-CPT-2 sample (N = 19; 7 female, 12 male; mean age = 5.46 (SD = 0.74)). The K-CPT and K-CPT-2 are computerized measures of attentional maintenance for use with young children. Parent report measures included the Kiddie Disruptive Behavior Disorder Schedule (KDBDS) semi-structured Attention-Deficit/Hyperactivity Disorder (ADHD) module and Conners Parent Rating Scales – Revised Short Form (CPRS-R; K-CPT sample) or the Conners Early Childhood Behavior Short Form (Conners EC; K-CPT-2 sample). The K-CPT and K-CPT-2 samples did not differ significantly in ADHD symptom severity.

**Results:** Results of Mann-Whitney U tests indicated that Omissions [ $U=124.00$ ,  $p=.026$ ], Hit Reaction Time [ $U=104.50$ ,  $p=.006$ ], and Hit Rate Standard [ $U=132.50$ ,  $p=.045$ ] scores were significantly more impaired on the K-CPT-2 than in the K-CPT sample. Two-tailed Spearman correlations between each outcome score and KDBDS symptom counts indicated no significant relations between K-CPT scores and KDBDS inattention, hyperactivity, or combined symptoms counts. In the K-CPT-2 sample, inattention, hyperactivity, and combined symptom scores on the KDBDS were significantly related to several K-CPT-2 outcome scores. Two-tailed Spearman correlations indicated no significant relations between the K-CPT and the CPRS-R Cognitive Problems/Inattention or Hyperactivity scales. In the K-CPT-2 sample, several outcome scores were significantly related to the Conners Early Childhood Inattention/Hyperactivity scale.

**Conclusions:** This study is a preliminary look into the comparative utility of the K-CPT and K-CPT-2 for young children with NF1, and the first investigation of performance on the K-CPT-2 in an NF1 sample. Young children with NF1 showed weaker performance on the K-CPT-2 than on the K-CPT, specifically with a slower response speed, less consistency in responding, and more missed targets. This pattern of performance is suggestive that the KCPT-2 is more likely to pick up on attention difficulties in NF1. In addition, the K-CPT-2 was more closely related to functional indicators of attention difficulties than was the K-CPT, as evidenced by the pattern of relations to parent-reported difficulties. Given the additional sensitivity of the K-CPT-2 and its relation to functional measures, the K-CPT-2 may better serve clinicians and clinical trials researchers when assessing attention difficulties in young children with NF1.

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**Keywords:** neurofibromatosis, psychometrics, attention

### **M. MAHALE, E. LIMA, J. PIVONKA-JONES. Neuropsychological Profile of Pediatric Hypotonia, Ataxia, and Delayed Development Syndrome (HADDS): A Case Study.**

**Objective:** Hypotonia, ataxia, and delayed development syndrome (HADDS) is a neurodevelopmental syndrome characterized by intellectual delays, global developmental delay, ataxia, hypotonia and dysmorphic features, as well as varying severities of genitourinary malformations and cerebellar hypoplasia (Harms et al., 2016; Chao et al., 2017; Blackburn et al., 2017; Sleven et al., 2017; Tanaka et al., 2017). Limited published data exists on neuropsychological profiles and long-term outcomes of individuals diagnosed with HADDS. The following case presentation sought to add to the literature on HADDS with specific focus on the neuropsychological profile of the patient.

**Participants and Methods:** Six-year-old right-handed Caucasian/African American male with a history of developmental delay, who was diagnosed with HADDS at age five-years via genetic counseling with de novo nonsense variant in EBF3. Mother reported that her pregnancy was uneventful. Patient was not as active as a toddler, interacted with others less than expected, and had delayed developmental motor and language acquisition milestones. Neurologist noted ataxia,

slight tremor and atypical head shape. Initial brain MRI indicated white matter periventricular, and subcortical hyperintensities of the cerebrum; follow up MRI indicated interval improvement of periventricular hyperintensity. There was some concern for Autism Spectrum Disorder (ASD), which was ultimately ruled-out. Hearing is within normal limits, vision is significant for hyperopia of both eyes with astigmatism, and patient underwent surgical intervention for bilateral strabismus and umbilical hernia. Mother reported concerns related to HADDs, difficulty writing, and behavioral concerns at home and at school, but did not have social concerns.

**Results:** Neuropsychological testing revealed areas of cognition that were intact/average included acquired verbal knowledge, immediate and delayed verbal memory, visual spatial reasoning, adaptive functioning, and one aspect of executive functioning (organization verbal output). Areas of neurocognitive weakness included fluid reasoning, expressive and receptive language, nonverbal memory, verbal contextual memory recognition, fine motor control, and aspects of executive functioning (working memory, processing speed and inhibitory control).

**Conclusions:** The profile pattern of the patient is consistent with individuals diagnosed with HADDs. Further study into genetic variants, co-occurring health conditions, and long-term behavioral changes would help develop a deeper understanding on age related changes associated with this syndrome.

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**Keywords:** genetic disorders, child development disorders, pediatric neuropsychology

**L. KAIS, E. BENNETT, R. BOADA, S. DAVIS, C. CRERAND, A. TISHELMAN, J. KREMEN, C. HUTAFF-LEE. Neuropsychological Screening in a Multidisciplinary Turner Syndrome Clinic: Feasibility and Preliminary Outcomes.**

**Objective:** Turner syndrome (TS) is a genetic condition that occurs in 1:2000-2500 females due to the complete or partial absence of the second sex chromosome. Individuals with TS are at risk for neurocognitive and psychosocial differences. TS clinical practice guidelines recommend annual screening for concerns in these domains; however, available screening measures have not been validated with patients with TS. The aim of this project was to investigate the utility of neurocognitive screening measures (Colorado Learning Difficulties Questionnaire, CLDQ; Pediatric Perceived Cognitive Function, PCF) completed by caregivers in a multidisciplinary TS clinic.

**Participants and Methods:** Thirty-six caregivers of girls with TS (M patient age =  $11.80 \pm 4.66$  years; 75% Caucasian) completed screening measures (Colorado Learning Difficulties Questionnaire, CLDQ; Pediatric Perceived Cognitive Function, PCF) during a clinic visit. One sample test of proportions were used to compare the proportion of TS caregiver scores in the at-risk of clinically significant range to population norms.

**Results:** Girls with TS were more likely to be in the at-risk or clinically significant range compared to general population norms for 4 of the 5 CLDQ scales (mathematics, social cognition, spatial disorganization, and anxiety; all  $p < .001$ ). Additionally, caregivers of girls with TS endorsed significantly more difficulties with attention and aspects of executive functioning on the PCF ( $p < .001$ ).

**Conclusions:** The pattern of deficits observed on these screening tools is consistent with the known neurocognitive impairments in the TS population, supporting the use of these

instruments. Future steps include assessing the metrics of these screening questionnaires compared to traditional neuropsychological measures.

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**Keywords:** Turner syndrome, pediatric neuropsychology

**N. KAMATH, E. BEGYN, J. DYKSTRA, R. N. JENSEN, K. KINGERY, S. KOCH, B. MCDONALD. Conduct Problems are Associated with Parent-Reported Learning Difficulties in Children with Neurofibromatosis Type 1.**

**Objective:** At least half of individuals with neurofibromatosis type 1 (NF1) demonstrate academic underachievement due to a unique combination of cognitive, behavioral, and emotional difficulties. This study intended to further explore the relationship between these domains and parent-reported learning difficulties among children and adolescents with NF1.

**Participants and Methods:** The study examined 16 children ages 5-16 with NF1 who were clinically referred for outpatient neuropsychological assessment. Inclusion criteria included no history of treatment for comorbid tumors. Participants were divided into a parent-reported learning difficulties ( $n = 10$ ) group and a control ( $n = 6$ ) group. Measures included the WISC-V/WPPSI-IV Working Memory and Processing Speed Indices, Conners CPT-3, Woodcock Johnson Tests of Achievement, Fourth Edition, Behavior Rating Inventory of Executive Function, Second Edition (BRIEF-2), and the Behavior Assessment for Children, Third Edition (BASC-3).

**Results:** Independent samples t-tests revealed statistically significant between-group differences ( $p < .05$ ), such that the parent-reported learning difficulties group rated more conduct problems, aggression, withdrawal, and organization of materials, but did not reveal differences on lab-based measures of working memory, processing speed, or academic skills, or other parent-reported behavioral, emotional, or cognitive symptoms. After Bonferroni correction ( $p < .002$ ), only the difference in conduct problems was maintained.

**Conclusions:** Contrary to expectations, results suggested that parent-reported learning difficulties were not associated with academic, attention, or executive functioning deficits, but rather with conduct problems. While additional research with larger samples is needed, results highlight the importance of appropriately identifying and treating behavioral problems in optimizing academic success.

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**Keywords:** genetic disorders, learning, pediatric neuropsychology

**J. WESTDAL, A. ISAIA, J. EISENGART, K. KING. Children with Mucopolysaccharidosis I and ASD: Observations from Case Studies.**

**Objective:** Mucopolysaccharidosis type I (MPS I) is a lysosomal disorder caused by deficiency of the enzyme  $\alpha$ -L-iduronidase, which results in accumulation of glycosaminoglycans (GAGs) in cells and leads to multi-organ dysfunction, including the central nervous system (CNS). Research on cognitive and behavioral functioning in MPS has generally shown that the severe phenotype of MPS (Hurler syndrome, MPS IH) is associated with rapid cognitive decline and the attenuated forms of MPS (Hurler-Scheie and Scheie syndromes, MPS IA) are more varied, with some cognitive functions ranging from average to impaired. While some MPS types have been

described as at risk for autism spectrum disorder (ASD), such as MPS type III, this diagnosis is less commonly reported in MPS I. However, our collective clinical observations suggest that a portion of individuals with MPS I meet criteria for autism spectrum disorder (ASD). This poster describes the neurocognitive and behavioral functioning of individuals with MPS I and ASD.

**Participants:** We present three young adults ( $n = 1$  MPS IH, age 26;  $n = 2$  MPS IA, ages 24 and 18) with diagnoses of MPS I and ASD and consider their neuropsychological and medical findings.

**Results:** Consistent with other domains of the neuropsychological profile, the individual with MPS IH presented with more severe symptoms of ASD than those with MPS IA (e.g., meeting DSM-5 level 2 and 3 versus level 1 impairment) and with more severe aspects of ASD (e.g., self-injurious behaviors). Notably, the individuals with MPS IA had a genetic variant previously identified to be linked with a more severe neurocognitive and neurobehavioral manifestation of attenuated disease. Repetitive movements (e.g., flapping, flicking, stimming) were not described in any of the cases. FSIQ on the WASI-II ranged from impaired in the participant with MPS IH to slightly below average and average in the participants with MPS IA. Nonverbal IQ scores were higher than Verbal IQ scores and nonverbal IQ scores were low average to average for all 3 cases. Adaptive ratings were below average to impaired for all 3 cases.

**Conclusions:** These observations demonstrate a possible link between MPS I and behaviors associated with ASD, namely with more prominent social communication deficits than restricted and repetitive behavioral deficits. A prospective longitudinal study of the neurologic, neuropsychological, and behavioral correlates of comorbid MPS I and ASD is strongly indicated. There is also the need for increased awareness of this overlap in the clinical setting.

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**Keywords:** genetic disorders, autism spectrum disorder, medical disorders/illness

**A. DEL CASTILLO, S. P. SILBER, J. M. PAYNE, N. PRIDE, K. K. HARDY, K. WALSH.**  
**Examining cognitive load in children with Neurofibromatosis Type 1 compared to typically developing children.**

**Objective:** Cognitive load refers to the extent of working memory resources needed to complete a given task. Cognitive load includes intrinsic, extraneous, and germane factors. Deficits in attention, inhibition, and working memory are highly prevalent in children with neurofibromatosis type 1 (NF1), which align with overload in the intrinsic and extraneous factors of cognitive load. Susceptibility to cognitive overload can impact multiple areas of functioning, including learning, socialization, and adaptive skills secondary to disruptions along the processing pathway that result in a lack of adequate encoding and rehearsal of information. In this study, we aim to understand and describe the presence of cognitive overload in children with NF1 compared to non-affected children.

**Participants and Methods:** Participants include children diagnosed with NF1 ( $N=24$ ) and age- and sex-matched typically developing controls ( $N=27$ ). All participants were between 7 and 15 years of age ( $M=10.7$ ;  $SD=3.35$ ). Participants underwent a brief neurocognitive evaluation that included an intellectual screen and the Tasks of Executive Control (TEC). The TEC combines an n-back paradigm that increases working memory load, and a go/no-go task that manipulates inhibitory control demands. There are 3 levels of WM demand presented (0, 1, 2-back), crossed with absence vs. presence of an inhibitory signal. Alpha was set at .05 for all analyses. General

linear models were applied to evaluate between (NF1 vs. control) and within group (task load) differences.

**Results:** Children with NF1 had significantly greater problems with accuracy and speed tasks than normative children when cognitive load was increased. Results indicate statistically significant differences in target accuracy between the NF1 and control groups ( $F=5.31$ ;  $p=.03$ ;  $Eta\ squared=.23$ ), with the NF1 group demonstrating significantly poorer accuracy for target stimuli responding. There were trends towards significance for response efficiency and incorrect responding, with the NF1 cohort performing worse than controls. Further, the NF1 group performed significantly worse when the task involved inhibitory control and adjusting to increasing load.

**Conclusions:** Children with NF1 appear to be particularly susceptible to an increase in cognitive load resulting in poorer accuracy and decreased efficiency compared to typically developing peers. When cognitive load is increased, children with NF1 tend to sacrifice the mundane/background task responses in favor of the novel task responses. Examination of the contribution of attention and working memory deficits in this pattern will be reported.

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**Keywords:** neurofibromatosis, cognitive, cognitive functioning

**C. BOADA, T. THOMPSON, R. WILSON, M. BROWN, T. TANDA, G. STEFY, J. ROSS, N. TARTAGLIA, J. JANUSZ. eXtraordinary Babies: Early Developmental Profile of Infants and Toddlers with Prenatally Identified Sex Chromosome Trisomies.**

**Objective:** Children with sex chromosome trisomies (SCTs: i.e. XXY, XYY, XXX) are at risk for cognitive, language, and motor deficits. Increased use of non-invasive prenatal testing (NIPT) has allowed for prenatal identification of SCT and the study of early development in these children. This study uses the Bayley Scales of Infant and Toddler Development - Third Edition to characterize early development and identify risk factors in this population.

**Participants and Methods:** Participants included infants and toddlers identified prenatally by NIPT as having XXY, XYY, and XXX. Participants were assessed with the Bayley-3 at 6 months ( $n = 100$ ), 12 months ( $n = 98$ ), and 24 months of age ( $n = 42$ ). One sample t-tests were conducted with the entire cohort to compare scaled scores on the Bayley-3 at 6, 12, and 24 months of age to the population mean of 10 ( $SD=3$ ). Paired samples t-tests were conducted to compare expressive vs. receptive language and fine vs. gross motor at each timepoint. Finally, repeated measures ANOVAs were used to explore Bayley-3 scores across time in a subgroup of children who had data for all 3 timepoints ( $n=23$ ).

**Results:** One-sample t-tests showed no differences in cognitive skills compared to the population mean at all timepoints (Cognitive scale means (SD): 6 month  $ss= 9.93 (2.46)$ ; 12 months  $ss= 10.49 (1.91)$ ; 24 months  $ss= 10.76 (2.58)$ ). At all 3 timepoints, expressive language and gross motor scales were lower than the population mean ( $p \leq .001$ ), but generally in the average range. Similarly, the receptive language scale was lower at the 6 and 12 month timepoints ( $p \leq .001$ ), and the fine motor scale was lower at 12 months ( $p < .05$ ), but all scaled scores were average. Across the entire cohort, gross motor skills were lower than fine motor skills at 6 and 12 months ( $p \leq .001$ ), and a trend was seen at 24 months ( $p = .10$ ). Expressive language was lower than receptive language at 6 and 24 months ( $p < .05$ ). Secondary analyses with 23 children with data at all timepoints showed that receptive language was lower at the 12 month assessment compared

to the 6 and 24 month assessment ( $p < .05$ ). Scaled scores were stable across timepoints for all other Bayley-3 scales.

**Conclusions:** This is one of the first prenatally-identified SCT cohorts observed from infancy. Cognitive skills are average at all three timepoints. While statistical differences are seen, scores on language and motor scales across all timepoints are generally average. However, relative weaknesses are seen in expressive language and gross motor skills, which are known areas of deficit in older children with SCT. Children's skills are relatively stable over time with the exception of receptive language, which lags at 12 months but then improves at 24 months. This study extends prior findings and suggests that a profile of risks seen in SCTs can be identified in infancy and early childhood.

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**Keywords:** neurocognition, language: development, pediatric neuropsychology

**K. LEE, E. M. OLSZEWSKI, B. YUND, B. P. KLEIN-TASMAN. Pre-Academic Predictors of Later School Age Academic Functioning in Children with Neurofibromatosis Type 1.**

**Objective:** Academic problems are commonly found among school age children with neurofibromatosis type 1 (NF1); however, there is a need for literature examining early school predictors of later school age academic functioning for children with NF1. Thus, pre-academic skills will be examined in relation to later school age academic functioning in children with NF1.

**Participants and Methods:** Twenty-four children with NF1 (14 boys/10 girls) were seen at two time points: early school age (ESA; ages 5-7) and late school age (LSA; ages 9-13). Assessments of pre-math (Differential Abilities Scales, Second Edition Early Years Form (DAS-II) Early Number Concepts (ENC) subtest) and pre-reading skills (DAS-II Phonological Processing (PP) and Rapid Naming subtests (RN) subtests) were examined at the ESA time point. Assessments of reading ability (Wechsler Individual Achievement Test, Third Edition (WIAT-III) Word Reading (WR), Pseudoword Decoding (PD), and Reading Comprehension (RC)) and math ability (WIAT-III Numerical Operations (NO) and Math Problem Solving (MPS)) were completed at the LSA time point.

**Results:** ENC was significantly correlated with later NO ( $r_s(22) = .612, p = .001$ ) and MPS ( $r_s(22) = .632, p = .001$ ). PP was significantly correlated with later WR ( $r_s(22) = .650, p = .001$ ), PD ( $r_s(22) = .633, p = .001$ ), and RC ( $r_s(22) = .571, p = .004$ ). RN was not significantly associated with later WR ( $\tau_b = .250, p = .095$ ), PD ( $\tau_b = .236, p = .116$ ), and RC ( $\tau_b = .116, p = .439$ ).

