

# Correspondence

*Psychological Medicine*, 46 (2016).  
doi:10.1017/S003329171500255X

## Childhood trauma as a risk factor for psychosis: the confounding role of cognitive functioning

### Introduction

Van Dam *et al.* (2015) describe childhood trauma as a contributor to vulnerability for psychosis and depressive symptoms. In this context, the role of cognitive functioning deserves attention, as cognitive impairment precedes the onset of psychosis (Bora *et al.* 2014; Agnew-Blais *et al.* 2015) and is associated with childhood trauma (Aas *et al.* 2012, 2014). The neurodevelopmental view of psychosis states that negative environmental influences, such as trauma, in addition to early developmental (genetic) abnormalities give rise to psychotic symptoms (Read *et al.* 2005; Owen *et al.* 2011).

The underlying mechanisms of the association between childhood trauma and increased risk for psychosis are unknown. Early traumatic events are associated with reduced cognitive functioning in the domains of executive functioning, working memory and (verbal) intellectual abilities, which is similar to cognitive profiles of patients with psychotic disorders and ultra-high-risk individuals (Reichenberg, 2005; Aas *et al.* 2012). It can therefore be hypothesized that childhood trauma exerts neurobiological consequences that contribute to psychosis-associated cognitive impairment.

Our group studied psychotic experiences such as auditory verbal hallucinations in non-clinical individuals (Sommer *et al.* 2010), without a history of hospitalization, anti-psychotic medication use, or negative symptomatology. This population shows reduced performance in the cognitive domains of executive functioning, working memory and language (Daalman *et al.* 2011) and, interestingly, reports high rates of childhood trauma, similar to patients with a psychotic disorder (Daalman *et al.* 2012). We investigated whether increased exposure to early traumas can explain the reduced cognitive performance associated with a vulnerability to experience psychotic symptoms, in non-clinical adults with and without psychotic experiences.

### Method

#### Participants and procedures

We included 101 non-clinical individuals with psychotic experiences (auditory verbal hallucinations) and

101 controls (selection procedures and inclusion criteria described previously; Daalman *et al.* 2011, 2012). Participants did not meet criteria for Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) diagnosis, yet depression in remission was allowed. Neuropsychological assessment included several cognitive domains (Daalman *et al.* 2011). Childhood trauma was rated using the Childhood Trauma Questionnaire Short Form (CTQ-SF; Bernstein *et al.* 2003). Both groups were similar with regard to gender, age, handedness and education (Daalman *et al.* 2011).

#### Statistics

Correlations between the CTQ-SF and cognitive test scores were calculated using Spearman's rho ( $\rho$ ).

To address the effect of childhood trauma, we conducted step-wise regression analyses for those cognitive measures that were significantly lowered in individuals with psychotic experiences in our previous study (Daalman *et al.* 2011). Group was included as a predictor in the first step and CTQ-SF score was added in the second step, for verbal inhibition (Stroop interference), working memory [digit-span backward; Wechsler Adult Intelligence Scale-III (WAIS-III)], verbal abilities (vocabulary and similarities; WAIS-III) and verbal intelligence (National Adult Reading Task). If trauma severity is a significant factor in explaining the association between reduced cognitive performance and psychotic experiences, adding CTQ-SF score to the regression model will reduce the significance level of this association (partial explanatory variable) or render it non-significant (full explanatory variable).

#### Ethical standards

All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

#### Results

Individuals with non-clinical psychotic symptoms reported more childhood trauma (CTQ-SF: mean = 45.1, s.d. = 15.7), compared with controls (mean = 36.4, s.d. = 8.6,  $t = 23.7$ ,  $p < 0.001$ ).

Associations between cognitive performance and CTQ-SF score were corrected for multiple analyses,

**Table 1.** Step-wise regression analyses evaluating the effect of childhood trauma on the reduced cognitive functioning associated with non-clinical psychotic experiences

