

Abstracts for the ISTS Mid-Congress Conference

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Listed in alphabetical order according to presenting author.

LEARNING NEEDS OF MULTIPLE BIRTH CHILDREN AND THE RESPONSE OF THE EDUCATIONAL SYSTEM

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The combination of research with educational best practices can result in a positive change in the educational environment for multiple birth children. The National Organization of Mothers of Twins Clubs, Inc. drew from both of these arenas along with anecdotal data gathered from parents of multiples and educators in order to develop a set of guidelines for the education of multiple birth children. This presentation will review those guidelines and present information as to their implementation in schools throughout the United States of America. Data from NOMOTC's most recent studies with educators and parents on this topic will also be included.

READING PROFICIENCY AND MULTIPLE BIRTH CHILDREN

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The National Organization of Mothers of Twins Clubs, Inc. recently completed research focused on the reading proficiency of multiple birth children. The research tool was a 24-question survey to be completed by parents of multiples. The survey aimed to determine differences and similarities in the reading proficiency of multiple birth children. Specific attention was given to determining the impact of premature birth on later development in literacy. Classroom placement and information on family support in terms of literacy were examined as factors.

Responses were provided by nearly 300 parents of twins and/or higher order multiples from throughout the United States. Results in some cases mirrored the results of recent research in reading proficiency for the overall population. However, results also showed an above the norm percentage of multiples reading at or above grade level, including those born prematurely, and a significant amount of at home literacy support provided by parents of multiples.

TOKYO TWIN COHORT PROJECT (TOTCOP): OUTLINE OF A POPULATION-BASED STUDY OF TWIN CHILDREN IN JAPAN

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A new project of twin study in childhood, the Tokyo Twin Cohort Project (ToTCoP), started in December 2004 in the Tokyo area. ToTCoP is a part of the national program 'Brain Science and Education' conducted by the Japan Science and Technology Agency (JST). This project aims to establish a population-based twin registry for the first time in Japan in the Tokyo Metropolitan area and then to conduct a 5-year longitudinal study of twins' growth and development. A cross-sectional study for twin children of a wider range of age (2 to 15 years) is also planned this summer. The estimated number of newborn twin pairs in this target area is about 3000 per year. The disclosed information on the resident registration is used to construct the registry through transcribing the data of individuals who share the same address and date of birth, as it is impossible to use a personal identification number for the purpose of research in Japan. A pilot study was conducted for selected regions (about 20% of target areas) in April 2005, in which entry sheets were sent to 309 families rearing twins of 9 to 14 months of age. The response rate was about 40%. A subsequent survey, which contains detailed questions as to obstetrical findings, growth and development of twins, parenting attitude of parents, and so on, is to be conducted for those families who have returned entry

sheets. Preliminary findings of the pilot study, which contains the information of zygosity classification, birthweight, feeding method, sleeping patterns and others, will be reported.

A TWIN-SIBLING STUDY OF ADOLESCENT WELLNESS

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Adolescence is a developmental period marked by rapid changes in behavior, cognition, health, and risk-taking behavior. Despite the perception that the majority of adolescents suffer from one or more emotional behavioral problems during the years between childhood and adulthood, most adolescents live healthy and happy lives. On this poster we will present the first results of our twin-sibling study of adolescent wellness. In order to study adolescent wellness (comprising psychological and physiological wellbeing), self-report data using the Dutch Health Behavior Questionnaire (DHBQ) are collected in a pilot sample. This self-report instrument contains direct measures of wellness, such as life satisfaction and happiness. Twin-sibling comparisons of wellness in Dutch adolescents will be presented. In this pilot study it was found that twins were not more or less happy or satisfied with their life than their nontwin siblings. On a scale from 0 to 10, twins rated their lives as being 6.67, while their nontwin siblings rated their lives at 6.52.

DEVELOPMENT OF BEHAVIORAL AND EMOTIONAL PROBLEMS: DO TWINS BORN AFTER IVF DIFFER FROM OTHER TWINS?

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Since 1987 the Netherlands Twin Register has recruited newborn twins shortly after birth. The development of these twins is followed in longitudinal survey studies. Approximately every 2 years, parents complete mailed questionnaires which track the growth, motor, behavioral and emotional development of the children. From age 7 years onwards, surveys are also sent to the teachers of the twins. In the past years, we see a substantial increase in the number of twins born after IVF: in 1990 less than 6% of twin pairs were born after IVF, in 2001 this was almost 20%. In this presentation we will compare the development of IVF twins to matched control twins. We look at growth, the age at which the twins reach specific milestones and at the prevalence of internalizing and externalizing problems.