**Conclusions:** Findings from this study suggest that early math skills are indeed predictive of later math problem solving and math calculations abilities in school age children with NF1. Early phonological abilities, but not rapid naming abilities, are predictive of later basic reading, non-word reading, and reading comprehension abilities in school age children with NF1. Thus, assessment of pre-academic abilities in the early school age years may help to identify children with NF1 who may benefit from early academic interventions to support their learning. Further implications about the predictive utility of domain specific and domain general variables will be explored.

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**Keywords:** academic skills, neurofibromatosis

**Paper Session 17: Lifespan Trajectories & Predictors  
9:00 AM - 10:00 AM**

**A. KAPOOR, A. GAUBERT, A. MARSHALL, B. YEW, J. K. HO, A. E. BLANKEN, S. DUTT, I. SIBLE, Y. LI, J. JANG, K. E. RODGERS, M. SOTO, A. TAN, D. A. NATION.**  
**Systemic Markers of Angiogenesis and Neuropsychological Functioning in Older Adults.**

**Objective:** Damage to blood vessels commonly occurs with increasing age and can trigger angiogenic processes. Abnormal angiogenesis may adversely affect the circulatory system, including the cerebral circulation, and contribute to cognitive decline. However, few previous studies have explored whether systemic angiogenic processes may be related to cognitive function in older adults. We aimed to explore associations between circulating levels of proangiogenic factors and neuropsychological functioning.

**Participants and Methods:** Seventy-five independently living older adults (mean age = 70.3 years, SD = 7.9; age range 55-90 years; mean education = 16.0 years, SD = 2.9; 37.3% male) free of dementia or clinical stroke were recruited from the community and underwent venipuncture and comprehensive neuropsychological evaluation. Plasma was assayed for proangiogenic factors (VEGF-A, VEGF-C, VEGF-D, Tie-2, Flt-1). Multiple cognitive domains were assessed including verbal memory (RAVLT word list learning and memory, Logical Memory I and II), executive function (D-KEFS-2 Letter Fluency, Stroop, Trail Making B), language (Animal Fluency, D-KEFS-2 Fruits/Vegetables Fluency), visuospatial ability (WAIS-IV Block Design) and processing speed (Trail Making A). We conducted an exploratory analysis, utilizing multiple linear regression to examine the relationship between circulating proangiogenic proteins levels and cognitive performance after controlling for age and education.

**Results:** Worse performance on animal fluency was significantly associated with higher circulating levels of Flt-1 ( $\beta_{\text{standardized(s)}} = -.28, p = .012$ ), bFGF ( $\beta_s = -.31, p = .058$ ) and VEGF-D ( $\beta_s = -.22, p = .056$ ). Similarly, Fruits/Vegetables Fluency was negatively associated with levels of Flt-1 ( $\beta_s = -.36, p = .001$ ), and VEGF-D ( $\beta_s = -.30, p = .009$ ). Greater completion time on Trail Making Test A (worse performance) was associated with higher circulating levels of Tie-2 ( $\beta_s = .22, p = .041$ ) and VEGF-A ( $\beta_s = .29, p = .008$ ).

**Conclusions:** Older adults with higher proangiogenic markers in circulation exhibited worse performance on tests of semantic fluency and attention/processing speed. Higher levels of circulating proangiogenic factors may be indicative of vascular injury related to cognitive dysfunction. Alternatively, pathological angiogenic responses may have a causal impact on cognition by interfering with normal vascular function. Future longitudinal studies in the aging population may help elucidate the mechanism and causal directionality behind the observed relationship between angiogenic factors and cognition in older adults.

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**Keywords:** cognitive functioning, cerebrovascular injury, vascular cognitive impairment

**G. M. EGLIT, J. A. ELMAN, M. PANIZZON, M. SANDERSON-CIMINO, M. E. WILLIAMS, A. M. DALE, L. T. EYLER, C. FENNEMA-NOTESTINE, N. A. GILLESPIE, D. E. GUSTAVSON, S. N. HATTON, R. HAUGER, A. JAK, M. W. LOGUE, L. K. MCEVOY, R. E. MCKENZIE, M. C. NEALE, O. K. PUCKETT, C. A. REYNOLDS, R. TOOMEY, X. M. TU, N. WHITSEL, H. XIAN, M. J. LYONS, C. E. FRANZ, W. S.**

**KREMEN. Cognitive trajectories in later adulthood: Impact of peak cognitive reserve and prior cognitive reserve decline.**

**Objective:** Higher levels of young adult general cognitive ability (i.e., cognitive reserve) are thought to enable stronger cognitive maintenance in later life. However, most longitudinal studies of aging lack objective cognitive data from earlier ages. It is therefore unclear how directly measured young adult peak cognitive reserve and maintenance of peak reserve predict subsequent later life cognitive performance. Using the same measure of general cognitive ability (GCA) administered at two time points, we evaluated the extent to which young adult peak cognitive reserve and maintenance of cognitive reserve from young adulthood to average age 56 predicted specific cognitive abilities at age 56 and age-related change in specific cognitive abilities across three assessments from age 51-73.

**Participants and Methods:** In the Vietnam Era Twin Study of Aging (VETSA), 1173 individuals were administered the same measure of general cognitive ability (GCA) at average age 20 and at three VETSA waves at average ages of 56, 62, and 68. Age 20 GCA was used as a measure of peak cognitive reserve and cognitive reserve maintenance scores were created by residualizing age 56 GCA on age 20 GCA. Thus, good cognitive reserve maintenance was based on observed relative to expected scores. Specific cognitive abilities consisted of memory, processing speed, general verbal fluency, semantic fluency, working memory, and executive function factor scores. Peak cognitive reserve and cognitive reserve maintenance scores were entered into mixed effects models to predict specific cognitive abilities across the three VETSA waves. To further understand midlife cognitive reserve change and to validate our residual-based measure, we also explored associations of cognitive reserve maintenance with vascular burden, alcohol consumption, Alzheimer's disease risk (*APOE* genotype), and predicted brain age difference score, a commonly used measure of accelerated brain aging, which were all collected at average age 56.

**Results:** Both higher peak cognitive reserve and stronger cognitive reserve maintenance were associated with better performance on all specific cognitive abilities at age 56 (all  $ps < .001$ ), but neither predicted rate of age-related specific cognitive ability change from age 51-73. Poorer cognitive reserve maintenance was observed among *APOE*  $\epsilon 4$ -positive individuals with elevated vascular burden ( $t = -3.274, p = .001$ ) and was associated with accelerated brain aging ( $t = 2.868, p = .004$ ).

**Conclusions:** Both peak reserve and maintenance of reserve contribute to specific cognitive ability performance at late midlife, but contrary to cognitive reserve theory, are not associated with stronger cognitive maintenance with aging. Poor cognitive reserve maintenance coincides to some degree with poor brain maintenance and may be attributable to elevated vascular burden, but, given its lack of association with subsequent age-related cognitive change, does not appear to reflect the nascent stages of a neurodegenerative process. Overall, these findings suggest that there is meaningful midlife change in cognitive reserve, and highlight the importance of distinguishing between peak reserve, current reserve, and maintenance of cognitive reserve.

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**Keywords:** cognitive reserve, aging (normal), cerebrovascular disease

**B. G. COLLIN, C. BROWN, D. RAJU, S. KATSIKAS. Comparing Patterns of Benzodiazepine and Anticholinergic Drug Use on Cognitive Functioning in the Wisconsin Registry for Alzheimer's Prevention Study.**

**Objectives:** The goal of the study was to compare the effects of patterns of benzodiazepine and definite anticholinergic drug use on change in neuropsychological functioning in the Wisconsin Registry for Alzheimer's Prevention (WRAP) study. A secondary aim was to determine if the medications had different effects on apolipoprotein  $\epsilon 4$  carriers and non-carriers.

**Participants and Methods:** The WRAP study is a longitudinal study, which includes a sample of 1,573 subjects, most of which have familial risk factors for dementia with non-Alzheimer's related causes ruled out. Participants were administered tests of working memory (Digit Span), Verbal Learning and Memory (Auditory Verbal Learning Test, immediate and delayed recall), psychomotor speed (Trail Making Test, Part A), and cognitive flexibility (Trail Making Test, Part B) during four different visits over a 12 to 15 year span.

During each visit, subjects self-reported their daily medications, which was used in combination with the Anticholinergic Cognitive Burden Scale (ACBS) to classify medications by anticholinergic drug use. Subjects were organized based on if they were a non-user started, stopped, or reported consistent use of benzodiazepines or definite anticholinergic drugs between visits. Change in neuropsychological assessment variables were created by subtracting performance during the earlier visit from the more recent visit, which was used as the dependent variable in all statistical models.

Linear mixed models were conducted assessing main effects for patterns of anticholinergic or benzodiazepine use and interaction effects between medication use, apolipoprotein  $\epsilon 4$  carrier status, and time on change in neuropsychological assessment performance. To control for extreme scores during earlier visits regressing toward the mean, performance during the earlier visit was included as a covariate. Each model also controlled for gender, heart disease, diabetes, depression, anxiety, lung disease, depression (as measured by the Center for Epidemiological Studies-Depression Scale), age, cigarette use, weekly engagement in physical activity, and days on a level one or "possible" anticholinergic drug.

**Results:** The findings did not yield significant effects for medication use on working memory, immediate verbal memory, or psychomotor speed. As expected, consistent definite anticholinergic drug and benzodiazepine use were associated with a greater decline in cognitive flexibility performance than non-users. In contrast, non-users, consistent benzodiazepine users, and subjects who quit a definite anticholinergic had less of a decline in delayed memory than consistent anticholinergic drug users and subjects who started a benzodiazepine during the same period. It should also be noted that subjects who started an anticholinergic drug had less of a decline than consistent users. The models did not yield any significant interaction effects between apolipoprotein  $\epsilon 4$  carriers and medication use on any of the neuropsychological test scores.

**Conclusions:** The findings suggest that long-term benzodiazepine and definite anticholinergic drug use may have deleterious effects on cognitive flexibility in subjects with familial risk factors for dementia. Although the findings suggest there is a short term decline in delayed memory performance after starting a benzodiazepine, long-term definite anticholinergic use appears to have more negative effects on delayed verbal memory than long-term benzodiazepine use.

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**Keywords:** genetics, memory: normal, cognitive processing

**M. GRILLI, A. A. WANK, M. J. HUENTELMAN, L. RYAN. Autobiographical Memory Fluency Reductions in Cognitively Unimpaired Middle-Aged and Older Adults at Increased Risk for Alzheimer's Disease Dementia.**

**Objective:** Recent research has revealed that cognitively unimpaired older adults who are at higher risk for developing Alzheimer's disease (AD) dementia often exhibit subtle cognitive alterations in their neuropsychological profiles. Emerging evidence suggests that autobiographical memory, which is memory for personal events and knowledge, may be sensitive to early AD-related cognitive alterations. In the present study, we investigated whether the rapid generation of autobiographical memory category exemplars, a retrieval process that taxes the neural network that is vulnerable to early AD, is compromised in cognitively unimpaired middle-aged and older carriers of the e4 allele of the apolipoprotein E gene (APOE4), which increases risk for AD dementia.

**Participants and Methods:** In addition to standard neuropsychological tests, we administered a fluency task that requires generating exemplars for two types of autobiographical memory, namely episodic memories and personal semantics, to a group of cognitively unimpaired middle-aged and older adults ( $n = 45$ ) that was enriched with APOE4 carriers ( $n = 20$ ).

**Results:** While no APOE4 deficits were found on standard neuropsychological tests, including standard language fluency tasks, episodic and personal semantic exemplar generation was reduced in the APOE4 group. These autobiographical memory fluency reductions were evident for retrieval of recent and remote episodic memories and personal semantics.

**Conclusions:** We found that middle-aged and older APOE4 carriers, despite being cognitively unimpaired, tended to show reduced autobiographical fluency relative to age and cognitively similar APOE4 non-carriers. Overall, these findings indicate that there may be broad autobiographical memory alterations associated with increased risk for clinical AD. We interpret our findings as consistent with the notion that tasks placing heavy computational demands on the neural network most vulnerable to clinical AD can amplify signs of subtle cognitive alteration in higher risk individuals.

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**Keywords:** dementia - Alzheimer's disease, memory disorders, genetics

**L. BERTOLA, I. M. BENSEÑOR, P. A. LOTUFO, C. SUEMOTO. Early-Life Socioeconomic Status Impact on Cognition is Higher for Older Than Middle-Aged Adults and Independent of Education Level and Late-Life Socioeconomic Status.**

**Objective:** Early-life socioeconomic status (SES) might continue to impact cognitive performance later on life, and even dementia risk. Early-life SES is also a relevant predictor of an individual's educational attainment and late-life SES, which also contributes to cognitive performance. We aimed to investigate the effect of early-life SES, education, and late-life SES on Brazilians middle-aged and older adults' cognitive performance.

**Participants and Methods:** The sample consisted of 13,395 Brazilian participants from the ELSA-Brasil study (age range 34-75; education range: illiterate-college or more), who provided information about their early-life and late-life SES and were evaluated regarding health status and cognitive performance (episodic memory recall, verbal fluency, and cognitive flexibility). We built the early-life SES index using the participant's maternal education, if he/she started to work before 16 years old, and did not complete the formal education within the expected age limit. The late-life SES index was built using the participant's occupational status, the per capita

income, and the Brazilian Criteria for Economic Status that consider household material goods. Education was included as a separate variable once Brazil's educational system allows adults to take tests to prove they have the necessary knowledge to receive higher school degrees, even though they did not undergo the formal years' process. Path analysis was used to decompose associations between SES measures across the lifespan and cognition by quantifying the total direct and indirect standardized effects of the life course factors on cognitive outcomes. The built model included direct paths to cognition from early-life SES, education and late-life SES, and indirect paths from early-life passing through education and late-life-SES. Additionally, we performed a multiple group path analysis to verify if the effects of early-life SES are similar across middle-aged and older adults.

**Results:** The direct path from early-life SES remained significant in the presence of mediation paths through education, late-life SES, or both. This result indicates that early-life SES still contributes to middle-aged and older adults' cognitive performance. Education and late-life SES direct paths were also significant, suggesting that both distinctly affect cognitive performance. All mediated paths were significant, indicating that the early-life SES can impact cognitive impairment through education, late-life SES, and both. The percent mediation revealed that the education mediated path is the most explicative of the association between early-life SES and the cognitive outcomes, with percentages ranging from 36-56%. The indirect and total effect of early-life SES is smaller for middle-aged adults than older adults, except for semantic verbal fluency.

**Conclusions:** Early-life SES continues to impact cognitive performance later on life independently of the educational level achieved and late-life SES. The higher percent mediation for education mediated path suggests that education achievement might improve later life cognition in the face of lower early-life SES. Finally, middle-aged adults might have benefited from small, but essential, socioeconomic changes faced by Brazil during their birth and schooling decades, through better social conditions and education access, reducing the early-life effect. Our results highlight the importance of early-life and educational politics to improve cognitive aging quality in a low-/middle-income country.

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**Keywords:** aging (normal), cognitive functioning, diversity

**C. E. FRANZ, N. WHITSEL, E. BUCHHOLZ, S. PAHLEN, R. C. PEARCE, C. A. REYNOLDS, W. S. KREMEN. Associations Between Cigarette Smoking in Early Midlife and Accelerated Brain Aging in Late Midlife.**

Objective. To examine whether smoking in the first half of life is associated with accelerated brain aging in late midlife. Smoking is associated with higher morbidity and mortality and has come to be recognized as a risk factor for Alzheimer's Disease. Neuroimaging studies consistently find differences between brain morphometry of smokers and non-smokers, especially in total brain and grey matter volume. Having a predicted brain age older than one's chronological age (i.e., accelerated brain aging) has been identified as a risk factor for Alzheimer's Disease, and we have shown that MCI was associated with accelerated brain aging in late midlife. Most of these studies are cross-sectional and do not examine influence of premorbid cognitive ability. Here we examined associations between smoking history at age 40, and predicted brain age difference (PBAD) scores at average ages 56, 62, and 68.

**Participants and Methods:** Participants were 712 men from the nationally representative Vietnam Era Twin Study of Aging (VETSA). Smoking in pack years and alcohol consumption were assessed via self-report at ages 40, 56, 62, and 68. MRIs at ages 56, 62, and 68 were used to construct predicted brain age difference scores based on BARACUS software (PBAD=chronological age minus predicted brain age). Full models examined associations between age 40 packyears and later PBAD adjusted for age, ethnicity, education, age 20 cognitive ability, scanner, cardiovascular health, respiratory health, psychological health, alcohol consumption, and change in smoking or alcohol consumption. The packyears-by-alcohol interaction was added in a separate model. Models adjusted for nonindependence of family as a random effect.

**Results.** Smoking packyears at age 40 was significantly correlated with PBAD at ages 56, 62, and 68 ( $r=-0.12, -0.09, -0.15$  respectively). Age 20 cognitive ability was significantly associated with packyears ( $r=-0.24$ ) and PBAD ( $r_s=0.14, 0.16, 0.16$  ages 56, 62, and 68 respectively). Alcohol consumption at age 40 was also significantly correlated with PBAD at ages 56, 62, and 68 ( $r=-0.17, -0.23, -0.22$  respectively). Lower cognitive ability, heavier smoking and alcohol consumption predicted more advanced brain age at each time point.

In full SEM models adjusted for covariates and accounting for the covariance among the variables, smoking packyears at age 40 was significantly associated with age 56 PBAD ( $p=0.013$ ) and only indirectly--through age 56 PBAD--with later PBAD. Age 40 alcohol consumption was associated with both age 56 ( $p=.001$ ) and age 62 ( $p=.004$ ) PBAD. The effect of age 20 cognitive ability on PBAD was mediated by packyears. There was no packyears-by-alcohol consumption interaction.

**Conclusions.** Cigarette smoking is understood to be a global health risk. Here we show that both heavier smoking and alcohol consumption as early as age 40 contributed to accelerated brain aging in late midlife. Having lower levels of smoking and drinking earlier in adulthood appeared to be protective for brain integrity. The fact that MCI in this sample was also associated with accelerated brain aging suggests that targeting lifestyle modification—including smoking—early may promote healthier brain aging and dementia risk reduction.