	B (S.E.)	$\beta$	<i>t</i>	<i>p</i>	<i>R</i> <sup>2</sup>	Adjusted <i>R</i> <sup>2</sup>	<i>p</i>	$\Delta R$	<i>p</i>
Executive functioning and working memory									
Verbal inhibition (Stroop interference)									
Step 1									
Non-clinical psychotic experiences	6.44 (2.34)	0.19	2.75	0.007 <sup>a</sup>	0.036	0.032	0.007 <sup>a</sup>		
Step 2									
Non-clinical psychotic experiences	4.21 (2.44)	0.13	1.73	0.086	0.073	0.064	<0.001 <sup>a</sup>	0.073	0.005 <sup>a</sup>
Total CTQ-SF	0.26 (0.09)	0.20	2.81	0.005 <sup>a</sup>					
Working memory (digit-span backward)									
Step 1									
Non-clinical psychotic experiences	-0.78 (0.29)	-0.19	-2.73	0.007 <sup>a</sup>	0.036	0.031	0.007 <sup>a</sup>		
Step 2									
Non-clinical psychotic experiences	-0.67 (0.30)	-0.16	-2.23	0.027	0.042	0.032	0.014	0.006	0.275
Total CTQ-SF	-0.01 (0.01)	-0.08	-1.09	0.275					
Verbal abilities and abstract reasoning									
Vocabulary test (WAIS-III)									
Step 1									
Non-clinical psychotic experiences	-6.33 (1.26)	-0.34	-5.03	<0.001 <sup>a</sup>	0.112	0.108	<0.001 <sup>a</sup>		
Step 2									
Non-clinical psychotic experiences	-5.69 (1.33)	-0.30	-4.29	<0.001 <sup>a</sup>	0.122	0.113	<0.001 <sup>a</sup>	0.010	0.140
Total CTQ-SF	-0.07 (0.05)	-0.10	-1.48	0.140					
Similarities test (WAIS-III)									
Step 1									
Non-clinical psychotic experiences	-1.73 (0.56)	-0.21	-3.07	0.002 <sup>a</sup>	0.045	0.040	0.002 <sup>a</sup>		
Step 2									
Non-clinical psychotic experiences	-1.72 (0.60)	-0.21	-2.87	0.005 <sup>a</sup>	0.045	0.036	0.010 <sup>a</sup>	0.000	0.927
Total CTQ-SF	-0.002 (0.02)	-0.01	-0.09	0.927					
Intelligence									
National Adult Reading Test									
Step 1									
Non-clinical psychotic experiences	-5.25 (1.24)	-0.29	-4.23	<0.001 <sup>a</sup>	0.082	0.077	<0.001 <sup>a</sup>		
Step 2									
Non-clinical psychotic experiences	-4.45 (1.31)	-0.24	-3.41	<0.001 <sup>a</sup>	0.098	0.089	<0.001 <sup>a</sup>	0.016	0.063
Total CTQ-SF	-0.09 (0.05)	-0.13	-1.87	0.063					

S.E., Standard error; CTQ-SF, Childhood Trauma Questionnaire Short Form; WAIS, Wechsler Adult Intelligence Scale.

<sup>a</sup> Given the five cognitive tests, we corrected for multiple analyses using Bonferroni correction by dividing the significance level of 0.05 by 5, therefore set at  $p < 0.01$ .

using Bonferroni correction. Given the 14 cognitive tests, significance level was set at  $p < 0.0036$ . Childhood trauma was related to reduced verbal inhibition (Stroop interference:  $\rho = 0.210$ ,  $p = 0.003$ ). Childhood trauma was unrelated to other cognitive measures ( $\rho = -0.167$ – $0.110$ , all  $p > 0.0036$ ). Childhood trauma fully explained the previously observed association between reduced verbal inhibition and non-clinical psychotic features (Daalman *et al.* 2011), as group was no longer a significant predictor for Stroop interference when adding CTQ-SF score (Table 1). Childhood trauma also accounted for the association between non-clinical psychotic symptoms and reduced working memory. Childhood trauma was of no explanatory value with regard to the association between psychotic features and reduced verbal abilities, nor intelligence (Table 1).

## Discussion

In adults with and without non-clinical psychotic experiences, we observed a correlation between level of childhood trauma and reduced verbal inhibition in the domain of executive functioning. Childhood trauma fully explained the previously observed associations between psychotic experiences and reduced executive functioning, as well as lower working memory performance. Childhood trauma was not relevant for the relationships between non-clinical psychotic experiences and reduced verbal abilities or intelligence.

Our results extend the finding of van Dam *et al.* (2015) that childhood trauma increases the vulnerability for psychotic symptoms later in life, by showing its potential impact on executive functioning and working memory performance. These cognitive domains are largely supported by the prefrontal cortex, just like many symptoms of primary psychotic disorder resemble those associated with frontal abnormalities, including reduced spontaneity, mental rigidity and lack of social judgment (Reichenberg, 2010). The prefrontal lobes play a central role in the neurodevelopmental hypothesis of psychosis, as they are especially vulnerable to stress and mature late, in the phase when brain abnormalities following genetic and environmental influences are hypothesized to interfere with normal brain development (Reichenberg, 2010).