EARLY LIFE RISK FACTORS ASSOCIATED WITH ASTHMA IN TWINS

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The hygiene hypothesis suggests that protection from the usual childhood viruses in childhood produces an immune system susceptible to asthma and other diseases. In a large cohort of native California twins, we assessed early childhood risk factors for asthma by comparing 366 asthma-concordant (case pairs) to 8033 pairs in which neither twin developed asthma (control pairs). Asthma was assessed by self-report. Smokers were excluded from the analysis. Analysis was performed using unconditional logistic regression (SAS version 8.1), adjusted for age, race/ethnicity, parental education level and parental smoking and stratified by zygosity and gender. The effect of birth order (i.e., of the twin pair relative to other siblings) was stronger than that of sibship size. Twins were more likely to report asthma in both members of the pair if they were born first compared to those born fourth or later. These

effects were strongest for male–male pairs, especially in dizygotic twins (odds ratio for asthma concordance in twins who were born first vs. born fourth or later = 13.8, $p = .013$, test of trend for birth order = .0006). When birth order and sibship size were combined, twins of each zygosity/gender group who were only children consistently had higher risks than twins who were last born in large families. Twins who moved to separate rooms relatively late were somewhat protected against asthma, although trends were not statistically significant. These results demonstrate that even among twin pairs, growing up in relative isolation from other children may increase asthma risk.

OPPORTUNITIES FOR EXPOSURE TO INFECTION AND RISK OF YOUNG ADULT HODGKIN LYMPHOMA IN TWINS

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Risk factors for Hodgkin lymphoma diagnosed before age 50 (young adult Hodgkin lymphoma, YAHL) include lack of close siblings (either no siblings or first or last born with a large interval between the closest sibling's birth), high socioeconomic status of parents, and single family residence. These risk factors suggest that relative social isolation and protection from exposure to common childhood infections lead to increased susceptibility. We conducted a case-control study in twins discordant for Hodgkin lymphoma to test the hypothesis that the twin with more opportunities for exposure to infections as a child would have lower risk. Detailed questionnaires were mailed out to 366 twin pairs with YAHL registered in the volunteer International Twin Registry. We received 120 questionnaires from one member (single respondents) and 104 questionnaires from both members (double respondents) of YAHL-discordant pairs (61% overall pair-wise response rate). Statistical analysis was performed using conditional logistic regression (SAS, Version 8.1). Analyses for single and double respondents were combined if responses were similar. The twin who sucked a pacifier, thumb or fingers more was at a lower risk for YAHL (OR 0.66, 95% CI 0.39–1.11), as was the twin who put things into their mouth more (OR 0.40, 95% CI 0.21–0.78), or had more contact with pets (OR 0.81, 95% CI 0.48–1.36). The twin who kissed people more often at any age was at a lower risk, although this was not statistically significant. More exposure to infections as a young child appears to be protective against YAHL.

STRUCTURAL MRI OF MONOZYGOTIC TWINS DISCORDANT FOR THE RISK FOR ANXIETY AND DEPRESSION

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Current biological psychiatric models assume that the environmental risk factors for anxiety and depression converge on the same neurobiological pathways as the genetic risk factors. To test this assumption, we compared the intrapair differences in brain volume in extremely discordant monozygotic (MZ) twin pairs ($N = 9$) to the differences between groups of concordant twin pairs, in which both members were either at very high ($N = 7$) or very low risk ($N = 15$) for anxiety and depression. MZ twins are genetically identical, so that discordance in their risk for anxiety and depression must arise from differential exposure to environmental influences. The differences between extreme low and high scoring MZ concordant pairs are more likely to reflect differences in genetic vulnerability. Differences in brain anatomy were assessed by optimized voxel-based morphometry (VBM) on high resolution T1 weighted MR images obtained from a 1.5 T Sonata system. In MZ discordant pairs, we observed a volume reduction in the right hippocampal area in subjects at high risk for anxiety and depression. A group comparison of high-risk subjects from concordant versus those of discordant pairs confirmed right hippocampal volume reduction to be selective to the high-risk subjects from the discordant pairs. Our results suggest that the smaller hippocampal volume is specific to the environmentally driven etiology of anxiety and depression. Future MRI studies on anxiety and depression should avoid admixture of subjects who are at risk due to genetic factors with those at risk due to environmental factors.

THE ASSOCIATION BETWEEN REGULAR EXERCISE AND NEGATIVE AFFECT IN TWINS, SIBLINGS AND OTHER FAMILY MEMBERS: A STUDY FROM THE NETHERLANDS TWIN REGISTRY

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Population studies that investigated the relationship between regular exercise and negative affect (i.e., anxiety, depression and neuroticism) are scarce. In fact, these studies entirely focused on the relation between exercise and depression. Moreover, they often used measures of exercise that were based on a single question.