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**Keywords:** substance abuse, aging (normal), brain structure

### **Paper Session 18: Concussion/Traumatic Brain Injury**

**9:00 AM - 10:00 AM**

**D. SHEPPARD, H. RAU, E. H. TRITTSCHUH, M. L. WERHANE, A. G. SCHINDLER, E. PESKIND, K. PAGULAYAN. Poorer Prospective Memory Performance is Associated with Reduced Time Monitoring Among OEF/OIF/OND Veterans with a History of Blast-Related Mild Traumatic Brain Injury.**

**Objective:** Mild Traumatic Brain Injury (mTBI) often results in cognitive symptoms that are not always reliably measured on traditional neuropsychological measures. However, one cognitive ability that has been shown to be reduced in Veterans with histories of mTBI is prospective memory (PM) or “remembering to remember,” particularly for executively demanding PM tasks. Time monitoring during PM is thought to rely on frontal systems and could potentially explain reduced time-based PM performances in mTBI. The current study evaluated whether reduced

time monitoring as measured by clock checking during a standardized PM task contributes to poorer PM performances in a mTBI Veteran sample.

**Participants and Methods:** 52 OEF/OIF/OND Veterans with a history of mTBI and 17 Veterans without a history of TBI (controls) completed the Memory for Intentions Screening Test (MIST) as a measure of PM during which their time monitoring (i.e., number of clock checks) was recorded. Veterans also completed a standardized battery of validated neurocognitive measures and mood questionnaires (i.e., Patient Health Questionnaire-9, PTSD Checklist-Military).

**Results:** Total MIST scores were lower in the mTBI than the control group at trend-level, and this was associated with a medium effect size (Mann-Whitney  $U=1.8$ ,  $p=.075$ , Hedge's  $g=.51$ ). Controlling for age, education, and PTSD status, a repeated measures mixed-model ANOVA revealed that the mTBI group checked the clock less frequently across the MIST compared to the control group ( $F(1,64)=12.1$ ,  $p<.001$ ,  $\eta_p^2=.159$ ), while across groups Veterans checked the clock more frequently during time intervals that included a time-based response at the level of a trend ( $F(1,64)=3.4$ ,  $p=.070$ ,  $\eta_p^2=.050$ ). There also was a trend-level interaction between mTBI status and time interval ( $F(1,64)=3.2$ ,  $p=.078$ ,  $\eta_p^2=.048$ ), and examination of effect sizes demonstrated a relatively larger group difference during intervals that included a time-based response ( $p=.035$ ,  $g=1.02$ ) compared to those without a time-based response ( $p=.022$ ,  $g=.84$ ). Within the mTBI group, less frequent time monitoring during intervals with time-based responses was associated with poorer performances on total PM, time-based PM, 15-minute delay PM responses, prospective memory errors, time loss errors, and recognition memory of PM item details ( $r_s$  range:  $.28-.52$ , all  $ps < .05$ ) and with executive functions at the level of a trend ( $r_s = .26$ ,  $p=.070$ ), but was not related to demographic variables, mood, or other neurocognitive performances (all  $ps > .10$ ).

**Conclusions:** Veterans with a history of mTBI evidenced significantly reduced time monitoring during a PM task compared to Veterans without a history mTBI, which was associated with the executively demanding aspects of PM performance and at trend-level with executive functions. Given that time monitoring is considered to rely frontal systems, the current findings provide evidence that frontally mediated behaviors may underly mTBI-associated PM difficulties. Future studies are needed to determine if reduced time-monitoring also contributes to mTBI-associated PM difficulties in the real-world (e.g., medication non-adherence). Nevertheless, the current data suggest that interventions aimed at improving environmental monitoring may be beneficial for addressing PM difficulties in individuals with a history of mTBI.

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**Keywords:** memory: prospective, executive functions, mild traumatic brain injury

**S. JURICK, L. CROCKER, K. R. THOMAS, E. W. TWAMLEY, R. AUPPERLE, S. NORMAN, A. J. LANG, D. M. SCHIEHSER, A. JAK. Trauma-focused Treatment Enhanced with Cognitive Rehabilitation Improves Memory Performance in Iraq and Afghanistan Veterans with Cognitive Impairment.**

**Objective:** Posttraumatic stress disorder (PTSD) and history of mild to moderate traumatic brain injury (mTBI) are commonly comorbid in Iraq and Afghanistan Veterans. Objective cognitive impairment is also common within Veterans returning from the recent conflicts, particularly within the domain of memory. Previous work from our group has shown that trauma-focused treatment enhanced with cognitive rehabilitation improves cognitive and emotional functioning.

However, the extent to which outcomes differ for those with objective cognitive impairment has not been evaluated. Determining whether Veterans with cognitive impairment demonstrate increased benefit from trauma-focused treatment enhanced with cognitive rehabilitation may guide more precise treatment for these individuals.

**Participants and Methods:** Iraq and Afghanistan Veterans (N = 75) with PTSD, history of mTBI, and subjective cognitive impairment underwent comprehensive neuropsychological testing as part of a randomized controlled trial comparing 12-week cognitive processing therapy (CPT; n = 35) and CPT plus cognitive rehabilitation (SMART-CPT; n = 40). Participants were tested at baseline, posttreatment, and three months posttreatment. Cognitive impairment was defined as greater than one standard deviation below the mean on at least two tests within any cognitive domain including attention/working memory, executive functioning, processing speed, and memory. Performance below standard cutoffs on performance validity measures was exclusionary.

**Results:** Twenty-nine Veterans were classified into the objective cognitive impairment group at baseline (39%). Memory (16%) and executive functioning (16%) were the most commonly impaired domains, and 10% were impaired on more than one domain. Veterans who were impaired versus not impaired did not differ on mTBI-related, physical health, or mental health variables at baseline or number of treatment sessions completed ( $p > .05$ ). Multilevel modeling (MLM) revealed no impairment group  $\times$  time interactions or 3-way treatment condition  $\times$  impairment group  $\times$  time interactions on self-reported measures of PTSD or neurobehavioral symptoms. However, there was a significant 3-way interaction for memory measures. For Veterans that were impaired at baseline, those in the SMART-CPT condition showed greater improvement on the California Verbal Learning Test – Second Edition short delay free recall ( $b = .08$ ,  $t(70.88) = 2.63$ ,  $p = .011$ ) and long delay free recall ( $b = .06$ ,  $t(49.83) = 2.66$ ,  $p = .010$ ) z-scores compared to those in the standard CPT condition, whereas Veterans that were not impaired at baseline demonstrated similar improvements following the CPT and SMART-CPT conditions. Results remained significant after controlling for relevant demographic differences (i.e., race). No treatment condition  $\times$  impairment group  $\times$  time interactions were identified for the other cognitive tests ( $p > .05$ ).

**Conclusions:** Objective cognitive impairment, especially memory and executive functioning impairment, was relatively common in our sample of Veterans with comorbid PTSD and history of mTBI. Cognitive impairment did not limit Veterans' improvement with regard to PTSD or neurobehavioral symptoms following trauma-focused treatment, suggesting that Veterans with cognitive impairment should not be excluded from such treatment. However, adding cognitive rehabilitation strategies to trauma-focused treatment did boost memory performance over and above standard trauma-focused treatment for those with objective cognitive impairment. Given the frequency of both objective and subjective memory difficulties within this population, augmenting trauma-focused treatment with cognitive rehabilitation strategies may be particularly useful in this group.

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**Keywords:** cognitive rehabilitation, brain injury, post-traumatic stress disorder

**S. RASKIN, O. DEJOIE, C. EDWARDS, O. WHITE, C. OUCHIDA, D. ANIKA, B. NJOKU, M. MORDASIEWICZ. Cognitive and Emotional Functioning in Women who Experience Traumatic Brain Injury as a Result of Intimate Partner Violence.**

**Objective:** The potential for traumatic brain injury to occur as the result of intimate partner violence has received increased interest in recent years. This study sought to document the occurrence of brain injury in a group of women who survived intimate partner violence and to measure the specific profile of cognitive and emotional deficits demonstrated by this group.

**Participants and Methods:** A comprehensive questionnaire about abuse history; a series of neuropsychological measures of attention, memory and executive functioning; and measures of depression, anxiety and post-traumatic stress disorder symptoms were given to 50 women who were intimate partner violence survivors and a comparison group of 50 women who were not intimate partner violence survivors.

**Results:** Overall, rates of potential traumatic brain injury, as measured by the HELPS, were high and consistent with previous studies. Deficits were demonstrated on measures of memory and executive functioning. High rates of depression, anxiety and post-traumatic stress disorder were measured. Of note, cognitive and emotional difficulties were highest among women who experienced non-fatal strangulation compared to those who did not. Performance on measures of cognition were related to self-report of quality of life.

**Conclusions:** Women who experience intimate partner violence show high rates of possible brain injury and resulting cognitive deficits. Women who experienced nonfatal strangulation showed greater impairments in cognitive functioning than women who did not and health care providers need to screen carefully and consider referrals for comprehensive neuropsychological evaluations. Better screening measures are needed that include questions about strangulation and that are culturally sensitive.

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**Keywords:** anoxia, brain injury, quality of life

**N. D. SILVERBERG, W. J. PANENKA, M. CAIRNCROSS, D. L. SNELL, K. YEATES, A. VRANCEANU, P. M. BRASHER, C. T. DEBERT, M. BAYLEY, G. L. IVERSON, C. HUNT, A. BAKER, M. BURKE. Matching Concussion Rehabilitation Approaches to Psychological Coping Styles: A Feasibility Randomized Controlled Trial.**

**Objective:** Fear avoidance behavior (self-limiting participation in activities and situations that might provoke symptoms) and excessive endurance behavior (persisting with activities until the point of “crashing” with worsened symptoms and requiring recuperative rest) may contribute to persistent symptoms and disability after concussion. These maladaptive coping styles may be malleable targets for rehabilitation, but whether they require different treatment approaches is unclear. The present study assessed the feasibility of randomizing patients to rehabilitation programs designed to address fear avoidance or excessive endurance coping, in preparation for a larger efficacy trial.

**Participants and methods:** Sixty-three adults who sustained a concussion according to the World Health Organization Neurotrauma Task Force definition, continued to report at least 3 moderate-severe symptoms on the Rivermead Postconcussion Symptoms Questionnaire, and obtained elevated scores on fear avoidance or excessive endurance behavior questionnaires, were recruited from two outpatient concussion clinics and enrolled at M=12.9 (SD=9.7) weeks post injury. The sample was 63% female and 71% white, with a mean age of 42.5 years. Most participants were injured in a motor vehicle collision (39%), sport/recreation incident (24%), or fall (19%). In a patient-blinded design (Clinicaltrials.gov#: NCT03972579), participants were randomized to an interdisciplinary rehabilitation program tailored to avoidance (graded exposure

therapy) or endurance coping (operant condition-based pacing strategies plus mindfulness training). Both programs were manualized and delivered via a remote videoconferencing platform by an occupational therapist and psychology provider, over 10 weeks (16 therapy hours total). Perceived credibility was assessed at the end of the second treatment session, after the therapy approach had been explained. Therapy sessions were audio-recorded. Blinded raters audited 20% of all treatment sessions.

**Results:** Recruitment accrual exceeded the target rate but was stopped early due to COVID-19 restrictions. Patients rated both rehabilitation programs as similarly credible with respect to how logical the treatment approach seemed to them (9.4 vs 9.3 out of 10), how likely they would be to recommend it to a friend (8.0 vs 7.9), how confident they felt that it would help (8.0 vs 8.7), and how willing they were to pursue it (9.2 vs 9.1). Of 180 audited sessions, 5 could not be coded because of audio-recording problems. Therapists covered M=96.7% of essential prescribed elements and performed (proscribed) behaviors compatible with the non-assignment treatment in only 6 instances (0.03% of audited sessions), indicating excellent fidelity. Of the 63 randomized patients, 11 (17.5%) did not fully complete treatment. Treatment drop-out was higher for exposure therapy (n=8) than pacing plus mindfulness therapy (n=3).

**Conclusions:** Indicators of recruitment accrual, fidelity, credibility, and adherence were consistent with prespecified targets. A Phase III efficacy trial appears feasible using the current randomized controlled trial methods.

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**Keywords:** concussion, mild traumatic brain injury

### **E. K. BRENNER, R. A. BERNIER, E. C. GROSSNER, F. G. HILLARY. Demographic and Injury Characteristics Interact with Cognitive Reserve and APOE e4 Status to Affect Delayed Memory in Traumatic Brain Injury.**

**Objective:** Cognitive reserve (CR) refers to the observation that two individuals with similar or identical disease pathology can present as functionally different (Stern, 2002). It has been proposed as a protective mechanism against neurologic disruption (Stern, 2012) and a predictor of cognitive outcome following a traumatic brain injury (TBI). Classic factors such as age, sex, and post-traumatic amnesia (PTA) have also been shown to be associated with cognition following TBI. More recent studies have demonstrated that patients with the APOE e4 allele are more likely to have memory deficits following TBI. However, the degree to which APOE influences the relationship between CR and cognition is unclear. Recent work in healthy older adults indicates that factors such as age and educational attainment modulate the effect of APOE genotype on cognition (López et al., 2017). We sought to examine the interactions between these factors and CR on delayed memory following TBI and investigate how APOE genotype affects these relationships.

**Participants and Methods:** Participants included 108 individuals (44 [41%] women, 33 [31%] APOE e4 carriers) who were on average 64.42 (SD=8.27) years of age, 9.56 (SD=6.66) years post-injury, had on average 13.59 (SD=2.72) years of education and 20.52 (SD=22.69) days of PTA. All participants had a history of mild-complicated (i.e. positive imaging findings) or moderate-severe TBI and underwent neuropsychological testing and APOE genotyping. Standardized score on the Test of Premorbid Functioning (TOPF) was used as a proxy for CR. Delayed memory performance on a measure of list-learning memory (Hopkins Verbal Learning Test-Revised) was the outcome measure.

**Results:** There was a significant interaction between age and CR on delayed memory in APOE e4 carriers,  $\beta=4.34$ ,  $p<0.05$  (but not APOE e4 non-carriers,  $\beta=-0.61$ ,  $p<0.637$ ). At high age, CR was positively associated with memory,  $\beta=0.57$ ,  $p=0.086$ , but at low age, CR was not associated with memory,  $\beta=-0.04$ ,  $p=0.853$ . There was also a significant interaction between sex and CR on memory in APOE e4 non-carriers,  $\beta=-1.82$ ,  $p<0.05$ , but not in APOE e4 carriers  $\beta=1.08$ ,  $p=0.349$ . For men, CR was positively associated with delayed memory,  $\beta=0.60$ ,  $p<0.001$  whereas for women, it was not,  $\beta=0.10$ ,  $p=0.670$ . Lastly, there was an interpretable interaction between CR and PTA on memory in the APOE e4 carriers,  $\beta=-2.54$ ,  $p=0.061$ . At low PTA, CR was positively associated with memory,  $\beta=0.62$ ,  $p=0.027$ , while at high PTA, CR was not associated with memory,  $\beta=-0.03$ ,  $p=0.884$ . In APOE e4 non-carriers, this interaction was not significant,  $\beta=0.11$ ,  $p=0.881$ , as CR was always positively associated with memory, regardless of high or low PTA,  $\beta=0.37$ ;  $p<0.05$ ;  $\beta=0.90$ ,  $p<0.01$ .

**Conclusions:** Results demonstrate that the relationship between CR and delayed memory depends on age, sex, and PTA and that these interactions are differentially observed in APOE e4 carriers and non-carriers. For example, in the non-carrier group, as age increased, the relationship between CR and memory increased. Also, being a non-carrier was associated with the benefit of CR in men, but not women, and in the e4 allele group, the benefit of CR on memory was lost at high PTA. Thus, this study suggests that APOE e4 status influences the interactions between CR and demographic characteristics. It also suggests that the relationship between CR and memory in TBI depends on factors that are often overlooked and controlled for in analyses, especially age and sex, highlighting the critical role of these relationships in determining outcome.

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**Keywords:** cognitive reserve, apolipoprotein E, demographic effects on test performance

### **K. C. DELL, R. A. BERNIER, F. G. HILLARY. Exercise May Reduce Depression in Women but not Men Aging with Moderate/Severe TBI.**

**Objective:** Cardiovascular health interacts with the normal aging process to impact both mood and cognitive functioning. Regular exercise in older adults has been shown to buffer against negative outcomes associated with worse cerebrovascular health, including cognitive decline and depression. There are known sex-differences in depression and cognitive functioning in older adults. For example, prior research has also established that not only are women twice as likely to experience depression than men, but that sex differences exist in presentation, depression symptom type, and responses to interventions. However, these same sex-specific findings after traumatic brain injury (TBI) are mixed. We sought to examine whether exercise relates to depression and cognition in older adults aging with TBI in a sex-dependent manner.

**Participants and Methods:** Participants included 101 individuals (75 men, 26 women) aging with a moderate/severe TBI who were on average 64.4 (8.3) years-old, 9.6 (5.8) years-post-injury, and had 13.6 (2.7) years of education. We examined the independent and interactive effects of sex and exercise on depression (BSI-Depression score), cognitive speed (composite based on the WAIS-IV Symbol Search, WAIS-IV Coding and Trail Making Test A subtests), and verbal memory (composite based on Hopkins Verbal Learning Test-Delayed Recall and RBANS Story Memory Total Score). Linear regression analyses, controlling for demographic and injury variables, were implemented to test for sex-by-exercise interactions and main effects of exercise on outcomes of interest.

**Results:** There was a significant sex-by-exercise interaction on depression, such that self-reported weekly exercise levels were associated with reduced depression ratings in women ( $\beta = -.49, p = .012$ ), but not men ( $\beta = -.09, p = .467$ ). There was no sex-by-exercise interaction on processing speed ( $\beta = .18, p = .20$ ) or verbal memory ( $\beta = .17, p = .55$ ). After removing the interaction term, there was still no main effect of exercise on processing speed ( $\beta = .02, p = .73$ ) or verbal memory ( $\beta = .10, p = .41$ ).

**Conclusions:** Results suggest that benefits in mood that are derived from weekly exercise may only be seen in women, but not men, among older adults aging with TBI, mirroring findings in older adults without history of TBI. Prior literature has demonstrated that women are more susceptible to depression associated with inflammation than men. Further, women have an increased risk for inflammation and autoimmune disease. Neuroinflammation and cerebrovascular health have been implicated in moderate/severe TBI. Given that cerebrovascular health and inflammation are tightly yoked, it may be that exercise exerts positive effects on mood in women via an inflammation pathway in older adults aging with TBI.