The aim of the present study was to examine the association between regular exercise and negative affect in a large population-based sample as a function of gender and age. Our sample comprised subjects who participated in the study on health-related behavior from the Netherlands Twin Registry and consisted of adolescent and adult twins, their siblings, parents and spouses ($N = 19,462$). Measures of regular exercise (type, frequency and duration), anxiety, depression and neuroticism were obtained by means of questionnaires.

The overall prevalence of regular exercise in our sample was 51.4 %. The prevalence of exercise showed a strong decline with age. No gender differences in prevalence of exercise were found. Twins and siblings did not differ in prevalence of exercise, except for age 35 to 40 and 55 to 60 years, where twins exercised more often than siblings. Regular exercisers were on average less anxious, depressed and neurotic than nonexercisers. Although these differences were modest in size, they appeared to be very consistent across gender and age.

To determine causality of these associations, a longitudinal study of negative affect and exercise habits in genetically related subjects may provide unique opportunities.

A COMPARISON OF HEIGHT OF 5-YEAR-OLD TWINS AND SINGLETONS

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During the first 2.5 years of life differences in body size between Dutch twins and general population infants decrease but do not disappear despite correcting for gestational age. Some studies have shown that these differences disappear during childhood, but in other studies differences remain until at least the age of 18 years. We studied height in a large group of 5-year-old twin pairs in relation to the Dutch reference growth charts in order to investigate the persistence of twin–singleton differences. Maternal report on height of 5-year-old twins and information on parental height were available from 5905 twins (2910 boys, 2995 girls) of the Netherlands Twin Register (NTR). Standard deviation scores (SDS) for height and target height were calculated with the Dutch reference growth charts for the general population from 1997. Between 4.5 and 5.5 years of age, Dutch female twins are as tall as singletons, while male twins are significantly shorter than singletons (SDS -0.17 ; $p < .01$). For both boys and girls the mean height SDS is 0.6 SDS below the mean target height ($p < .01$). At age 5, Dutch twin girls show a complete catch-up in height compared to singletons. Dutch twin boys catch up in body height, but are still significantly shorter at age 5. As for height, twins grow fairly well compared to singletons. However, they grow below their target height, due to the above average height of the parents (reflected in above average target height for the children) of these twins.

POSTPARTUM DEPRESSION IN MOTHERS OF MULTIPLES

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Postpartum depression (PPD) is a serious problem that often goes unrecognized or is dismissed cavalierly by medical personnel and/or patients' families. This condition can range from mere "baby blues" to a suicidal or homicidal depression and even to psychosis. The National Organization of Mothers of Twins Clubs, Inc. (USA) conducted a survey of mothers of twins and higher-order multiples for the occurrence of PPD. A total of 758 mothers of twins and higher-order multiples completed NOMOTC's survey, with the rate of PPD being just over one third of mothers (37%). Only 10% of this same group of mothers of multiples reported having had similar symptoms during a singleton pregnancy.

NOMOTC's rate of PPD will be compared to rates in three other studies: MOST (Mothers of Supertwins, a support group for higher order multiple birth families in the United States), TAMBA (Twins & Multiple Births Association, a multiple birth support group in Great Britain), and a singleton study done in the United States.

RISK FACTORS AFFECTING SMOKING INITIATION AND PERSISTENCE IN CALIFORNIA TWINS

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Objective. To determine the relative effects of genetic versus environmental influences on smoking initiation (SI) and smoking persistence (SP) as well as risk factors affecting these behaviors.

Methods. Analyses were based on 33,881 twin pairs (22,810 dizygotic [DZ] pairs and 11,071 monozygotic [MZ] pairs) from the California Twin Program. Analyses were stratified by zygosity, gender, closeness between twins, and birth cohort. Standard epidemiologic and genetic analyses were conducted. Adjusted odd ratios for SI and SP, were determined using multiple logistic regression models. Tetrachoric twin-pair correlations were computed, and structured models were constructed to estimate the variance due to additive genetic factors, shared environment and individual environment.

Results. The strongest risk factor for SI was the co-twin's smoking status, with adjusted odds ratios of 9.7 (95% C.L. 8.8–10.6) among MZ twins and 5.7 (95% C.L. 5.2–6.2) among DZ like-sex twins if the co-twin also smoked. The co-twin's continued smoking also was a significant risk factor for SP (Adjusted OR = 3.2; 95% C.L. 2.8–3.7) for MZ twins and 2.2 (95% C.L. 1.9–2.5) for like-sex DZ twins. While the MZ and DZ twin-pair tetrachoric correlations were higher for SI than SP, the MZ/DZ correlation ratios were higher for SP indicating a larger genetic effect for SP and relatively greater effect of shared environment for SI; however, differences by gender were seen for both phenotypes. Genetic factors were relatively more important for males than females for SI, whereas the reverse was true for SP. From the best-fitting model for SI the proportion of variance due to additive genetic effects, shared environment, and individual environment was 31.6% (24.2–39.1), 47.5% (41.1–53.7) and 20.9% (18.8–23.1) for females, and 71.2% (66.7–75.4), 12.0% (8.7–15.7) and 16.7% (15.0–18.7) for males. For SP the corresponding values were 54.1% (49.0–59.0), 0%, and 45.9% (45.9–59.0) for females, and 33.1% (22.1–45.2), 18.3% (8.5–27.3) and 48.6% (43.6–53.7) for males. Modification by cohort and closeness was seen.

Conclusions. While both genetic and environmental factors affect smoking behaviors, the gender differences seen in the relative contribution of genetic and environmental influences on SI and SP indicate that different approaches need to be developed for smoking cessation efforts aimed at males and females. Interventions may be possible that could modify a genetic propensity to smoke or continue to smoke.

HAVING A CO-TWIN WITH ADHD

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Attention Deficit Hyperactivity Disorder (ADHD) is a common childhood disorder and may be more common in twins. Our data on monozygotic (MZ) twins discordant for ADHD indicate it is associated with birth complications, especially breathing difficulties. This paper focuses on the long-term psychosocial consequences for the twin who does not have ADHD, using two waves of data from the Australian Twin ADHD Project (ATAP) In one wave, parental report data on 1550 twin pairs aged 8 to 16 years plus their siblings were used to examine the rate of behavioral problems in DZ pairs discordant for ADHD, how the effects on the non-ADHD twin depended on whether or not they were of the same gender and whether the effects were greater for the nonaffected twin than any nontwin siblings. One key issue was that of comorbidity and whether the ADHD twin had additional problems besides ADHD which may confound the family dynamics. The second study explored why some twins may cope better than others with their co-twin's ADHD, using self-report from the next wave of ATAP when the twins were aged 12 or more. Stimulant medication may help siblings as much as it does the ADHD child. Some of the protective factors for the non-ADHD twin are identified, but one uncontrollable influence is that of the media presentation of ADHD as a family-stigmatizing disorder. More needs to be done to attend to the co-twin who does not have ADHD and to appreciate the effects on them and their peers.

CONGENITAL CARDIAC MALFORMATIONS IN TWINS: A DANISH NATIONWIDE POPULATION-BASED REGISTER STUDY

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The risk of congenital heart defect has in several studies been found to be higher in twin pregnancies than in singleton pregnancies, but the concordance rate has been found to be low even in monozygotic twins. However, most previous studies have been small and highly selected.

We linked the population-based Danish Twin Registry with the National Patient Register to obtain information on all hospitalizations for Danish twins born 1977 to 2001. A total of 1136 twin pairs (624 with known zygosity) in which at least one of the twins had a congenital cardiac malformation were identified. The proband concordance rate for any heart defect was 37% in monozygotic (MZ) twins and 27% in dizygotic (DZ) twins corresponding to a heritability of 43% (95% CI 26% to 59%) and a common environment factor of 42% (29% to 54%). Among the 188 concordant pairs, 84% (157 pairs) had the same diagnosis on an ICD-8 3-digit level. The study suggests a high occurrence of a similar congenital heart defect in co-twins to twins with congenital heart defects.

HERITABILITY OF TESTOSTERONE LEVELS IN 12-YEAR-OLD TWINS

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The sex hormone testosterone is reported to be linked to several behavioral problems, such as aggression and antisocial behavior. However, the underlying factors influencing the testosterone-behavioral link are ill understood. Relatively little research has focused on the etiology of individual differences in testosterone levels in the normal population and data in children in this field are lacking. The aim of this study was to estimate genetic and environmental influences on variation in testosterone levels in 12-year-old children. Midday salivary testosterone samples were collected on two consecutive days in a sample of 183 unselected twin pairs. A significant contribution of genetic effects to the variance in testosterone levels was found. Heritability was approximately 68% in both boys and girls. The remaining proportion of the variance could be explained by nonshared environmental influences. Data on opposite-sex twin pairs showed no evidence that different genes influence variation in testosterone levels in boys and girls, suggesting that sex differences in genetic expression take place in later phases of puberty.