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**Keywords:** depression, cardiovascular disease

## **Program Chair Welcome & Plenary E: Centering Social Justice and Public Health in Neuropsychology**

**Presenter: Jennifer Manly**

**9:55 AM - 10:55 AM**

### **J. J. MANLY. Centering Social Justice and Public Health in Neuropsychology.**

Neuropsychological science and practice have primarily operated in settings that have limited applicability to the world's diverse population. This narrow focus is inconsistent with the fundamental principles of our field, which include understanding the brain's flexible adaptation to different contexts, and the neural and environmental mechanisms underlying behavior among all people, not just a select, privileged few. I will discuss how using social justice as an organizing principle for neuropsychological research and clinical assessment can richly enhance and accelerate gain of scientific knowledge and improve public health. A social justice framework must first recognize barriers to entry into our field for trainees from underrepresented backgrounds. Centering scientific questions within a brain health justice framework creates opportunities for underrepresented trainees to develop innovative ideas that build on their own experiences. A social justice framework also reveals how neuropsychological data have been used to maintain racial and social inequalities. I will describe an alternate approach of forming equal partnerships with representative research participants that has produced rigorous study designs and outcomes that reveal the potential impact of neuropsychology on public health and policy. I will present lessons learned from interdisciplinary research that has linked cognitive aging trajectories to lifecourse social exposures, such as structural racism, educational experiences, immigration, bilingualism, occupational opportunities, neighborhood investment, and residential segregation. Neuropsychology can provide the intellectual tools for building

policies that address the fundamental determinants of brain health, promote fair distribution of resources, and eliminate disparities.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe how a social justice framework can benefit neuropsychological research and practice 2) Identify methods to determine causal relationships between social forces across the lifecourse and disparities in cognitive function in aging 3) Describe approaches to address barriers to a diverse neuropsychology work force and explain why this is fundamental to innovation in our field.

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### **Plenary F: The Impossibility of Monolingualism in the Mind of the Bilingual**

**Presenter: Monika S. Schmid**

**11:00 AM - 11:55 AM**

#### **M. S. SCHMID. The Impossibility of Monolingualism in the Mind of the Bilingual.**

Bilinguals are different from monolinguals in that they can never elect to speak, process and comprehend only one language at a time. Even when there are no obvious intrusions from another language, such as a foreign accent, code-switched words or grammatical structures, language use is always to some degree underpinned by all of the languages represented in the mind of the speaker. While this means that second language acquisition can never be entirely 'targetlike' – assuming that the hypothetical target is set to the ideal and idealized monolingual – it also means that speakers with more than one language will be similarly 'non-targetlike' in their native language: there is increasing evidence to show that both beginning classroom L2 learners and experienced and proficient immersed L2 users use and process their native language in ways that are distinct from how 'true' monolinguals do it. These differences are cumulatively referred to as 'language attrition'. My talk will present some recent evidence on how native language processing can differ between monolinguals and multilinguals, and show both the scope and the limits of such crosslinguistic effects of language co-activation.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Recite the characteristics, scope and limitations of the phenomenon of language attrition 2) Discuss recent developments in the field of bilingualism research 3) Critique theoretical models used to account for language attrition.

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### **Plenary G: Age-related Trajectory of Brain Changes and Cognitive Decline in Autosomal Dominant Alzheimer's Disease**

**Presenter: Yakeel T. Quiroz**

**12:00 PM - 12:55 PM**

#### **Y. QUIROZ. Age-related Trajectory of Brain Changes and Cognitive Decline in Autosomal Dominant Alzheimer's Disease.**

We work with an extraordinary extended family of approximately 6,000 individuals in Antioquia, Colombia, which contains roughly 1,200 carriers of an autosomal-dominant mutation (PSEN1 E280A). These carriers are expected to develop early onset Alzheimer's Disease, with almost 100% certainty, and have a well-characterized disease course, with mild cognitive impairment (MCI) occurring at a median age of 44, and dementia at a median age of 49. For the past two decades, we have been studying these families to identify some of the earliest brain changes that are associated with their predisposition to develop Alzheimer's dementia later in life. Our work with these families has provided evidence of abnormalities in brain structure and function, several years before clinical onset. We have also shown that young adults who carry this PSEN1 mutation have brain amyloidosis, as measured by PET imaging, at the age of 28, an average of 16 years before their estimated age of clinical onset and have elevated levels of tau pathology in their late 30s, an average of 6 years before symptom onset. Most recently, we started to study carriers from these Colombian families who remained cognitively unimpaired until older ages. We reported on the first case who developed MCI three decades after the estimated age of clinical onset. This patient was found to also have two copies of the APOE3 Christchurch mutation, suggesting for the first time that this genetic variant may be protective against AD dementia. This extraordinary case has offered a truly unique opportunity to understand resistance to Alzheimer's disease, and is opening completely new avenues for Alzheimer's research and treatment.

**Learning Objectives:** Upon conclusion of this course, learners will be able to: 1) Describe the trajectory of Alzheimer's disease (AD) biomarkers in preclinical autosomal dominant AD 2) Explain the relationships between markers of brain pathology and cognitive decline in preclinical AD 3) Discuss advantages and disadvantages of studying biomarkers in familial forms of AD  
Correspondence: *Yakeel Quiroz, Massachusetts General Hospital. Email: yquiroz@mgh.harvard.edu*

**Panel Discussion hosted by the INS Student Liaison Committee 02: Navigating Racial/Ethnic and Cultural Differences between the Neuropsychologist and the Client: Implications for Assessment**

**Presenters: Xavier E. Cagigas, Jennifer J. Manly, Lucette Adeline Cysique, Lauren Mai**

**1:00 PM - 2:00 PM**

**Paper Session 19: Assessment**

**1:00 PM - 2:00 PM**

**J. J. YÁÑEZ, M. DÍAZ-SANTOS, R. E. DURAN. Behavioral Symptoms of Dementia (BSD) Mediate Stress and Cognitive Symptoms Among Latinx Caregivers Caring for a Relative with Alzheimer's Disease and Related Dementias (ADRD's).**

**Objective:** Dementia caregivers are at higher risk of cognitive decline and conversion to dementia. Cognitive decline among dementia caregivers have been attributed to several factors, including shared lifestyle (e.g. poor diet) with the care-receiver, poor sleep, environmental barriers (inadequate transportation, poor access to healthcare, economical inequities, lack of

cognitively stimulating activities, and limited community resources), depression, social isolation, anxiety, and chronic stress. Latinx dementia caregivers report greater distress compared to non-Hispanic White caregivers, however, the underlying contributors to this disparity remain understudied. Behavior symptoms of dementia (BSD) represent a potential mediator between caregiver stress and cognitive changes as Latinxs with neurodegenerative disorders report greater BSD compared to other groups. The aim of this study was to examine whether BSD (i.e., behavioral disruption, memory impairment, depressive symptomatology) mediate the relationship between caregiving stress and caregiver's cognitive functioning in Latino/a adults caring for a relative with Alzheimer's disease and Related Dementias (ADRD).

**Participants and Methods:** Our study recruited 96 Latinx family caregivers of Latinx older adults diagnosed with an Alzheimer's Disease and Related Dementias (ADRD's). Approximately 42% (n=40) participants were spousal caregivers, 43% (n=32) were adult children, and 15% (n=15) were siblings. In our study, 92 participants completed an online protocol available in either English or Spanish. In our study, 92 participants completed the study in English, while four completed it in Spanish. The online battery included a demographics questionnaire, the Caregiver Self-Assessment Questionnaire (CSAQ; American Psychological Association, n.d.); the Revised Memory and Behavior Problem Checklist (Teri et al., 1992); and the Promis Bank v2.0 Cognitive Function (PROMIS, 2019). Data collection was completed online through Qualtrics Survey Software.

**Results:** Caregiver stress was significantly associated with cognitive symptoms and BSD in relatives with Alzheimer's Disease and Related Dementias (ADRD's). The relationship between caregiver stress and cognitive symptoms was mediated by BSD. The standardized indirect effect was  $(1.05) (.70) = .74$ . Our study examined the significance of the indirect effect using a bootstrapping method. The unstandardized indirect effects were computed using 5,000 bootstrapping samples, and the 95% confidence interval was computed by determining the indirect effects at the 16th, 50th, and 84th percentiles. The bootstrapped unstandardized indirect effect was .33, and the 95% confidence interval ranged from .14, 1.44. As a result, the indirect effect was statistically significant.

**Conclusions:** Our study found that behavioral symptoms of dementia (BSD) explain the relationship between Latinx caregiver stress and cognitive functioning. To our knowledge, our study was the first of its kind to examine the effects of dementia caregiving on cognition with Latinx dementia caregivers. Future studies are needed to explore how specific BSD may impact specific cognitive domains amongst Latinx dementia caregivers. This study also alludes to a potential pathway for prevention and intervention efforts in the Latinx community targeting stress management and cognitive health. We suggest that exploring the experiences of dementia caregivers can enhance ADRD research by identifying models that may inform preventative efforts in understudied populations.

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**Keywords:** cognitive functioning, chronic stress, caregiver burden

**J. SCOTT, T. M. MOORE, D. ROALF, T. D. SATTERTHWAITE, D. WOLF, A. M. PORT, E. BUTLER, K. RUPAREL, D. G. BAKER, V. RISBROUGH, C. NIEVERGELT, R. C. GUR. Development and Application of Novel, Data-Driven Performance Validity Metrics for Computerized Neurocognitive Batteries.**

**Objective:** Neuropsychological assessments are widely used as indicators of brain functioning, although data such assessments may not be accurate in the context of factors impacting validity, such as disengagement, unmotivated responding, or intentional underperformance. Performance validity tests (PVTs) were developed to address these phenomena and assess underperformance on neurocognitive tests. However, PVTs can be burdensome, rely on cutoff scores that reduce information, do not examine potential variations in task engagement across a test battery, and are not typically well-suited to the collection of large cognitive datasets. Here, we describe and apply a novel method for developing data-driven performance validity measures that address some of these limitations by leveraging psychometric modeling from data embedded within the Penn Computerized Neurocognitive Battery (PennCNB).

**Participants and Methods:** The development and testing of these performance validity metrics proceeded in four stages. First, we developed multivariate validity metrics using item-level response patterns from a large neurocognitive dataset. Second, we applied these metrics to simulations of invalid response patterns with item parameters drawn from real data. Third, we examined associations of these multivariate validity metrics with manual validation decisions in two large, independent samples: 1) a large sample of youth (Philadelphia Neurodevelopmental Cohort;  $n=9,498$ ); and 2) a large sample of adult servicemembers (Marine Resiliency Study-II;  $n=1,444$ ). Finally, to reduce the likelihood of false positive errors for individuals with valid clinical presentations, we examined associations with psychopathology in these samples.

**Results:** Our multivariate performance validity metrics detected patterns of invalid responding in data that simulated careless responding, even at subtle levels (e.g., valid responding on up to 75% of items). Further, a combination of these validity metrics significantly predicted previously established manual validation decisions on most measures in both developmental and adult datasets, with areas under the curve (AUCs) ranging from 0.61-0.94, depending on the test and sample. Moreover, most clinical diagnostic groups did not show reduced validity estimates.

**Conclusions:** These results provide initial evidence for the potential utility of a multivariate, data-driven performance validity metric that could be widely applied to computerized neurocognitive tests with available accuracy and response time data. This metric offers a novel method for determining the validity of performance for individual neurocognitive tests that is scalable for “big data” acquisition, applicable across different tests, less burdensome, dimensional, and potentially beneficial for tests administered over the internet or through telehealth.

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**Keywords:** test validity, test theory, computerized neuropsychological testing

**J. M. GARCIA, M. W. GALLAGHER, S. O'BRYANT, L. D. MEDINA. Differential Item Functioning of the Executive Interview (EXIT) and its Shorter Versions in a Rural, Multi-Ethnic Cohort.**

**Objective:** We sought to examine differential item functioning of the Executive Interview (EXIT), and its 14-item (Quick EXIT) and 8-item (EXIT8) versions. The EXIT is a brief cognitive measure to assess executive functioning in a neurological population.

**Participants and Methods:** EXIT data from a sample ( $n=505$ ) from rural West Texas communities were analyzed. The sample was 69.7% female, 41% Hispanic/Latin American (H/L), and 19% Spanish-speaking, with a mean age of  $61.5\pm 12.6$  and  $11\pm 4.3$  years of education. The majority (72%) of the sample were cognitively normal, 27% had mild cognitive impairment

(Clinical Dementia Rating, CDR, of 0.5), and 1% had mild dementia (CDR=1). Item-response theory (IRT) / logistic ordinal regression differential item functioning (DIF) was conducted across dichotomized demographic grouping factors (age, ethnicity, education, gender, test language). DIF assesses item-level bias across specified groups by comparing item-level responses between groups that have the same total score. Confirmatory factor analysis and composite reliability were assessed to affirm the unidimensional assumption of IRT DIF. Analyses were conducted in R.

**Results:** Unidimensional fit and composite reliability were best for the EXIT8 followed by the Quick EXIT while the full version demonstrated poor fit and low reliability. Significant DIF presented in the EXIT8 across education (4/8 items), ethnicity (1/8 items), and language (3/8 items), as well as in the Quick EXIT across education (6/14 items), ethnicity (1/14 items), and language (5/8 items). Item-level bias was identified against Spanish-speaking respondents as well as less educated respondents at all levels of impairment measured by the EXIT tool. On the EXIT8, salient DIF by education was identified in 1 participant; on the Quick EXIT, salient DIF by education was identified in 24 individuals and by language in 2 individuals. When aggregating demographics, salient DIF was identified in 73 (14.5%) participants for the EXIT8 and in 91 (18%) participants for the Quick EXIT such that education, language, and ethnicity contributed together towards observable bias in the assessment.

**Conclusions:** The EXIT8 demonstrated the best model fit, highest internal consistency, and least bias over the longer versions. Education, ethnicity, and test language demonstrated a combined effect where Spanish-speaking H/Ls with low education may have inflated total scores due to item-level bias. Results emphasize the importance of simultaneously considering various sources of bias that could artifactually influence cognitive assessment.

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**Keywords:** diversity, test validity, cross-cultural issues

**A. J. KARSTENS, T. J. CHRISTIANSON, E. S. LUNDT, M. M. MACHULDA, M. M. MIELKE, W. KREMERS, C. R. JACK, D. S. KNOPMAN, R. C. PETERSEN, N. H. STRICKER. Mayo Normative Studies: Regression-Based Normative Data for Category Fluency and Boston Naming Test for Ages 30–91 Years and the Varying Impact of Demographic Variables Across Measures.**

**Objective:** Normative neuropsychological data is essential for interpretation of test performance in the context of demographic factors. The Mayo Normative Studies (MNS) aim to provide updated normative data for neuropsychological measures administered in the Mayo Clinic Study of Aging (MCSA), a population study of aging that randomly samples residents of Olmsted County, Minnesota, from age- and sex-stratified groups. We recently published updated norms for the Auditory Verbal Learning Test (Stricker et al., 2020 JINS). The current study presents methods for deriving norms for the following language measures: category fluency (animals, fruits, vegetables) and Boston Naming Test. Across the lifespan, verbal abilities are stronger in women, including cohorts with incipient Alzheimer's disease. Despite this verbal advantage in women, normative data does not always correct for sex differences or apply strict exclusionary criteria for individuals with mild cognitive impairment. We describe varying relationships with age, sex and education across these measures in participants aged 30-91.

**Participants and Methods:** The MNS includes cognitively unimpaired adults  $\geq 30$  years of age ( $n = 4,286$ ) participating in the MCSA. Quantitative (e.g.,  $r^2$ =percent variance explained via

linear regressions) and visual inspection methods were used to determine independent and interactive effects of age, age<sup>2</sup>, sex, and education on raw and adjusted scores. Regression based normative formulas were developed by first converting raw scores to normalized scaled scores and then regressing age, age<sup>2</sup>, sex and education.

**Results:** Independent linear regressions revealed significant effects of age, age<sup>2</sup>, sex and education on all test scores (all  $p$ 's < .05). Greater variance was explained by age for Category Fluency Total (16-17%) relative to that explained for BNT (6-7%). Though significant, sex explained less relative variance in Category Fluency Total (5%) and BNT (2%). Examined separately, sex accounted for greater variance in fluency for Fruits and Vegetables (9-13%) than Animals (0.1%). Education explained 8-9% of variance on the BNT and Category-Animals and 2-4% of variance on Fruits and Vegetables. Two-way interactions and additional higher order terms did not explain an a priori requirement of 1% incremental variance (IPV) explained and were not included in normative models. Both raw and scaled scores were plotted to illustrate effects of age, sex, and education on raw and scaled scores.

**Conclusions:** Demographic factors accounted for significant variance across language tests and are important to include in normative scores. A pattern emerged where education accounted for the greatest variance in confrontation naming and age accounted for the greatest variance in category fluency. The effect of sex was robust for categories Fruits and Vegetables and minimal for Animals. BNT performance had a curvilinear relationship with age, such that individuals in lower age brackets performed worse than middle-aged adults. Thus, the relative relationship between demographic variables and language performance varies between construct and test stimuli. Specifically, the salience of fluency or naming stimuli may depend on population level trends or generational effects. Future directions include examination of generational effects using linguistic corpuses for BNT items and sex-specific data on hours spent completing household tasks (e.g., cooking, grocery shopping).

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**Keywords:** normative data, psychometrics, demographic effects on test performance

**S. B. PUDUMJEE, T. J. CHRISTIANSON, E. S. LUNDT, M. M. MACHULDA, M. M. MIELKE, W. KREMERS, C. R. JACK, D. S. KNOPMAN, R. C. PETERSEN, N. H. STRICKER.** **Mayo Normative Studies: Amyloid and Neurodegeneration Negative (A-N-) Auditory Verbal Learning Test Normative Data and Preliminary Validation.**

**Objective:** Conventional normative samples include individuals with undetected neuropathology, lowering test sensitivity. With the advent of biomarkers, including amyloid (A) PET and MRI markers of neurodegeneration (N), neuropathology can be measured *in vivo*. We developed normative data for individuals without A or N (A-N-) for the Auditory Verbal Learning Test (AVLT). We compare these A-N- norms to recently published conventional norms adjusted for age, sex and education (Stricker et al., 2020). We hypothesized that A-N- norms would be more sensitive to MCI/dementia relative to conventional norms.