PERSONALITY AND SELF-CONCEPTS IN TWINS AND SINGLETONS IN SOUTH KOREA

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The present study compared South Korean twin children to their age- and gender-matched singletons in personality traits and self-concept. Three hundred and forty-five pairs of twins (197 monozygotic, 94 same-sex dizygotic and 54 opposite-sex dizygotic) and 761 singletons aged between 8 and 12 years completed 6 cluster scales of Piers-Harris Children's Self-Concept Scales. A subsample of these twins and singletons also completed a short form of Multidimensional Personality Questionnaire. Mx (Neale, 1999) was used to examine mean differences between twins and singletons. Whereas personality traits were not significantly different between twins and singletons, self-concepts were significantly higher for twins than for singletons. These results support recent findings from adult twin studies that demonstrated no significant differences in personality traits between twins and singletons (Johnson et al., 2002). We speculate that twins have higher self-concepts than singletons because they are generally more popular than nontwins among elementary school children.

ACTIVITIES ASSOCIATED WITH SUN EXPOSURE IN CHILDHOOD MODIFIES RISK OF MULTIPLE SCLEROSIS AMONG MONOZYGOTIC TWINS

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Objective. We intended to investigate the association between sun exposure and multiple sclerosis (MS) risk, among monozygotic (MZ) twins.

Subject. The International Twin Registry has information on 1294 twin pairs, with at least one case of MS, who were identified through newspaper advertisements from 1980 to 1992. Disease- and exposure-discordant MZ ($n = 195$) twin pairs were detected from this registry for this analysis.

Exposure. Each twin was asked about their sun exposure in childhood and prior to developing MS. The data were comparative (comparison of exposure within pairs) in nature.

Analysis. Data was analyzed using conditional logistic model and the point estimates were expressed as odds ratio.

Results. Among the MZ twins, we found that childhood sun exposure was a strong protective factor against MS. Twin members who spent more time outdoors in two or more seasons were 59% ($p = .05$) less likely

to develop MS compared to their co-twins. Similarly twins who spent more time outdoors during whether 'hot' or 'cold' days were also less likely to have MS (OR = 0.47, 95% CI = 0.21–1.00). Similar reduction in MS risk was noted for those who performed activities directly related to sun exposure, that is sun tanning or going to the beach (OR = 0.48, 95% CI = 0.25–0.91). Twins participating more in team sports compared to their co-twin also appeared to be protected from MS (OR = 0.50, 95% CI = 0.22–1.11), with marginal significance.

Conclusion. After adjusting for genetic susceptibility sun exposure appears to be a strong protective factor against MS.

CHANGING CHALLENGES — LIFE ISN'T ALWAYS FAIR

J. Keating

Australian Multiple Birth Association (AMBA), Australia

Twins — just like having two closely spaced children ... or so the community assumes. Too often we, as parents of multiple birth children, hear this comment. But does the uniqueness of twins, triplets, quadruplets stop once they go to school? What support can multiple birth parents receive when their journey through parenting multiples include:

- adolescents
- twins facing separation when one accepts a scholarship to study overseas, the other remaining at home
- one decides to take recreational drugs and the other doesn't
- finding appropriate high schools for twins who are scholastically different or when one has a disability
- the 'hormone years' with multiples (especially different sex sets)
- families with two sets of adolescent multiples
- the dating scene
- when one or more of the multiples has died
- hormones run amok — when they develop at differing rates
- curfew
- one is at school and the other(s) work
- anger management.

In 2003 a number of multiple-birth parents in Australia were dissatisfied with the lack of focus in their local multiple birth groups with parenting 'older multiples'. Rather than lose their expertise, and to provide for other parents coming through the ranks, a support group affiliated with the Australian Multiple Birth Association was formed. We offer support, networking and dissemination of information and work to help other multiple birth groups to keep and harness the expertise of their 'parents of older multiples'.

HOSPITAL PROTOCOL AFTER A MULTIPLE BIRTH CHILD HAS DIED

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Australian Multiple Birth Association (AMBA), Australia

Currently most children hospitalized will, after treatment, be discharged into their families' care. Armed with a 'discharge plan' and with time, most of these children and their families, will become independent of medical care. Yet as we all know, in some cases, it doesn't matter how much medical intervention takes place, or how many well trained and caring staff these children come in contact with, some will still die.

What is done for these families? In the case of multiple birth loss the grief experienced is often compounded by the variety of 'types' of loss.

- where all of the multiples die
- where one or more survive
- length of time the survivors remain in hospital
- if the death occurred after fetal reduction
- where the pregnancy continues after the death of one or more
- when the death occurs after Twin–Twin Transfusion Syndrome
- when the children are older and one dies
- when a number of children from the set die at intervals.

Too often a discharge plan is only implemented when the child survives. The Multiple Birth Association Bereavement Support Group, which is affiliated with the Australian Multiple Birth Association, is working on a paper which it hopes will be the basis for hospitals within Australia to set up discharge protocols for families after one or more of their multiple birth children dies in hospital.

LINGUISTIC FEATURES OF JAPANESE TWINS AT 3 OR 4 YEARS OF AGE EVALUATED BY ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES

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In general, twins have retardation of language development early in childhood compared with singletons. The purpose of this study was to clarify the overall linguistic features of twins. We mainly performed a Japanese version of the ITPA (Illinois Test of Psycholinguistic Abilities) in 48 pairs of twins at home between 3 and 4 years of age ($n = 48$). The results showed that the mean PLA (psycholinguistic ages) of twins was 40.3 ± 5.2 months, which was 5 months behind the mean chronological age (45.3 ± 5.6 months). The overall linguistic features of twins was in a normal range (mean scale score: 33.0 ± 2.4 points) compared with those of singletons (normal mean scale score of the ITPA: 36.0 ± 6.0 points). In addition, among the subtests of ITPA, only 'auditory reception' of psycholinguistic abilities was within the region of language disorder (mean scale score: 24.9 ± 5.1 points). Our results in which current twin-talk pairs performed better on the auditory reception scale are in conflict with previous reports that have suggested that current twin-talk pairs experience greater delays in acquisition of language skills. This disparity was not explained by differences in the neuroanatomical development with increasing age between the two groups. Interestingly, there were no other differences in neuroanatomical factors in subscale scores, or in total score between the current twin-talk and no current twin-talk groups. These findings suggest that retardation of auditory reception ability characterizes the overall linguistic features of twin language development.

COMPONENT COGNITIVE PROCESSES OF WORKING MEMORY IN MIDDLE-AGED TWINS

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Working memory, the ability to maintain and manipulate information held briefly in memory, is an executive function that is important in cognitive aging. Few twin studies include tests that are used to disentangle maintenance (storage) from manipulation (executive) components. We addressed this issue in 679 middle-aged male twin pairs (mean age = 47.9 years). Storage was assessed by digit span forward (DSPF), which requires subjects to simply maintain numbers in short-term memory. Storage plus executive ability was assessed by a digit transformation (DT) task in which subjects heard digits and had to mentally add 3 or 4 to each digit. Bivariate genetic analysis indicated that the phenotypic correlation between the two measures was due entirely to genetic influences. The genetic correlation was 1.0 based on the best-fitting model, indicating complete overlap of genetic factors influencing the measures. Genetic influences contributed about one quarter of the variance in DSPF and nearly 60% of the variance in DT. Shared environmental influences contributed about one quarter, and unique environmental influences contributed about one half of the variance in DSPF. Unique environmental influences contributed about 40% of the variance in DT, but all of this was specific to DT. The common genetic factor could reflect storage ability (the component cognitive process common to both tests), but this would suggest that only unique environmental factors influence executive ability. The common factor could also indicate that genes influencing executive ability are the same genes that influence storage ability. The authors discuss how component cognitive processes may map onto genetic influences.

PARENTING STRESS AND LANGUAGE DEVELOPMENT IN TWINS

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Objective. There is increased child abuse in families with twins in Japan. It is reported that the maltreatment causes a delay in language development in children. In this study, we examined the relationship

between parenting stress in twins' mothers and language development in twins.

Methods. Questionnaires were mailed to 218 mothers of twins and 358 mothers of singletons aged 0 to 2 years. Of them, 110 mothers of twins (56.1%) and 96 mothers of singletons (26.8%) returned the questionnaires. Three pairs of twins were excluded for premature birth. The core questionnaire included biological characteristics (twin's age, sex, gestational age, birthweight, and birth height), family environments (maternal age and household members), parenting stress by Child Rearing Support Questionnaire, and infant motor and mental development by Tsumori-Inage infant developmental scale.

Results. The mean score of parenting stress score in mothers of twins was significantly higher than those of singletons ($p < .05$). Only in twins aged 2 was the score significantly correlated with language developmental score.

Conclusion. A significant relationship in the parenting stress score with linguistic development in 2-year-old twins suggests that parenting stress influences child development in twins.

ARE THERE DIFFERENCES IN BRAIN MORPHOMETRY BETWEEN TWINS AND SINGLETONS?

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Twin studies are important for assessing genetic and environmental influences on variation in phenotypic traits such as brain morphometry. However, a potential limitation to these studies is that brain morphometric data collected from twins may not be comparable to that collected from singletons because of differences in prenatal, perinatal and family environments. A previous study found no significant difference in brain volumes between adult twins and singletons in total brain volume, gray matter, white matter, and lateral ventricles, but finer subdivisions of the brain were not investigated (Hulshoff Pol et al., 2002). To determine whether there are volumetric differences in the brain between child and adolescent twins and singletons, 130 twins (one randomly selected per pair) and 130 age- and sex-matched singletons were scanned using magnetic resonance imaging. Total cerebral volume, gray and white matter volumes, and lobar gray and white matter volumes were not significantly different between twins and singletons. There were no significant differences between groups for subcortical regions. Hulshoff Pol et al. (2002) found differences in brain volumes between firstborn and secondborn twins which may be due to different prenatal and perinatal conditions, but this finding was not replicated. Brain volumes in twins did not differ based on zygosity. Birthweight correlated strongly with total cerebral volume, but did not differentiate twins and singletons. These findings suggest that brain morphometry during childhood and adolescence does not differ between twins and singletons.