**Participants and Methods:** A-N- Normative sample: Mayo Clinic Study of Aging (MCSA) participants who were cognitively unimpaired at baseline were eligible. Neuroimaging was not required for participants aged 30-49 (n=419) due to reduced incidence of A+/N+ in younger individuals. 640 participants aged 50+ were A-N- based on whole brain amyloid PET SUVR <1.48 (A-), and cortical thickness in the AD signature region <2.67mm from MRI (N-) at their last available neuroimaging visit (total N=1,059). Using a regression-based approach correcting

for age, sex and education, we derived T-score formulas for Trials 1-5 total, 30-minute delayed recall, and sum of trials (Trials 1-5 + Trial 6 + 30-minute delay). We then validated these A-N-norms in cognitively unimpaired (CU) and MCI/Dementia samples. Validation and normative comparisons: We examined the observed proportions of male and female MCSA participants performing below a cut-off of  $T < 40$  who were not in the A-N- normative sample and  $> 55$  years of age. Participants included cognitively unimpaired individuals (newly enrolled participants; 131 males, 130 females) and individuals diagnosed with MCI/dementia (excluded from normative samples; 221 males, 171 females) at their baseline visit, based on study coordinator and physician diagnosis (excluding neuropsychologists' diagnosis to remove circularity).

**Results:** A-N- norms showed higher sensitivity to MCI/dementia relative to conventional norms for both males (72% vs. 63%) and females (72% vs. 68%) for sum of trials. A similar pattern was seen on Trials 1-5 total; A-N- norms showed higher sensitivity to MCI/dementia relative to conventional norms for both males (69% vs. 58%) and females (69% vs. 63%). For delayed recall, A-N- and conventional norms performed similarly for males (62% for both) and females (58% and 59%, respectively). Within the CU sample, the number of individuals showing below cut-off performance for A-N- and conventional norms was within expectation (CI included 14.7%) for delayed recall, but slightly above expectations for sum of trials for A-N- norms for females (23%). Similarly, the number of CU individuals showing below cut-off performance was slightly above expectations for Trials 1-5 total for both conventional and A-N- norms for females (22% and 25%, respectively).

**Conclusions:** A-N- norms are more sensitive to MCI/dementia than conventional norms for sum of trials and Trials 1-5. A-N- norms do not confer added sensitivity for delayed recall relative to conventional norms, potentially due to floor effects. Future work will validate these normative data in biomarker-refined groups. The slightly elevated rates of below-cutoff performance in CU individuals could represent a subset of individuals at increased risk for conversion to MCI/dementia.

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**Keywords:** psychometrics, dementia - Alzheimer's disease, assessment

### **M. DULAY, M. A. BABICZ, V. BURTON, K. CARTER, J. CAROSELLI. Longitudinal Predictors of Memory and Executive Difficulties 17 Months After Stroke.**

**Objective:** Memory and executive difficulties are common in a subset of individuals who have suffered cerebrovascular accidents. Previous cross-sectional studies demonstrated that post-stroke cognitive difficulties are associated with older age, depression, ethnicity, history of previous stroke, stroke localization and lateralization, stroke severity and physical disability (e.g., see Tang et al., 2018 for a review). For the current investigation, using longitudinal data, patients who sustained a unilateral stroke underwent repeated neuropsychological assessment to evaluate what early factors (attained 5 months after stroke) predict neurocognitive difficulties during the chronic stages of recovery (17 months after stroke).

**Participants and Methods:** Sixty-two patients (average age of 58 years, range between 18-89 years, 53% female, 71% Caucasian) underwent comprehensive standardized neuropsychological and psychological testing on average 5.3 months after and 17.4 months after a unilateral stroke. Stroke lateralization and localizations were diverse (29 left-sided and 33 right-sided; localization included 23 middle cerebral artery or one-sided-multifocal, 14 frontal, 7 primarily temporal lobe, 7 cerebellar, 4 basal ganglia, 4 thalamic, and 3 pons). Impairment on neuropsychological tasks

was defined as z-scores  $\leq -1.32$ . Patients with suspected dementia, other comorbid neurological diagnoses, and comprehension difficulties were excluded.

**Results:** Memory impairment persisted in 56.3% of the same patients in the early (5 months after stroke) and chronic (17 months after stroke) stages of recovery, remitted in 25% of the patients between time periods, there was new onset forgetfulness in 2.1% of patients at the chronic stage, and memory issues were not present at either assessment in 16.6% of patients. Executive difficulties persisted in 52.1% of the same patients in the early and chronic stages of recovery, remitted in 20.8% of the patients between time periods, there were new executive difficulties in 8.3% of patients at the chronic stage, and executive issues were not present at either assessment in 18.8% of patients. Logistic regression indicated that side of stroke (left-sided), lower education level, the presence of memory difficulties in the early stages of recovery, and the presence of executive difficulties in the early stages of recovery were significant predictors of verbal memory difficulties at the chronic stage (odds ratio p values  $< 0.05$ ). Lower education level and the presence of executive difficulties in the early stages of recovery were significant predictors of executive difficulties at the chronic stage (odds ratio p values  $< 0.05$ ). Depression in the early stage, localization, time since stroke, marital status, and chronological age or gender were not significant predictors.

**Conclusions:** Notably, memory and executive difficulties persisted in over half of patients 17 months after stroke. Education was a protective factor likely reflecting greater cognitive reserve. Identification of patients at higher risk for persisting cognitive issues may allow for earlier implementation of cognitive interventions aimed at teaching compensatory strategies for managing memory and executive difficulties in the years after a stroke.

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**Keywords:** executive abilities - abnormal, memory disorders, cerebrovascular injury

## **Symposium 12: Good Trouble: Population Management Solutions For Diverse Pediatric Populations**

**Chair: Christine M. Salinas**

**Presenters: Beatriz MacDonald, Adriana M. Strutt, Veronica Bordes Edgar, Gretchen Berrios-Siervo, Heidi A. Bender, Adam Saad**

**1:00 PM - 2:00 PM**

### **C. M. SALINAS, B. MACDONALD, A. M. STRUTT, V. BORDES EDGAR, G. BERRIOS-SIERVO, H. A. BENDER, A. SAAD. Good Trouble: Population Management Solutions For Diverse Pediatric Populations.**

In the U.S., there are an estimated 74 million children with 15 million having mental health, neurocognitive, or substance abuse problems (Center for Disease Control & Prevention, 2020). Accumulating evidence from epidemiological and community studies reveals behavior and academic problems as well as psychopathology in children with neurodevelopmental and medically complex conditions compared to same-aged peers. Diagnosis of behavioral, emotional and cognitive comorbidities in children is too often undiagnosed, under-diagnosed, or

misdiagnosed. Historically, Black, Latinx, Asian, and other ethnic minority youth have the great risk for disparities.

The large gap between the mental health needs of children with neurological and neurodevelopmental disorders and their participation in behavioral health services challenges exploration into the factors that serve as barriers to mental health care access. Factors frequently associated with mental health care access include patient factors such as a) parental beliefs and attitudes about mental health concerns; b) parental lack of education about mental illness; and c) ethnic minority status, and provider factors such as a) implicit bias, b) role of physicians in providing mental health referrals; the stigma of poor mental health, as well as structural/organizational variables such as a) insurance coverage, b) transportation availability, c) distance from home and d) scheduling times of appointments.

Further, there are only 215,000 pediatric providers across disciplines to address these needs. Within neuropsychology only approximately 16% specialize in pediatrics (Postal et al., 2017; Sweet, Benson, Nelson, & Moberg, 2015). Due to the current talent crisis in our field, health care disparities are greatly compounded when children and families require evaluations with a culturally-informed and bilingual pediatric neuropsychologist since there is a dire shortage of such providers. Within this context, the current administrative and billing requirements drive providers to operate within small profit margins in pediatrics compared to adults, although the completion of most pediatric neuropsychology evaluations is time-intensive (Sweet et al., 2015), posing a clear threat to the sustainability of a traditional outpatient pediatric neuropsychology model.

Our objectives are to address population management solutions that aid in the prevention, detection, and early intervention of pediatric comorbidities. For example, a community participatory model that leverages technology and Design Thinking methodology brings youth closer to accessing equitable pediatric neuropsychology services. A comprehensive evidence-based equitable healthcare model establishes a framework that can be implemented broadly. We also highlight rapid screening models that aim to address specific at-risk pediatric populations. Finally, a video-based TeleNP treatment model for epilepsy will be highlighted.

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**Keywords:** cognitive screening, pediatric neuropsychology, diversity

## **B. MACDONALD, A. M. STRUTT. SALUD Strutt MacDonald Equitable Healthcare Model: A Comprehensive Approach to Addressing Healthcare Disparity in the Field of Neuropsychology.**

**Objective:** The U.S., heterogeneous from its founding, continues to see a rise in minority populations. This changing demographic landscape amplifies the need for equitable healthcare. In the field of neuropsychology, the impact of sociodemographic variables on cognitive outcomes has been well documented. Therefore, it is vital to tailor procedures and assessments to serve diverse populations and ensure delivery of equitable healthcare.

**Methods:** The SALUD Strutt MacDonald Equitable Healthcare Model is a dynamic process-oriented equitable healthcare model rooted in inclusion and intersectionality. It was developed to address the demographic shift in the United States and continuously cultivate program development. Components of this framework include education/training, research, clinical services, clinical application/integration, consultation/collaboration, development, and quality improvement.

**Results:** The SALUD model has been effectively utilized nationally in neuropsychological academic institutions across the lifespan. Moreover, the model has been implemented across medical disciplines with the goal of reducing healthcare disparities across diverse communities. Presentation will review barriers to equitable care, conceptual healthcare equity frameworks, and individual and institutional biases.

**Conclusions:** The SALUD model is a solution-focused approach to improving patient services, providing resources for healthcare practitioners, training and engaging stakeholders, and fostering change via the institutional structure. The SALUD model serves as a blueprint to further the field of neuropsychology as it systemically implements programmatic changes to safeguard inclusive and equitable training and evidence-based services.

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**Keywords:** cognitive screening, diversity, pediatric neuropsychology

### **V. BORDES EDGAR. Developmental-Pediatric Screening Model.**

**Objectives:** As neurobehavioral, developmental, and mental health problems continue to grow, an increased workforce will be needed. Neuropsychologists cannot do this with long assessment hours or in isolation. Working in partnership with other specialties including Developmental-Behavioral (DB) and General Pediatricians is one step towards filling the need. This was highlighted in a call-to-action for increased developmental and behavioral training during pediatric residency to empower future pediatricians who will be at the forefront of a looming mental health crisis (McMillan, Land & Leslie, 2017).

**Methods:** A neuropsychological screening model in conjunction with General and DB Pediatricians was developed in 2018 for use in a complex care primary medical home. The model includes teaching medical trainees and General Pediatricians whereby they are given tools for interview, triage, and first-line management of problems. The first step involves consultation with a DB Pediatrician or neuropsychologist. From there, recommendations for treatment/intervention are provided with one- to 12-month follow-up or referral for further assessment. The next step in the model includes a brief neurocognitive battery conducted within 60 days. If a full neuropsychological assessment is still needed, this is conducted within the next 12 months, otherwise ongoing monitoring is recommended 12-24 months.

**Results:** Reduced wait times for evaluation and increased access to intervention was noted. Those requiring full evaluation were the most complex, but had already begun receiving interventions that could then be improved upon.

**Conclusions:** Utilizing multidisciplinary teams for consultation and screening aids in access to care and increased efficiency of a neuropsychological service in neurodevelopmental disabilities.

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### **G. BERRIOS-SIERVO. Innovations in the Brief Neuropsychological Evaluation and Care of Children with Newly Diagnosed Epilepsy.**

**Objective:** Children with epilepsy (CWE) demonstrate cognitive deficits that predate seizure onset. Anti-epileptic medications are associated with iatrogenic cognitive and behavioral side effects. Epilepsy is frequently associated with specific conditions such as ADHD, Autism, and mood disorders, adversely impacting long term outcomes. Early detection of cognitive comorbidities and medication side effects improves medication effectiveness and facilitates

timely implementation of interventions, improving overall quality of life. These factors, along with the long wait times for obtaining pediatric neuropsychological evaluations, have prompted new approaches to screening patients with epilepsy. We developed a multidisciplinary model to improve population management strategies for pediatric epilepsy.

**Methods:** The New Onset Epilepsy (NOE) Clinic at Children's Hospital Colorado includes neuropsychological screening, neurological medication management, seizure education and information about community services and resources. Patients complete a 2-hour battery, while parents provide background information and complete questionnaires via REDCap to screen for comorbidities. Clinic procedures are available in Spanish. Results and recommendations are provided to families at their clinic visit. Parents complete a satisfaction survey and a follow-up clinic visit is scheduled for one year post initial visit.

**Results:** Over 40 children ages 4-16 have been seen. Wait times from referral to clinic visit were reduced. Inclusion criteria included recent diagnosis (within 6 months), and seizure/medication stability. Automatic integration of electronic screening instruments into REDCap facilitated assessment and interpretation. Education of referring providers is ongoing to establish NOE as a standard of care. Brief evaluation has been helpful in identifying pertinent diagnoses, establishing a baseline early in their treatment and maintaining appropriate medical care. Parents reported an overall positive clinic experience.

**Conclusions:** Leveraging multidisciplinary experts and technology optimizes efficiency for patient care in CWE. A targeted screening evaluation coupled with family education allows for improved population management for CWE, and helps to meet families' diverse needs.

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**Keywords:** cognitive screening, pediatric neuropsychology, epilepsy / seizure disorders

#### **H. A. BENDER, A. SAAD. Bridging the Gap: Providing Epilepsy Clinic Patients with Psychological Support and Center Outreach During the COVID-19 Pandemic.**

**Objectives:** Beyond the obvious challenges faced by frontline providers redeployed to assess and treat patients with COVID-19, the secondary impact to their traditional patient base cannot be under-estimated. Patients with chronic illness, such as epilepsy, often rely on consistent and frequent access to their physicians for symptom monitoring, acute intervention, medication adjustments, and management of comorbidities. Epileptologist redeployment during the apex of the COVID-19 pandemic resulted in an unmet need for clinical contact and provider engagement.

**Participants and Methods:** In an effort to bridge this gap, the Neuropsychology Service provided a treatment group for interested patients within a Level 4 Epilepsy Center. Eight participants met via telemedicine over 12 sessions. Management of diminished health-related quality of life and "medical isolation" through mindfulness-based stress reduction was employed.

**Results:** Patients reported a highly positive impact of engagement with neuropsychology clinicians, as well as deriving considerable support from others with epilepsy experiencing similar concerns.

**Conclusions:** Implementing an open-process group not only provided emotional support, but also served as an outlet for patients to process feelings of "disconnection" from their providers, which was clearly a source of considerable patient distress. The comprehensive, flexible skill set of neuropsychologists enables versatility in patient care duties during times of unprecedented need.

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#### **Invited Symposia 4: Symposium Honoring the Legacy of Nelson Butters**

**Chair: Meryl Butters**

**Discussant: James Becker**

**Presenters: Mark W. Bondi, Margaret O'Connor, Marlene Oscar Berman, David Salmon, Edith V. Sullivan, Mieke Verfaellie**

**1:00 PM - 2:25 PM**

#### **M. BUTTERS, J. BECKER, M. W. BONDI, M. O'CONNOR, M. OSCAR BERMAN, D. SALMON E. V. SULLIVAN, M. VERFAELLIE. Symposium Honoring the Legacy of Nelson Butters.**

Nelson Butters, otherwise known as the Godfather of Neuropsychology, died 25 years ago at the age of 58, from ALS. This 90-minute symposium will honor his Legacy with presentations in three major areas of neuropsychological research, memory, alcohol use disorders, and dementia, making clear the connections between his ground-breaking work and modern cutting-edge studies that continue to expand our knowledge in these areas. In addition to his legacy evident in current day neuropsychological research, the influence of Nelson's studies on evolving assumptions neuropsychologists make in everyday clinical practice will also be highlighted. Following these presentations, there will be a panel discussion and Q & A with the audience.

#### **M. VERFAELLIE, M. O'CONNOR. Memory.**

Nelson Butters made many original and lasting contributions to our understanding of the cognitive and neural mechanisms of diverse aspects of memory. Highlighting the heterogeneity among amnesic syndromes, his work demonstrated how different profiles of impairment could be understood in the context of contemporaneous models of memory. He drew attention to the distinct manifestation of anterograde memory impairments resulting from encoding and retrieval deficits and their associated neural underpinnings. Likewise, his keen eye for dissociations highlighted the importance of distinct neuroanatomical systems supporting declarative and procedural memory. His detailed case studies of patients with retrograde amnesia using novel assessments paved the way for a more comprehensive taxonomy of remote memory. Dr. Butters' pioneering studies of amnesic patients continue to inform both clinical assessment and contemporary memory research.

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#### **M. OSCAR BERMAN, E. V. SULLIVAN. Alcohol Use Disorders.**

Marlene Oscar Berman, Ph.D.

In the 1970s, Nelson Butters began a series of systematic studies of alcoholic Korsakoff's syndrome (KS), a disorder characterized by severe anterograde amnesia as the most striking feature. Butters and colleagues not only dissected material- and task-specific aspects of the

memory loss, their research showed abnormalities in problem solving, response inhibition, personality, and stages of information processing such as perception, encoding, and retrieval. Butters also explored the cerebral underpinnings of KS. He was among the first to use *in vivo* MRI to measure volume loss and shrinkage in cortical and diencephalic structures. Over the past 25 years, the neuropsychological, neuroanatomical, and theoretical foundations of cognitive and affective disturbances in KS have remained active topics of investigation. Advances in neuroimaging, electrophysiology, and neurochemistry have allowed finer analyses of the loci and nature of the pathologies. In turn, diagnoses have improved for differentiating neurological disorders with similar phenotypes but different etiologies.

Edith V. Sullivan, Ph.D.

Concurrent with his landmark studies of alcoholic KS were his quantitative findings in "uncomplicated" alcoholics, who initially served as a non-amnesic, affected comparison group. Subsequently, alcohol dependence, now called Alcohol Use Disorder, emerged from an under-appreciated status to a clinically relevant diagnosis, incorporating nearly 6% of the adult U.S. population, with a selective neuropsychological profile of impairments affecting working memory, problem solving, and focused attention; emotion regulation; and visuospatial construction. These observations directed neuroimaging studies where to look for neural substrates of impairments. Recognizing that AUD is not static but rather follows a dynamic course, Butters sought evidence for locus and extent of recovery and found resilience with sobriety in some executive functions but resistance to recovery in spatial abilities. The next horizon would be to test whether recovery could be directed and whether neuropsychological change was linked to neuro-remodeling, anticipated in his edited volume with Parsons and Nathan and now pursued at every level of neuroscience inquiry.