WORKING MEMORY IN 12-YEAR-OLD TWINS AND THEIR SIBLINGS

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Working Memory (WM) is conceptualized as a limited capacity system for information processing. It is an important aspect of cognition, and is often impaired in cognitive disorders. In the current study we investigated to what extent genetic or environmental factors explain individual differences in WM. Specifically, we looked at the sources of individual differences in two subcomponents of WM: speed (WMS) and capacity (WMC). WMS and WMC were assessed in a sample of 12-year-old twin pairs ($N = 177$) and their additional siblings ($N = 53$). WMS was assessed with a reaction time (RT) task with 3 increasing memory load conditions. WMC was measured with 3 subtests of the Wechsler Intelligence Scale for Children Revised (WISC-R): Arithmetic, Digit Span Forward and Digit Span Backward.

In the RT task, there was an increase in RT with increasing memory load. Also, correlations between WMS and WMC increased with increasing complexity of the 2 subcomponents. For both WMS and WMC, correlations for monozygotic twin pairs were generally higher than the correlations for dizygotic twin pairs and for twin-sib pairs. This suggests a genetic contribution to individual differences in the performance on WMS and WMC tasks.

A NOVEL METHOD FOR LINKAGE IN 294 TWIN PAIRS REPLICATES A QTL FOR EYE COLOR ON 15Q

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Since 1991 the Dutch Twin Registry has sent out biannual questionnaires to twins and their family members. All questionnaires included a question regarding the similarity in eye color for twins to determine zygosity status. This question was answered by the mother (4 occasions), the father (1 occasion), or the twins themselves (6 occasions). For 4748 twin pairs the similarity for eye color was available on a 3-point scale (*not at all alike*, *somewhat alike*, and *completely alike*). The probability that twins were alike for eye color was calculated from the response pattern on all questionnaires and all respondents. Based on DNA or questionnaire data, 2167 were monozygotic (MZ) twins, 2520 were dizygotic (DZ) twins, and for 61 twin pairs, zygosity was ambiguous. Of the MZ twins, 96.3% were alike for eye color (probability .75), whereas of the DZ twins 25.2% were completely alike and 34.5% were not at all alike (probability $< .25$). For 294 DZ twin pairs genome-wide marker information was available. We regressed the average amount of IBD sharing on the probability that the twins were completely alike for eye color. Using similarity in a pair as opposed to having determined actual eye color in individuals, we found a peak LOD-score of 2.85 at 15q, overlapping with the region implicated recently for eye color.

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POSTPARTUM DEPRESSION IN HIGHER ORDER MULTIPLES: INCREASED INCIDENCE AND OBSTACLES TO DIAGNOSIS

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Aim. To study postpartum depression (PPD) in mothers of higher-order multiples (triplets, quadruplets and above) in order to determine if a greater incidence of PPD occurs in this population and if the presentation and symptoms experienced differed from the description of PPD in current medical literature.

Methods. We conducted a survey assessment where members of Mothers of Supertwins were mailed a survey and asked to answer a set of questions. Data pertaining to sociodemographic status, medical, gynecologic, and obstetric history, pregnancy, perinatal and neonatal events were collected as well as symptom-specific data pertaining to PPD.

Results. In comparison to current medical literature on PPD, the incidence of PPD is greater in mothers of higher-order multiples (HOM), the onset is often delayed and the diagnosis is complicated. Maternal age, financial stress and number of infants were strong risk factors for PPD. No association was found between zygosity and gender of children, or the mother's work status and PPD symptoms. Nearly half (48%) of those reporting 'thoughts of hurting themselves/others' or 'thoughts of death or suicide' never sought professional help.

Conclusion. Mothers of HOM have a greater risk of experiencing PPD. Despite meeting many of the documented risk factors for PPD, under diagnosis in PPD in mothers of HOM remains a problem. The consequences of untreated PPD can be devastating and the increased infant number amplifies this possible outcome. Inquiry about symptoms on the part of the healthcare provider appears to increase the likelihood of diagnosis. Investigation into ways to enhance self-diagnosis and increase provider screening for PPD is warranted.

MONOZYGOTIC FEMALE TWINS DISCORDANT FOR TRANSSEXUALISM: A PAIR OF CASE REPORTS

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Monozygotic (MZ) female twin pairs discordant for transsexualism are rare. Data available from only two published case reports, an unpublished conference presentation and the nonscientific literature, include 12 such pairs: 3 concordant and 9 discordant. Two additional twin pairs came to the attention of this investigator during the last 2 years. Interviews with both the twins and several of their family members eliminated unusual social life history and medical life factors as playing a causal role in the twins' gender identity differences. In both pairs, these gender identity differences were observed in very early childhood, consistent with, but not proof of, co-twin differences in prenatal hormonal effects. Gathering data on additional MZ female twin pairs discordant for transsexualism can enhance biological and psychological understanding of this behavior. Findings from these 2 new twin pairs, as well as findings from extant studies of female-to-male transsexuals, suggest new directions for future research.

GENETIC AND ENVIRONMENTAL INFLUENCES ON EXERCISE PARTICIPATION: A COMPARATIVE STUDY OF TWIN COHORTS IN SIX COUNTRIES

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Twin studies have shown that a major component of variation in exercise participation is due to genetic differences. The aim of this study was to compare the prevalence and to assess the relative contribution of genetic and environmental influences on the variation in exercise participation across six countries participating in the GenomEUtwin. Self-reported data from Australia, Denmark, Finland, Norway, the Netherlands and Sweden were used. Preliminary results of 3378 complete twin pairs aged 21 to 30 years from the Dutch, Norwegian and Finnish cohorts showed that there was no geographical variation in participation rates for males. The percentage of females exercising was significantly lower in Finland compared to the Norwegian and Dutch sample. Importantly, model-fitting results showed that genetic effects play an important role in explaining individual differences in exercise participation. Broad heritability estimates of exercise participation ranged from 58% to 73% for males and from 57% to 62% for females. Shared environmental effects were of no importance in this age group. These results encourage the use of pooling across countries when searching for genes influencing exercise participation.

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IS THERE AN ASSOCIATION BETWEEN CAESAREAN SECTION AND A RISK FOR ASTHMA IN TWINS?

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The purpose of this study is to examine the association between cesarean section and the presence of asthma in 5-year-old twins. Information about birth delivery, birthweight, gestational age, smoking and drinking behavior of the mother before and during pregnancy was acquired from a questionnaire filled in by the mother shortly after birth of the twin. When the twins were 5 years old, the mother was asked about doctor-diagnosed asthma and allergy. Complete data was available for about 8000 twins. The prevalence of asthma was compared between twins born by means of vaginal delivery and by means cesarean delivery separately for smoking and nonsmoking mothers. Preliminary data analysis revealed that children of smoking

mothers and born by means of caesarean section had an increased risk for developing asthma.

WHAT TO DO WITH NONNORMAL DATA: CLASSICAL TEST THEORY VERSUS ITEM RESPONSE THEORY IN ESTIMATING VARIANCE COMPONENTS

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Many datasets that consist of sum scores show marked nonnormality in their distributions, which may be due to many causes. These data are usually analyzed under the assumption that these sum scores have normal distributions. Transformation does not necessarily get rid of the errors in inference. The approach that we prefer is to include explicit measurement models into the genetic modeling. Rather than modeling sumscores that are known to be nonnormal using normal models, which is necessarily wrong, we advocate an approach where one models the raw data themselves, modeling the underlying trait as normally distributed and partitioning the variance of the underlying trait into genetic and nongenetic components. We illustrate the approach using data on attention problems in adulthood and discuss several advantages and disadvantages of our approach.

CLASSROOM SEPARATION OF TWINS DURING PRIMARY SCHOOL

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We studied short- and long-term effects of classroom separation in twins on behavioral problems and academic achievement. Short-term effects were studied at age 7 in twins separated at age 5 and long-term effects at age 12 in twins who had been separated or together most of the school period. Behavioral problems were rated by mothers (CBCL at ages 3, 7 and 12) and teachers (TRF at ages 7 and 12). Academic achievement was measured at age 12 using a national academic achievement test (CITO). Short-term effects were studied in 6738 (5686 for TRF) twin pairs and long-term effects in 2184 pairs (284 for TRF, 843 for CITO). At age 7, separated twins had more internalizing and externalizing problems than nonseparated twins, as rated by both mothers and teachers. However, only for the maternal ratings of internalizing problems, these effects could be attributed to the separation itself, instead of to preexisting problems (at age 3). At age 12, there were differences in problem behavior, but again these could be explained by preexisting differences. There were no differences in academic achievement between separated and nonseparated twins. The results suggest that the decision to separate twins when they enter primary school is based in part on existing behavioral problems and that in the long run, separation does not affect problem behavior or academic achievement. The results were similar for monozygotic and dizygotic twins.