Support

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### **M. W. BONDI, D. SALMON. Dementia.**

The basis of Nelson Butters' many scientific accomplishments, and his true genius, may have been his ability to synthesize and apply knowledge and concepts from neuroscience and cognitive psychology to critical issues in human neuropsychology. This ability was exemplified in his systematic characterization and analysis of the neuropsychological processes underlying Alzheimer's disease (AD) and other dementing disorders. With his unique approach, he defined the relationship between specific neuropsychological deficits and regional neuropathological changes in AD, delineated the neuropsychological features that differentiate the dementia syndromes associated with primarily cortical or subcortical brain damage, and identified the neuropsychological characteristics that most effectively distinguish early AD from benign cognitive changes of normal aging. In this presentation we will first describe some of the seminal discoveries made by Nelson in each of these areas and how his findings and approach have been applied in more recent efforts to differentiate AD from similar, related disorders such as Dementia with Lewy bodies (DLB). We will then describe how the neuropsychological characterization of AD dementia pioneered by Nelson have been used to enhance early detection of cognitive decline in prodromal and preclinical stages of the disease.

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**INS Business Meeting****2:30 PM - 3:00 PM****Paper Session 20: Neurodevelopmental Disorders/Pediatric****2:30 PM - 3:30 PM****B. CHEN, A. LINKE, I. FISHMAN. Executive functioning in a community sample of children and adolescents with autism spectrum disorder and/or attention-deficit/hyperactivity disorder.**

**Objective:** Executive function (EF) deficits are common in individuals with neurodevelopmental disorders such as ASD and ADHD, which are often co-occurring. Prior research has mainly focused on group-level comparisons of children with ASD and ADHD without taking into account the frequent co-occurrence of ASD or ADHD symptoms, yielding mixed findings as a result (Craig et al., 2016). The current study aims to compare EF profiles in a transdiagnostic cohort of children and adolescents with ADHD, ASD, and comorbid ASD+ADHD diagnoses, to examine the associations between EF performance and ASD and ADHD symptoms across diagnostic groups.

**Participants and Methods:** Data from 1195 children and adolescents (ages 5-21) with confirmed ASD and/or ADHD diagnoses from the publicly available Healthy Brain Network (HBN) project (Alexander et al., 2017) were analyzed for the current study. HBN is an ongoing initiative that aims to create a biobank from a community sample of children and adolescents in the New York City area. Psychiatric diagnoses were established based on the DSM-5 criteria, supported by the computerized KSADS, which includes a clinician-administered parent and child interview, as well as additional diagnostic assessments such as the Autism Diagnostic Observation Schedule for ASD. Three EF domains were assessed with performance-based measures from the NIH Toolbox, including the Flanker Task, Card Sort, and List Sorting, which assess inhibition, flexibility, and working memory, respectively. For this study, ASD and ADHD symptoms were quantified with the parent ratings on the Social Responsiveness Scale-2 (SRS-2) and the Strengths and Weaknesses of ADHD Symptoms and Normal Behavior Scale (SWAN), respectively. Categorical analyses were conducted to compare performance on the three EF tasks among the three diagnostic groups (i.e., ASD, ADHD, and ASD+ADHD) using MANCOVA and post-hoc F-tests. Dimensional analyses were carried out to examine the contribution of ASD or ADHD symptoms to the three EF domains, using linear regression models with the scores on the SRS-2 Total, SWAN Inattention, and SWAN Hyperactivity subscales as predictors, while controlling for the other symptoms scale(s). Age and gender were included as covariates in all analyses. Analyses were repeated with and without Full-Scale IQ as an additional covariate.

**Results:** Categorical analyses revealed that the ASD+ADHD and ASD groups exhibited greater deficits on flexibility and working memory than the ADHD group (all  $p < 0.035$ ) after controlling for age and gender. Dimensional analyses showed that poorer performance on flexibility, inhibition, and working memory tasks was significantly associated with more ASD symptoms across diagnostic groups (all  $p < 0.008$ ), controlling for age and gender. After including IQ as an

additional covariate, no significant group differences were present in the categorical analyses; however, the negative relationship between flexibility and ASD symptoms was retained ( $p=0.02$ ).

**Conclusions:** The current results suggest that deficits in inhibition and working memory may reflect shared liability in ADHD and ASD. In contrast, impairment in flexibility may be uniquely associated with ASD symptomatology, independent from ADHD symptomatology. The large number of null findings after controlling for IQ is remarkable and may partially explain the often contradictory findings in prior studies that differ in sample characteristics (number of participants, age, and IQ level).

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**Keywords:** executive functions, attention deficit hyperactivity disorder, autism spectrum disorder

### **C. AMMONS, P. PATEL, N. LOOMBA, V. SEGHATOL-ESLAMI, R. KANA. Structure of the Mid-Fusiform Sulcus in Autism Spectrum Disorder and its Relationship to Social Functioning.**

**Objective:** Deficits in human face processing are common in autism spectrum disorder (ASD) and relate to the characteristic social difficulties of this neurodevelopmental disorder. The mid-fusiform sulcus (MFS) is strongly associated with face-selective regions of the fusiform gyrus (FG) as well as other functional and structural divides in the ventral occipitotemporal cortex (Weiner et al., 2014). However, this brain-behavior link has been overlooked in ASD and the relationship between MFS structure and real-world social functioning has yet to be investigated.

**Participants & Methods:** Using newly established and validated methodology (Weiner et al., 2014; Ammons et al., 2020), the MFS was identified on cortical surface reconstructions of T1 weighed magnetic resonance imaging (MRI) collected from 76 individuals with ASD and 76 age and IQ matched controls from the autism brain imaging data exchange (ABIDE). MFS surface patterns and morphometric features were compared between groups and correlated with scores on the Social Responsiveness Scale (SRS) and the Vineland Adaptive Behavior Scale (VABS-II) Social Domain.

**Results:** The MFS was identifiable in 99% of hemispheres. Relative to overall brain size, individuals with ASD had less gray matter volume (GMV) in the MFS largely driven by an increase in left hemisphere surface area specific to the TD group. Increases in MFS GMV were associated with lower SRS and higher VABS-II scores. MFS GMV predicted SRS beyond diagnosis alone.

**Conclusions:** The MFS is a stable anatomical feature in ASD. Reduced GMV of the MFS is associated with poorer social functioning and a greater number of ASD behaviors. Future studies of face processing in ASD may benefit from a better understanding of this FG feature and its structure-function relationships.

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**Keywords:** autism spectrum disorder, neuroimaging: structural, social processes

### **K. NAYAR, L. M. VENTURA, Z. J. RESCH, T. W. RHOADS, A. C. NEALE, J. R. SOBLE. Concordance of the Dot Counting Test with the Test of Memory Malingering Trial 1 and Reliable Digit Span in a Mixed Clinical Pediatric Sample.**

**Objective:** Performance validity tests (PVTs) are widely used in adult clinical populations to assess the extent to which obtained neuropsychological test performance adequately reflects the examinee's true cognitive abilities. PVT usage in pediatric populations is less well studied, although recent efforts have found relatively robust specificity using PVT cut-scores established in adult populations. However, both of the Dot Counting Test (DCT) diagnostic accuracy studies in the pediatric literature have documented relatively poor sensitivity for detecting invalid performance, especially compared to the Test of Memory Malingering Trial 1 (TOMM-T1) and Reliable Digit Span (RDS). The latter PVTs have been particularly robust among children, with minimal to no impact of learning/memory performance on pass/fail rates. As such, this study examined the concordance between DCT and TOMM-T1 as well as with RDS to examine the relative efficacy of using DCT as a freestanding PVT in a mixed clinical pediatric setting.

**Participants and Methods:** This cross-sectional study included data from 44 referrals, with a mean age of 10.97 ( $SD=3.97$ ) and mean education of 5.89 years ( $SD=3.81$ ). The sample was 52% male, 14% Caucasian, 43% Hispanic, 34% African American, and 9% Asian. To determine concordance, patients were divided into four groups: 1) valid DCT and valid TOMM-T1/RDS; 2) questionable DCT and questionable TOMM-T1/RDS; 3) questionable DCT and valid TOMM-T1/RDS; and 4) valid DCT and questionable TOMM-T1/RDS. Spearman correlations between each of the PVTs were also examined. Finally, t-tests were conducted to examine DCT performance between those who passed versus failed TOMM-T1/RDS.

**Results:** PVT failure rates were 36% for the DCT (28 valid/16 invalid), 14% for TOMM-T1 (38 valid/6 invalid), and 38% for RDS (25 valid/15 invalid). Overall, results indicate that DCT and TOMM-T1/RDS were concordant in 64%/82.5% of cases, with 57%/55% valid and 7%/28% invalid on both measures, respectively. In the 36%/18% of cases with discrepant PVT findings between DCT and TOMM-T1/RDS, respectively, patients were more likely to provide invalid DCT/valid TOMM-T1 (30%) than valid DCT/invalid TOMM-T1 (7%). This was not the case for RDS, whereby percentages were more comparable. DCT scores did not significantly correlate with TOMM-T1 performance ( $p = .21$ ), but were significantly related to RDS scores ( $p < .001$ ). Relatedly, DCT scores did not differ between those who passed versus failed TOMM-T1 ( $p = .43$ ), whereas those who passed RDS, performed significantly lower (i.e., better) on the DCT ( $p < .001$ ).

**Conclusions:** Findings demonstrate that the non-memory PVTs are more strongly concordant (i.e., RDS and DCT), while PVTs that tap disparate cognitive domains are not (i.e., TOMM-T1 and DCT). In an effort to be parsimonious and to reduce battery length and patient burden on testing, high concordance between DCT and RDS provides support for the use of one (versus both) PVT during pediatric neuropsychological assessment. Results further highlight the efficacy of using TOMM-T1 as a standalone PVT above and beyond DCT, given their poor concordance rates and prior literature supporting the application of TOMM-T1 adult cut-scores to pediatric settings.

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**Keywords:** pediatric neuropsychology, effort, psychometrics

**L. DEMERS, R. SHANLEY, S. FRENCH, N. E. SHERWOOD, S. M. CARLSON, A. S. KUNIN-BATSON. Household Income and Executive Functioning Development in Early Childhood: A Prospective Three-Year Study.**

**Objective:** Previous cross-sectional studies have demonstrated a relationship between household income and children's executive functioning (EF). Longer exposure to low household income has been related to lower EF skills, and a household income gradient on children's cognitive flexibility and working memory has been observed. Yet, there has been limited longitudinal research on the relationship between household income and growth in children's EF skills. It remains unknown whether household income relates to persistent differences or variation in the rate of EF development across the early childhood years. We sought to examine the relationship between parent-reported annual household income and objectively measured child EF development over a 3-year period. We hypothesized that lower household income during the early childhood years would be associated with persistently lower and slower developing EF skills.

**Participants and Methods:** This is a secondary data analysis from a three-year randomized controlled obesity prevention trial (NET-Works, NCT0166891). Five-hundred and thirty four children ages 2-4 years ( $M=3.4$ ,  $SD=0.7$  years) from diverse racial/ethnic backgrounds (58% Hispanic) and predominantly lower income households (63% reporting annual household income < \$25,000/year at their baseline visit) were enrolled, with 92% retention at 36-month follow-up. At baseline, parents completed surveys about household characteristics including income (i.e., 5 categories ranging from \$14,999 or less to \$50,000-\$65,000/year), and children completed a game-like measure of EF that involved working memory and cognitive flexibility (Minnesota Executive Function Scale; MEFS) at baseline and annual visits. A correlated data model using generalized estimating equations (GEE) with autoregressive correlation was used to examine associations between household income at baseline and children's EF performance over time. Analyses were adjusted for both baseline age and visit, as there seemed to be an effect of testing environment exposure. Baseline income, household size, and frequency of English language spoken in the home were used as predictors.

**Results:** As expected, total MEFS raw score was strongly associated with age ( $\chi^2=317$  on 2 df;  $p<0.001$ ) such that mean MEFS total score improved 9 points with every year. The impact of household income on MEFS score was in the expected direction and was a gradient effect, such that lower income predicted lower total MEFS score. There was a lack of evidence that the rate of EF development over time varied by baseline income category ( $\chi^2=9.2$  on 12 df;  $p=0.69$ ). Rather, baseline differences in MEFS total score by income category persisted over time ( $\chi^2=10.9$  on 4 df;  $p<0.027$ ). On average, there was a 5 point difference in MEFS score between the lowest and highest income categories.

**Conclusions:** Young children from lower income households showed lower EF skills than children from higher income families, which persisted across three years even after adjusting for effects of age, testing environment exposure, household size, and frequency of English spoken in the home. This gap represents about a half-year delay in EF skills between the highest and lowest income-earning households. Future analyses will examine social and biological mechanisms through which household income may influence children's EF development.

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**Keywords:** child development (normal), executive functions, chronic stress

**I. GAUDET, N. PAQUETTE, N. POIRIER, M. SIMARD, M. BEAUCHAMP, A. GALLAGHER. Social outcomes in preschoolers with congenital heart disease : an integrative perspective.**

**Objective:** Children born with congenital heart disease (CHD) are at increased risk for various neurodevelopmental impairments. Previous studies that have characterized this population have focused predominantly on motor, cognitive, and language outcomes, revealing developmental delays in language acquisition, poorer intellectual and executive functioning and behavioral problems. However, little is known regarding the social competence of children with CHD, particularly at young ages. Social interaction is one fundamental component of children's development. The emergence of social skills is a highly complex process involving the maturation of a broad range of cognitive functions. According to the *socio-cognitive integration of abilities model* (SOCIAL, 2010), social competence requires intact abilities in executive functions (EF), communication, and social cognition (e.g. theory of mind [ToM]). The current study aimed to assess the relationship between EF, language, ToM, and social competence in preschool children with CHD.

**Participants and Methods:** Five-year-old children with CHD followed at the *Clinique d'Investigation Neuro-Cardiaque* (CINC) were invited to undergo an interdisciplinary evaluation. Inclusion criteria were having undergone at least one invasive procedure for correction or palliation of a major heart defect. Exclusion criteria were the presence of any comorbid genetic syndrome known to impact neurodevelopment (e.g. Down syndrome).

Neuropsychological assessment included a comprehensive battery assessing a range of developmental domains. The present study used a subset of data including measures of language (core language score – CELF-4), social cognition (ToM – NEPSY-II) and EF (tower – NEPSY; Global Executive Composite [GEC] of the BRIEF parent questionnaire). Social competence was assessed using the PEERS-Q, a standardized parent questionnaire.

Hierarchical regression was conducted to examine the concurrent relations among language skills, social cognition, EF (performance-based and parent-rated), and social competence. Adjustments for age at assessment and maternal educational level were taken into account.

**Results:** Fifty-three children with CHD were included (mean age  $5.56 \pm 0.26$  years; 53% male). Maternal education and child age, entered in step 1, did not make significant contributions to the model (R-squared changes = .069,  $p > .05$ ). In contrast, cognitive functions (CELF-4 core language score, ToM and tower scores) significantly accounted for 19.9% of the variance in social competence. The parent-rated EF (BRIEF GEC) added another 36.1% to the total explained variance. Overall, the model accounted for a total of 63.0% of the variance in parent-rated social competence as measured by the PEERS-Q.

**Conclusions:** These findings provide new evidence for understanding social competence among preschoolers with CHD. The model suggests a combined contribution of social cognition, language, and EF on social outcomes, with behavioral deficits in EF being the most important contributor. Targeted remedial programs addressing these intervention targets could be useful in promoting social outcomes in this vulnerable population.

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**Keywords:** social cognition, executive functions, child development disorders

**L. E. BRADSTREET, K. A. MCNALLY, J. E. CASS, A. E. BOUTZOUKAS, D. FREEDMAN, M. G. CHUNG, E. DE LOS REYES, W. HUNT, C. P. OUELLETTE.**  
**Neuropsychological Outcomes Associated with La Crosse Virus Encephalitis in a Pediatric Sample.**

**Objective:** La Crosse virus encephalitis (LACE) is the most common mosquito-borne neuroinvasive infection in children in the USA, with frequent neurologic sequelae including seizures. Data regarding neurocognitive and neurobehavioral problems are limited. The current study aimed to examine neuropsychological outcomes in a clinically referred pediatric sample.

**Participants and Methods:** We reviewed medical records for pediatric patients (age  $\leq 18$  years) with serologically confirmed LACE diagnosed at Nationwide Children's Hospital between 2009-2019 who were referred for neuropsychological evaluation. We defined "severe disease" as the presence of status epilepticus, pediatric intensive care unit admission, mechanical ventilation, intracranial pressure monitoring, syndrome of inappropriate antidiuretic hormone secretion, parenteral/tube feeds, or inpatient rehabilitation. We converted all age-normed scores to z-scores to allow for comparisons across different tests. We categorized test scores into 10 neurocognitive domains: IQ, Verbal, Nonverbal, Processing Speed, Attention/Working Memory, Executive Function, Verbal Memory, Visual Memory, Fine Motor, and Academics. We calculated mean z-scores for each domain and categorized patients as having a deficit (e.g.,  $\geq 2$  scores with  $z < -1.5$ ) or not in each domain.

**Results:** Thirty-two children ( $M_{age} = 9.94$  years,  $SD = 3.31$  years, range = 3.17-14.83 years; 14 [43.8%] females; 19 [59.4%] with severe disease) completed neuropsychological evaluations (7 inpatient and 25 outpatient). We categorized patients into three groups based on time since admission (TSA) until neuropsychological testing (Acute = within 30 days [ $n=13$ ; Median TSA = 17 days]; Subacute = 31-180 days [ $n=11$ ; Median TSA = 84 days], Chronic = 181+ days [ $n=8$ ; Median TSA = 518 days]). Mean z-scores across all domains were within one standard deviation below normative scores (range = -0.72 to -0.22). Across time groups, most patients (65.5%) showed a deficit in one or more cognitive domains, with 28.1% showing deficits in  $\geq 2$  domains. Patients with severe disease more often demonstrated deficits in  $\geq 2$  domains compared to those without severe disease (36.8% vs. 15.4%, Fisher's Exact Test  $p=0.25$ ). Similarly, patients who were evaluated in closer temporal proximity to the onset of LACE more often demonstrated deficits in  $\geq 2$  domains compared to patients evaluated later in time (Acute = 46.2%, Subacute = 18.2%, Chronic = 12.5%,  $\chi^2=3.59$ ,  $p=0.17$ ). Patients most frequently showed deficits in Fine Motor (34.4%,  $M_z = -0.72$ ), Verbal (28.1%,  $M_z = -0.43$ ), Verbal Memory (20.0%,  $M_z = -0.23$ ), and Executive Function (19.2%,  $M_z = -0.44$ ) domains.

**Conclusions:** Results indicate that pediatric patients with a history of LACE are at risk of experiencing neurocognitive deficits, with a trend towards increased risk for children with severe disease. Neurocognitive deficits were most common earlier in the recovery period, though deficits were still apparent in some children tested six months or longer after diagnosis. Findings support a multidisciplinary approach to patient care that includes brief neuropsychological screenings and consultation during hospitalization and, when persistent concerns for cognitive changes are present, long-term follow-up with outpatient neuropsychological evaluations. Such an approach may improve school re-entry for these patients by including recommendations targeting physical and cognitive symptoms of LACE. Coordinated, multisite research efforts are needed to build on our preliminary results.

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**Keywords:** encephalitis, pediatric neuropsychology, neuropsychological outcome

### Poster Symposium 1: Ethical Issues in Clinical Supervision

**Chair and Presenter: Lynn A. Schaefer**  
**Presenters: Dede Ukueberuwa, Nicolette Gabel, Brian P. Yochim**

**2:30 PM - 3:30 PM**

**L. A. SCHAEFER, D. UKUEBERUWA, N. GABEL, B. P. YOCHIM. Ethical Issues in Clinical Supervision.**

Definitions of supervision include “directing,” “guiding,” and “overseeing.” Supervision is an essential component of the training of future generations of neuropsychologists, however most psychologists do not in turn receive formal training in performing supervision. The APA Ethical Principles of Psychologists and Code of Conduct (2017) addresses supervision broadly in all of its Principles (i.e., beneficence, fidelity and responsibility, integrity, justice, and respect for people’s rights and dignity). The Ethics Code also identifies specific Standards regarding supervision in Section 7, Education and Training. However, guidance here is scant, focusing solely on disclosure of student information, assessing performance, and prohibitions about sexual relationships with students and supervisees.

The APA Guidelines for Clinical Supervision in Health Service Psychology (2014) was a recent attempt to outline essential practice in the provision of supervision using a competency framework. The Guidelines on Supervision are organized around seven domains, including: supervisor competence, diversity, the supervisory relationship, professionalism, assessment/evaluation/feedback, problems of professional competency, and ethical and legal considerations. Nonetheless, within each of these domains, examples of specific ethical “does” and “don’ts” are not provided. Therefore, providing formal education to neuropsychologists regarding potential ethical dilemmas in supervision would meet an important need. Multicultural supervision and working with under-represented populations are topics in particular need of attention and will be addressed here.

This symposium will feature clinical neuropsychologists who serve as supervisors and clinical training directors. They will discuss examples of case vignettes, specify ethical challenges and relevant guidelines involved, and offer courses of action. Furthermore, the authors will offer updated insights into the ethical dilemmas and their resolutions.

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**L. A. SCHAEFER. Slippery Slopes and Blurred Boundaries.**

**Objective:** Case Examples include the power differential, dual relationships, multiple roles/role confusion, self-disclosure, socializing with supervisees, and issues of confidentiality.

**Participants and Method:** Audience members will discuss the following questions based on the case examples. What is the likelihood of exploitation of the supervisee? Am I treating this supervisee differently (better or worse) than others? Is the behavior meeting the need of the supervisor rather than the supervisee? How appropriate is the behavior and could it be interpreted in a way that becomes problematic? Might the supervisee feel less safe with or untrusting of the supervisor?

**Results/Conclusions:** Some specific standards from existing Guidelines that apply to this ethical theme include Competence, particularly with regard to avoiding delegation of work to persons with a multiple relationship and thus involving possible loss of objectivity, and being

aware of personal problems (of either party) interfering with supervision. Under Human Relations, standards dealing with avoiding harm, multiple relationships, conflicts of interest, and exploitative relationships certainly apply here. Informed consent through the use of a supervision contract, or at least a delineation of supervision goals, boundaries, and limitations (including confidentiality and the limits of confidentiality) would appear prudent and make explicit the supervisory relationship. Finally, under Education and Training, Standard 7.06 (Assessing Student and Supervisee Performance) and Standard 7.07 (Sexual Relationships with Students and Supervisees) are relevant ethical standards applicable to these dilemmas.

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#### **D. UKUEBERUWA. Culture in Ethical Supervision: Perceptions, Pitfalls, and Empowerment.**

**Objective:** Case examples include presentation of ethical incidents and opportunities within cross-cultural and multicultural supervision. Culture is defined as dimensions of ethnicity, race, or nationality and may be broadened to include additional dimensions of identity. Within culturally-relevant supervision, the supervisor provides ethical and professional guidance to the supervisee on culture-specific issues.

**Participants and Method:** Audience members will discuss the following questions based on the case examples. How can the supervisor create an open and respectful environment for discussing diversity and culture? How should the supervisor address a cultural insensitivity involving the supervisee? Are there ethnocentric dynamics apparent within the supervision? How might the supervisor empower the supervisee in culturally-relevant practice, including work with under-represented populations?

**Results/Conclusions:** Applicable guidelines for supervision and training includes the APA Guidelines on Multicultural Education, Training, Research, Practice, and Organizational Change for Psychologists. Guideline 2 addresses psychologists as cultural beings, whose attitudes and beliefs that can influence their perceptions of and interactions with others as well as their clinical and empirical conceptualizations. Guideline 9 indicates that psychologists strive to conduct culturally-informed supervision as part of higher goals of ecologically appropriate professional practice. These guidelines will be applied to case examples in order to inform ethical and culturally-relevant supervision practices. Discussion points include diversity in professional settings, perceptions of cultural identity, barriers and benefits to addressing culture within the supervision, cultural amplification of power dynamics, and unique issues between cross-cultural and multicultural supervision. Further resources will be discussed for assessing and enhancing culturally-relevant supervision in professional contexts.

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#### **N. GABEL. Feedback Flops to Gatekeeping Gaffes: Ethically Informed and Effective Feedback to Trainees.**

**Objective:** Case Examples include problems associated with timing of feedback (e.g., feedback that comes too late), communication of critical feedback, pitfalls in written feedback, and limitations in gatekeeping.

**Participants and Method:** Audience members will discuss the following questions based on the case examples. How do you salvage training for a trainee who has not received timely

feedback? How do you ensure criticism is constructive and supervision is effective and empowering? How do you balance trainees' need for face-to-face time with a heavy workload for the supervisor, while still maintaining quality of training? What happens when remediation plans don't work?

**Results/Conclusions:** The principle of Beneficence and Nonmaleficence applies here, as nonconstructive criticism may harm the trainee's sense of worth and competence, jeopardize the supervisor-supervisee relationship, and potentially alter the student's career trajectory. The principle of Fidelity and Responsibility pertains to gatekeeping for the profession, such as when a trainee's lack of competence is not responsive to remediation efforts, or when the trainee has behaved in an unethical manner and the situation cannot be salvaged despite feedback. Standard 7.06 (Assessing Student and Supervisee Performance) establishes the importance of timeliness and the use of specific processes for feedback that must be discussed when initiating supervision. The standard indicates that supervisees are to be evaluated on the basis of relevant performances and the requirements of the training program. Much day-to-day supervision, though, involves addressing unforeseen situations and discovering previously unknown gaps in clinical skills that need to be addressed, which prove challenging and create potential dilemmas.

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#### **B. P. YOCHIM. Promoting Positive Supervision.**

**Objective:** Case examples include hypothetical situations, such as when a supervisor finds that trainees are receiving suboptimal supervision, and must decide whether the situation merits intervention and what level of intervention. Other examples include supervisors practicing outside their competence, being unavailable for supervision, and delegating work to trainees who are not yet able to perform those duties competently. One potential dilemma is the wish to respect one's colleagues whose practices differ from one's own, versus the need to ensure trainees receive adequate supervision.

**Participants and Method:** Audience members will discuss the following questions based on case examples. How can psychologists prevent these situations from occurring? How can psychologists take a positive ethics approach to intervene when these situations occur, in a way that benefits our larger work environments? How can we promote a work environment in which psychologists are motivated and able to provide quality supervision?

**Results/Conclusions:** The Principle of Beneficence and Nonmaleficence says psychologists attempt to benefit everyone with whom they work. The Principle of Fidelity and Responsibility notes that psychologists are concerned about our colleagues' professional conduct. The Principle of Justice suggests that our potential biases should not lead us to unfairly criticize our colleagues' practices. The Standard of Competence ensures that not only we but our colleagues perform within the boundaries of our competence, and that we delegate responsibilities to our trainees only when they have received sufficient education and training. The Standard of Human Relations prompts us to prevent harm to those with whom we work.

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### **Symposium 13: Comparing Approaches to Gauging Practice Effects in Aging and Alzheimer's Disease: Highlighting an Often Neglected Issue**

**Chair, Presenter and Discussant: William S. Kremen**  
**Presenter: Daniel A. Nation, Kevin Duff, Mark Sanderson-Cimino, Alden Gross**

**2:30 PM - 3:30 PM**

**W. S. KREMEN, D. A. NATION, K. DUFF, M. SANDERSON-CIMINO, A. L. GROSS.**  
**Comparing Approaches to Gauging Practice Effects in Aging and Alzheimer's Disease: Highlighting an Often Neglected Issue.**

Although the occurrence of practice effects on repeated neuropsychological testing is well known, it is rarely systematically examined. Failure to account for practice effects can, however, have a substantial impact. In thinking about practice effects, there is often an implicit assumption—except for very short test-retest intervals—that we should otherwise expect stable performance with no change. Here, our focus is on older adults, for whom this notion is particularly problematic given that age-related cognitive decline is the norm. Even with observed decline, practice effects can still mask even greater decline. Although neuropsychologists often want to know which is the best approach for gauging practice effects, Dr. William Kremen, the moderator/discussant, will articulate the view that this question is often not particularly meaningful. Rather than a one-size-fits-all approach, different approaches to gauging practice effects may address very different issues and serve very different purposes. Dr. Kremen will provide a brief overview, including some of his recent findings regarding accounting for practice effects to detect progression from cognitively normal to MCI and its implications for clinical trials. Dr. Daniel Nation will present on the use of a regression-based approach based on a robustly normal sample to examine 12-month normative neuropsychological decline and its relationship to biomarkers. Dr. Kevin Duff will present on 1-week practice effects quantified with regression-based methods, their associations with diagnosis, prognosis, treatment response, and brain pathology, and implications for clinical trials. Mr. Mark Sanderson-Cimino will present on a replacement-subjects method to modify scores after accounting for practice effects, and how this approach affects prevalence, rates of reversion to normal, and progression from single-domain to multi-domain MCI in a 12-month follow-up of baseline MCI subjects. Dr. Alden Gross will present on 2 methods of gauging practice effects in people with Alzheimer's disease. Dr. Kremen will then outline some key issues relevant to the presentations and lead an extended discussion/debate among the panel and the audience. Some issues for discussion will be: 1) Which methods are most useful for accurately characterizing change over time, and for predicting who is at elevated risk of decline or progression to diagnosis over time? 2) Rather than risk prediction, can any practice effect methods be used to directly modify when a diagnosis should be assigned? 3) Should lack of practice effects be part of MCI diagnosis? 4) How do we address different intervals, different age effects, and different test effects? 5) Is accounting for practice effects too costly and labor intensive for clinical trials or other research? 6) What are limits to generalizability of practice effect algorithms? 7) What do we do in clinic for practice effects? 8) Do we need practice effect norms? The goal of the discussion/debate is to help clarify what particular approaches to practice effects can tell us and what they cannot tell us, and to demonstrate how different ways of accounting for practice effects can have very substantial real world clinical and research implications for understanding cognitive decline and disease progression, timely diagnosis, and cost savings in clinical trials.

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**Keywords:** cognitive course, dementia - Alzheimer's disease, mild cognitive impairment

**D. A. NATION. Older Adults Showing Neuropsychological Decline on Serial Testing Exhibit Greater Alzheimer's Disease Biomarker Abnormalities.**

**Objective.** Practice effects are commonly observed on serial testing. One solution is to compare performance to normative expectations on serial testing. Studies using this approach have demonstrated that older adults with decline relative to normative expectations are at increased risk for dementia. The current study examined biomarkers of Alzheimer's disease in older adults with neuropsychological decline (NP decline) relative to normative expectations on serial testing.

**Participants and Methods.** Regression analysis of serial cognitive test data (6 tests) from a robustly normal subsample (n=294) of the Alzheimer's Disease Neuroimaging Initiative (ADNI) study was used to develop a normative model of 12-month neuropsychological change. The regression model was used to calculate NP decline relative to expectations for the greater ADNI sample (n=1,074). Receiver operating characteristics curves determined optimal NP decline cutoff predicting future dementia. The relationship between NP decline and Alzheimer's disease biomarker abnormalities was examined after controlling for age, sex, education and genetic risk.

**Results.** Relative to those with normative change over 12-month follow up, older adults exhibiting greater than expected NP decline exhibited greater abnormalities in cerebral spinal fluid and neuroimaging markers of amyloid, tau and neurodegeneration.

**Conclusions.** Findings indicate increased Alzheimer's disease biomarker abnormalities in older adults showing decline on serial neuropsychological testing. These data corroborate prior studies demonstrating increased risk for Alzheimer's dementia in older adults with cognitive decline relative to normative expectations. Future studies should further refine neuropsychological change statistics to better address practice effects, more flexibly model time, and better account for demographics factors.

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**K. DUFF. Practice Effects in Research on Alzheimer's Disease: Save the Baby and the Bathwater.**

**Objective:** In their simplest form, practice effects are improvements in test scores when an individual is repeatedly exposed to tests or testing materials. Despite many attempts to minimize or control practice effects in longitudinal studies, it is possible that this artificial boost in test scores may provide useful information about an individual's cognitive and brain health.

**Participants and Methods:** Using multiple samples of older adults with intact cognition, amnesic Mild Cognitive Impairment, and mild Alzheimer's disease, practice effects, collected across one week, were quantified with standardized regression-based methods and compared to various outcomes.

**Results:** Across these various sample, practice effects provided useful information about diagnosis, prognosis, treatment response, and brain pathology. These results demonstrate how practice effects (or lack thereof) can be used to enrich clinical trials in Alzheimer's disease.

**Conclusions:** Although practice effects are a surprisingly complex phenomenon, they might also shed light on our understanding of late life cognitive disorders (as well as other neurological and psychiatric conditions frequently seen by neuropsychologists).

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**M. SANDERSON-CIMINO, J. A. ELMAN, X. M. TU, M. PANIZZON, G. M. EGLIT, A. JAK, E. EDMONDS, K. R. THOMAS, J. EPPIG, M. W. BONDI, C. E. FRANZ, W. S. KREMEN. Accounting for Practice Effects in Follow-Up of MCI Cases Reduces Reversion Rates and Improves Detection of New Impairments.**

**Objective:** We previously showed that failure to account for practice effects (PEs) delays detection of conversion from unimpaired to MCI and reduces diagnostic accuracy based on biomarker positivity data. Even among those who decline, PE can mask steeper declines by inflating cognitive scores. Within MCI samples, PEs may increase reversion rates and impede detection of new impairments. Here, within a baseline MCI sample, we evaluated how PEs affect prevalence, reversion rates, and progression from single-domain to multi-domain MCI at follow-up.

**Participants and Methods:** We examined 195 baseline ADNI MCI participants (mean age=73.9; SD=7.4). We used Jak/Bondi diagnostic criteria (6 tests). We identified participants who were demographically matched to returning subjects at their 1-year follow-up. The only difference was that one group was tested once and the other twice. We subtracted PEs—based on comparing these groups—from follow-up scores and recalculated MCI diagnoses.

**Results:** PEs were absent or small for 5 tests (Cohen's  $d=.00-.05$ ) and medium for 1 ( $d=.51$ ). Accounting for PEs increased MCI prevalence at follow-up by 6.7% (152 vs 165), and reduced reversion to normal by 30.2% (43 vs 30). PEs also masked progression from single-domain to multi-domain MCI: 10 vs 16 (+60.0% after accounting for PEs).

**Conclusions:** Although PEs were small, accounting for them in baseline MCI participants after 1 year, increased MCI prevalence and progression from single-domain to multi-domain, and decreased reversion rates. Failure to consider PEs reduces accuracy regarding conclusions about MCI stability/change and weakens our ability to determine when impairment spreads to new domains.

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**A. L. GROSS. Do People with Alzheimer's Disease Improve with Repeated Testing? Comparison of Two Methods for Characterizing Practice Effects.**

**Objective:** Practice effects are apparent in people with Alzheimer's Disease (AD) despite impaired episodic memory, suggesting a role of contextual memory (e.g., procedural memory, reduced anxiety for taking tests) in addition to episodic memory for test content. Our goal was to assess for practice effects using two methods among people with AD.

**Participants and Methods:** We used data from the Critical Path Institute's repository of placebo arm data from randomized controlled trials (RCTs) of dementia conducted by participating pharmaceutical companies (N=990 people, 4,170 study visits, up to 2.4 years of follow-up). Practice effects were estimated on the Mini-Mental State Examination (MMSE) using two approaches. First, we added a binary indicator for first testing occasion into a linear regression with random effects for people and time. Second, we calculated practice effects by contrasting

follow-up scores of demographically-matched participants to baseline scores of a subset of participants at baseline.

**Results:** Average MMSE score (16.6 points, SD=5.5, range 1, 27) declined by 2.0 points/year (95% confidence interval, CI: -2.3, -1.8). Using the indicator method, the mean practice effect was 0.6 points (95% CI: 0.4, 0.8) at second assessment (average 4 months after baseline). The average practice effect using the returnee-replacement approach was also apparent.

**Conclusions:** Practice effects are apparent in people with dementia despite reduced episodic memory, using two different approaches that estimate population-average retest and individual-level retest. Implications for measurement are discussed.

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## **Symposium 14: Characterizing Cognition Across Movement and Neuromuscular Disorders**

**Chair: Silvia Chapman**

**Presenters: Corey T. McMillan, Megan Barker, Marjana Tafader**

**2:30 PM - 3:30 PM**

### **S. CHAPMAN, C. T. MCMILLAN, C. A. MCHUTCHISON, M. BARKER, M. TAFADER, S. COSENTINO. Characterizing Cognition Across Movement and Neuromuscular Disorders.**

Cognitive functioning is well characterized in neurodegenerative diseases such as Alzheimer's disease (AD) in which cognitive impairments are the earliest identifying feature. However, in disorders that have motor symptoms as their primary identifying feature, the profiles, underlying mechanisms and associated factors of cognitive dysfunction are not well understood. This symposium brings together international researchers that study cognition across various movement and neuromuscular disorders to provide a comprehensive overview of current advances of the study of cognition in these fields. The first two talks led by Dr. McMillan and Dr. McHutchison will focus on cognition in amyotrophic lateral sclerosis (ALS). Opening the symposium, Dr. McMillan will present on estimates of cognitive impairment and Frontotemporal degeneration (FTD) in ALS and risk modifying effects of genetics on these estimates. Following Dr. McMillan's talk, Dr. McHutchison will present on the characterization of psychiatric symptoms in ALS patients and their family members to examine their association with cognitive and behavioral impairment in ALS. Our third speaker, Dr. Megan Barker will present an innovative error analysis of speech production in patients with Progressive Supranuclear Palsy (PSP) as compared to AD, providing evidence for the cognitive mechanism underlying the striking speech disturbances observed in PSP. The final presenter, Marjana Tafader, a scholar of the Summer of Translational Aging Research for Undergraduates (STAR-U) R25 program at Columbia University Medical Center, will present postmortem brain pathology analyses to elucidate the drivers of cognitive dysfunction in individuals with Essential Tremor. To finalize the symposium, our discussant Dr. Cosentino, will tie together all presentations and discuss future directions for cognitive research in movement and neuromuscular disorders.

**Keywords:** movement disorders, cognitive functioning, neuropsychiatry

**C. T. MCMILLAN, J. WUU, L. HENNESSY, K. PLACEK, C. QUINN, L. ELMAN, M. GROSSMAN, E. RAMPERSAUD, G. WU, J. TAYLOR, S. KALRA, M. BENATAR . Frequency, Hazard, and Genetic Risk Factors of Cognitive Impairment in Amyotrophic Lateral Sclerosis (ALS).**

**Objective:** Amyotrophic lateral sclerosis (ALS) is a multi-system disorder characterized primarily by progressive muscle weakness. However, ALS occurs along a spectrum with reports that frontotemporal degeneration (FTD) occurs in ~10-15% patients and as many as 50% have evidence for cognitive impairment (ALSci). There is now an internationally accepted method for measuring cognition in ALS using the Edinburgh Cognitive & Behavioral ALS Screen (ECAS). However, estimates for the frequency of ALSci have been over-estimated, and genetic factors contributing to ALSci risk remain largely unknown. We highlight our approach for establishing an objective method for defining ALSci and identifying genetic risk factors for ALSci.

**Participants & Methods:** We present three experiments: (1) We evaluate 2 statistical approaches - a two-standard deviation (2SD) and quantile regression (QR) - for establishing cut-offs on the ECAS in 269 healthy adults acquired from a multi-center collaboration between University of Pennsylvania (PENN), the Clinical Research in ALS (CRiALS) Study at University of Miami, and Canadian ALS Neuroimaging Consortium (CALSNIC). We then apply these cut-off approaches to 182 PENN ALS patients; (2) To evaluate genetic modifiers of ALSci/ALS-FTD risk we evaluated 270 autopsy-confirmed cases that initially presented with ALS or FTD and assessed the hazard of developing ALS-FTD/FTD-ALS and evaluate whether this is modified by initial phenotypic presentation (ALS vs. FTD) or genetic status (*C9ORF72*+ vs. noncarrier); (3) We use sparse canonical correlation analysis (sCCA), an unsupervised machine-learning technique, to generate a weighted polygenic risk score (WPRS) comprised of single nucleotide polymorphisms (SNPs) that associate with baseline cognitive performance in patients from the Clinical Research in ALS and Related Disorders for Therapeutic Development (CReATe) Consortium Phenotype-Genotype Biomarker (PGB) Study (N=327) and establish converging evidence for this WPRS through longitudinal evaluation of ECAS performance in CReATe PGB patients, neuroimaging of cortical thickness N=90 and post-mortem neuronal loss in N=87 autopsy-confirmed PENN ALS patients.

**Results:** QR models revealed that increased age and reduced educational attainment negatively impact healthy control ECAS performance. Based on QR-derived normative cutoffs, the prevalence of ALSci in PENN ALS patients was ~16% for ECAS ALS-Specific and ~15% for ECAS Total, which are more conservative frequencies relative to the 2SD approach. The hazard of a secondary phenotype is relatively equal for *C9ORF72*+ (5.2%) and noncarriers (3.8%) at 12 months from emergence of the initial phenotype, but nearly four-fold greater by time of death in *C9ORF72*+ (29.2% vs. 8.4% noncarriers). sCCA identified 27 SNPs that collectively contribute to a WPRS that associates with ECAS baseline performance, ECAS longitudinal decline, cortical thinning in frontotemporal cortex, and post-mortem motor cortical neuronal loss.

**Conclusions:** The method for defining ALSci has an impact on the estimates for the frequency of cognitive impairment in ALS. Furthermore, the hazard for ALSci increases substantially over disease course in *C9ORF72*+ compared to noncarriers, emphasizing the importance for genetic screening to develop clinical management strategies that include dual cognitive and neuromuscular referrals for *C9ORF72*+ patients. Moreover, a WPRS related to ALSci risk add to the increasing genetic contributions toward heterogeneity within the ALS spectrum.

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### **M. BARKER, G. ROBINSON. Spontaneous Speech in Progressive Supranuclear Palsy: A Distinctive Pattern of Speech Output Over Time.**

**Objective:** Progressive supranuclear palsy (PSP) is a movement disorder characterized by supranuclear vertical gaze palsy, akinetic rigidity, postural instability, and parkinsonism. Alongside motor symptoms, patients with PSP exhibit cognitive and language decline, including, in many cases, profoundly reduced spontaneous speech. Spontaneous speech is vital for everyday communication skills, such as relaying information, telling stories, and entertaining others. In order to successfully produce spontaneous speech, the speaker must initiate and sustain verbal output over time. Verbal fluency (i.e. continuously generating items for one minute in response to a stimulus cue, such as “animals”) is another skill that requires initiating and sustaining verbal output over time, and is also commonly reduced in PSP. However, PSP patients may demonstrate a unique pattern of verbal fluency: previous studies have shown that they are not consistently reduced across the one-minute timeframe. Rather, they begin responding at a satisfactory rate and then quickly decline or “drop off”. Anecdotally, this has been described as “running out of things to say”, and is theoretically linked to sustained attention / executive functioning abilities. It remains unknown whether this is evident on spontaneous speech tasks, and thus we aimed to investigate patterns of spontaneous speech over time in a case series of patients with PSP. We further explored whether a “drop off” pattern could be detected on a nonverbal task that required sustained responding over time.

*Participants & Methods:* Patients with a diagnosis of probable PSP (N = 5), patient controls with a neurodegenerative condition (dementia due to Alzheimer’s disease N = 3, frontotemporal dementia N = 2) and healthy older adult controls (N = 30) were assessed on a standard neuropsychological battery, including spontaneous speech tasks (description of a pictorial scene and favorite holiday), as well as executive (e.g. verbal fluency), attention and language tests. Patterns of performance over time were investigated on verbal fluency tasks, spontaneous speech samples, and a nonverbal button-pressing sustained attention task.

**Results:** Response rates for the spontaneous speech, verbal fluency, and nonverbal sustained attention tasks were separated into time periods (e.g., first 15 seconds vs. last 45 seconds in a 60 second task). Four of the five PSP patients showed a clear response pattern indicative of a sharp decrease in output over time on the spontaneous speech tasks, verbal fluency, and the nonverbal sustained attention task. Healthy and patient controls did not show the same sharp decrease in responding over time.

**Conclusions:** PSP patients demonstrated an initial period of satisfactory responding with a subsequent “drop off” on verbal and nonverbal tasks. Thus, reductions in spontaneous speech in PSP patients may be related to problems with sustained attention, spanning verbal and nonverbal domains. With further research this might be a useful cognitive diagnostic marker for PSP. Understanding how these underlying processes are impaired can ultimately inform intervention and management strategies.

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**M. TAFADER, S. CHAPMAN, K. FARRELL, D. IGLESIAS HERNANDEZ, K. RADLER, L. E. COLVIN, P. L. FAUST, J. F. CRARY, E. D. LOUIS, S. COSENTINO. Postmortem Neuropathological Substrates of Cognition in Essential Tremor.**

**Objective:** Essential Tremor (ET), historically viewed as an exclusively motor disorder, has been linked to increased risk for cognitive decline and dementia. The neuropathological basis of cognitive impairment in ET is not known, and is likely to be complex. Imaging and neuropathologic studies point to cerebellar dysfunction in ET, raising the possibility that cognitive deficits in ET arise secondary to a cerebellar-cortical syndrome. However, epidemiologic studies suggest that individuals with ET are at increased risk for developing Alzheimer's disease [AD]. At present, there is no way to tell whether a given ET patient, based on his/her observed cognitive features, has an early degenerative disease such as AD, or merely the expected cognitive profile of ET. The current study examined the extent to which cognitive functioning in older adults with ET is associated with cerebellar versus AD pathology.

**Participants and Methods:** Postmortem data were available for 48 non-hispanic white participants enrolled in an ongoing, prospective longitudinal study of cognition in ET (mean<sub>age</sub>=90.23, SD<sub>age</sub>=5.25; mean<sub>education</sub>=15.34, SD<sub>education</sub>=2.86; 58 % female). Prior to death, participants underwent extensive motor-free neuropsychological testing at ~1.5 year intervals.

Cognitive domain z-scores were calculated using the mean (SD) from participants diagnosed as cognitively healthy at baseline (n = 178). Postmortem pathological data included: AD pathology defined as Braak stage (distribution of tau tangles) and CERAD score (quantification of neuritic amyloid plaques). Cerebellar pathology was quantified with Purkinje cell and axonal torpedo counts. As 26 of the 48 participants met criteria for Mild Cognitive Impairment (MCI; n=11) or dementia (n=15), analyses were stratified by normal (n=22) versus abnormal (MCI/dementia; n=26) cognition. One-tailed Spearman analyses tested associations between cognition and neuropathological variables. Partial correlations adjusted for age at death and time between last cognitive assessment and death.

**Results:** There were no significant clinical-pathologic correlations in the cognitively normal group. In the MCI/dementia group, Braak and CERAD severity scores were inversely associated with memory and executive function (rho range = -.39 – -.57, p range = .002 - .029). CERAD scores were also inversely associated with attention (rho = -.57, p = .002) while Braak stage was also associated with language (rho=-.44, p=.014). Torpedo counts were inversely associated with memory (rho = -.38, p = .028) and attention (rho = -.51, p = .007). Results, attenuated in adjusted analyses, remained significant only for associations between AD pathology and cognition.

**Conclusions:** Preliminary results in this small cohort suggest that among individuals with ET diagnosed with MCI or dementia, cognitive impairment is associated with AD pathology rather than the pathologic cerebellar features previously described in ET. In contrast, among cognitively normal older adults with ET, variability in cognitive functioning is not linked to either type of pathology. Ongoing work is building a larger sample and a non-ET control group to more fully articulate the basis of cognitive impairment in ET. Such knowledge will directly inform clinical care by revealing the cognitive features in ET that may be expected in the context of cerebellar dysfunction versus those which may signal a comorbid degenerative disease.

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## **Symposium 15: Cultural Leadership in Neuropsychology: A Guide for Inter-Organizational Governance**

**Chair and Presenter: Christine M. Salinas**

**Presenters: David M. Lechuga, Karen Postal, Courtney Ray, Anny Reyes, Octavio A. Santos, Nicholas S. Thaler, Marc Norman, Antonio E. Puente**

**2:30 PM - 3:30 PM**

**C. M. SALINAS, D. M. LECHUGA, K. POSTAL, C. RAY, A. REYES, O. A. SANTOS, N. S. THALER, M. NORMAN, A. E. PUENTE. Cultural Leadership in Neuropsychology: A Guide for Inter-Organizational Governance.**

While cross-cultural leadership is recognized as critical for innovation and economic growth in governments, global corporations, and various sectors of our daily life, this critical methodology has received minimal attention in our discipline. A review of the literature indicates that only four peer-reviewed articles exist in the area of leadership in neuropsychology with only one describing leadership styles in women with anecdotal examples. This is surprising since cultural neuropsychology elucidates how culture is central to how individuals think, express themselves, and relate to one another. Leaders with expertise in culture often effect change that can go “viral” rapidly as culture is a key vehicle for creativity, innovation, and disruption. Cultural competency can guide scientists and leaders in organizations to increase diversity and effective communication among their members in the current digital era. In neuropsychology, there has been a slow increase in the number of trainee and professional leaders who represent various cultures. Within this context, neuropsychology organizations and departments require leaders who adjust to environments quickly and effectively work with others of culturally diverse backgrounds. Being a successful leader within one culture will not automatically lead to success in another culture.

Several organizations were established to lead cultural neuropsychology initiatives [Hispanic Neuropsychological Society; Society for Clinical Neuropsychology (SCN) Women in Neuropsychology Subcommittee; SCN Committee for Ethnic Minority Affairs; National Academy of Neuropsychology Diversity Committee; AACN Diversity Committee that evolved into AACN Relevance 2050; Association of Postdoctoral Programs in Clinical Neuropsychology Diversity Committee; Asian Neuropsychological Association; Society for Black Neuropsychology and International Neuropsychological Society Cultural SIG]. While cultural neuropsychology has gained momentum over the past two decades due to these noteworthy efforts, the seismic U.S. demographic shift, combined with the digital health era and a shortage of culturally responsive neuropsychologists (including a diverse trainee pipeline), have created the “perfect storm:” a current national patient-provider crisis.

Cultural Leadership is effective at solving complex problems, such as the social unrest and ongoing disparities in neuropsychology. To our knowledge, no initiatives exist in our discipline to “train the trainers or leaders” in Cultural Leadership, or to coalesce leaders and resources inter-organizationally to benefit from our collective expertise to create a true cultural neuropsychology at all levels. A recent survey indicates that neuropsychologists support the development of a Cultural Neuropsychology Council and Inter-Organizational Diversity Committee. The vision is to affirm Cultural Leadership in Neuropsychology and unite to drive a new era in achieving justice, equity, and sustainability for all in the field and patients we serve.

Our objectives are to address cultural factors that influence leadership. For example, the data on gendered leadership styles is robust as well as the gender and racial/ethnic gap in academia, executive positions, and salaries that reflect societal inequities. Cultural factors influence fundamental aspects of leadership: navigating power dynamics and relationships; discrimination and -isms (i.e., ageism, racism); negotiating strategies; and strategic leadership.

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**Keywords:** creativity, cross-cultural issues, inclusion

### **C. M. SALINAS. Cross-Cultural Leadership: A toolkit for creativity and innovation.**

**Objective:** Cross-cultural leadership requires reflecting humbly, thinking critically, adapting and communicating, as well as understanding one's own biases. We will demonstrate key dimensions of cross-cultural leadership: culture, risk, linear/parallel hierarchy, and individualism/collectivism.

**Participants and Methods:** After defining and sharing examples of each dimension, speakers will help explore their impacts on leadership as well as how to adapt to variations in different cultures. We will describe the challenges of cultural leaders as it relates to describing value, working in networks, and leading fearlessly for creative problem solving and disruption.

**Results:** Disparities in executive leadership exist in the field of neuropsychology with a small portion of leaders representing culturally diverse individuals. Training and research in the area of cultural leadership in our discipline is sparse. As a result of scenarios presented, leaders in science, training settings, and governance will gain practical tools to improve cross-cultural leadership skills.

**Conclusions:** Cultural leadership has implications for hierarchy of power and leadership styles. Leaders will examine their response to other cultures before creating an action plan around the impact of cultural variation on leadership.

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### **C. RAY. Leading Transformational Change: “What does gender and culture got to do with it?”**

**Objective:** We will demonstrate key aspects of gendered leadership across various racial and ethnic groups including: the perception of self-promotion vs. saying “yes” to opportunities; how gender and ethnicity impact leadership styles and responses to leadership; positive vs. negative threat incentives; transformational leadership; mentoring and altruism. We will review diverse women's role in executive leadership in neuropsychology including the history of women in leadership within established neuropsychology organizations.

**Participants and Methods:** Leaders from within various neuropsychology organizations will define and share examples of how gender has impacted perceptions of approaches to leadership, speakers will help explore their impacts on governance and leadership.

**Results:** This discussion will give emerging and current leaders in science, training settings, and governance tools to continuously improve leadership and be aware of how perceptions of gender may interact with leadership approaches. Speakers will share methods for facilitating introspective organizational evaluation and creating equitable leadership opportunities with regards to gender diversity.

**Conclusions:** Gender impacts economic potential, hierarchy of power, and leadership styles. Leaders will examine their response to gendered leadership before creating actionable solutions for themselves and their organizations.

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#### **O. A. SANTOS. Navigating Power Relationships Across the Leadership Lifespan .**

**Objective:** We will demonstrate key aspects of navigating power relationships at various career stages and address cultural factors that impact one's relationship to power, and how mentoring and sponsorship experiences hinder or strengthen leadership development in trainees and professionals of culturally diverse backgrounds.

**Participants and Methods:** After defining and sharing examples of navigating power relationships, speakers will help explore their impacts on governance and leadership as well as how to adapt to variations across one's career stage.

**Results:** This discussion will review (a) the impact of implicit bias, stereotype threat, structural racism, imposter syndrome, risk vs. resilience, and honoring predecessors on normalized power relationships and conflicting personal perspectives; and (b) the contribution of distributed types of Cultural Leadership to reduce hierarchical power relationships.

**Conclusion:** Culture plays a significant role in establishing a relationship between leadership and power. Interculturality is in essence about navigating power relationships and requires questioning social relationships, hierarchies, and unequal relationships between leaders and stakeholders. Cultural Leadership provides relevant tools to achieve these goals.

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#### **N. S. THALER. Cultural Influence in Negotiation Strategies.**

**Objective:** This panel will review cultural values among Asian, Latinx, and Black communities and how they can impact communication styles, conflict resolutions, and other aspects of negotiation strategies. These will be compared and contrasted to mainstream approaches towards negotiation with an emphasis on the advantages, as well as pitfalls, that may emerge.

**Participants and Methods:** Each panelist will review one or more aspects of specific cultural customs and values relevant towards group dynamics. Speakers will provide examples of how individuals within a culture might interact with each other in a negotiating environment, and how these examples may apply to culturally heterogeneous, as well as mainstream groups.

**Results:** This discussion will provide a frank look at the interplay between culture and negotiation across and within cultures. Salient factors include collectivist versus individualistic styles, Confucian values, indirect communication, and use of humor/deflection, among others.

**Conclusions:** There are distinct values among different cultural groups that yield distinct differences in interaction that can empower contextual communication during negotiation strategies. At the same time, there is a risk for a breakdown in communication if these values are not acknowledged and accepted during negotiations.

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