Interestingly, van Dam *et al.* (2015) also show a vulnerability after trauma for depressive symptoms. Several psychiatric disorders are characterized by impairments in executive functioning and working memory as well as increased exposure to trauma, such as depression, post-traumatic stress disorder and bipolar disorder (Gould *et al.* 2012). In these conditions, the mechanisms may be similar, which implies

that prevention of childhood trauma could be a means to forestall severe dysfunction from cognitive impairments in psychiatric disorders.

Our results indicate that reduced cognitive functioning, especially executive functioning and working memory, may be part of the causal pathway from childhood trauma to psychotic symptoms later in life. We emphasize the need for longitudinal studies to establish whether neurobiological consequences of early trauma increase the vulnerability for psychosis via a negative impact on cognition.

## Acknowledgements

This work was supported by NWO (Dutch Scientific Research Organization), Innovation Impulse (VENI) (grant number 916.56.172).

## Declaration of Interest

None.

## References

- Aas M, Dazzan P, Mondelli V, Melle I, Murray RM, Pariante CM (2014). A systematic review of cognitive function in first-episode psychosis, including a discussion on childhood trauma, stress, and inflammation. *Frontiers in Psychiatry* 4, 182.
- Aas M, Steen NE, Agartz I, Aminoff SR, Lorentzen S, Sundet K, Andreassen O, Melle I (2012). Is cognitive impairment following early life stress in severe mental disorders based on specific or general cognitive functioning? *Psychiatry Research* 198, 495–500.
- Agnew-Blais JC, Buka SL, Fitzmaurice GM, Smoller JW, Goldstein JM, Seidman LJ (2015). Early childhood IQ trajectories in individuals later developing schizophrenia and affective psychoses in the New England family studies. *Schizophrenia Bulletin* 41, 817–823.
- Bernstein DP, Stein JA, Newcomb MD, Walker E, Pogge D, Ahluvalia T, Stokes J, Handelsman L, Medrano M, Desmond D, Zule W (2003). Development and validation of a brief screening version of the Childhood Trauma Questionnaire. *Child Abuse and Neglect* 27, 169–190.
- Bora E, Lin A, Wood SJ, Yung AR, McGorry PD, Pantelis C (2014). Cognitive deficits in youth with familial and clinical high risk to psychosis: a systematic review and meta-analysis. *Acta Psychiatrica Scandinavica* 130, 1–15.
- Daalman K, Dierenen KMJ, Derks EM, van Lutterveld R, Kahn RS, Sommer IEC (2012). Childhood trauma and auditory verbal hallucinations. *Psychological Medicine* 42, 2475–2484.
- Daalman K, van Zandvoort M, Bootsman F, Boks M, Kahn R, Sommer I (2011). Auditory verbal hallucinations and cognitive functioning in healthy individuals. *Schizophrenia Research* 132, 203–207.

- Gould F, Clarke J, Heim C, Harvey PD, Majer M, Nemeroff CB** (2012). The effects of child abuse and neglect on cognitive functioning in adulthood. *Journal of Psychiatric Research* **46**, 500–506.
- Owen MJ, O'Donovan MC, Thapar A, Craddock N** (2011). Neurodevelopmental hypothesis of schizophrenia. *British Journal of Psychiatry* **198**, 173–175.
- Read J, van Os J, Morrison AP, Ross CA** (2005). Childhood trauma, psychosis and schizophrenia: a literature review with theoretical and clinical implications. *Acta Psychiatrica Scandinavica* **112**, 330–350.
- Reichenberg A** (2005). Cognitive impairment as a risk factor for psychosis. *Dialogues in Clinical Neuroscience* **7**, 31–38.
- Reichenberg A** (2010). The assessment of neuropsychological functioning in schizophrenia. *Dialogues in Clinical Neuroscience* **12**, 383–392.
- Sommer IE, Daalman K, Rietkerk T, Dierenen KM, Bakker S, Wijkstra J, Boks MP** (2010). Healthy individuals with auditory verbal hallucinations; who are they? Psychiatric assessments of a selected sample of 103 subjects. *Schizophrenia Bulletin* **36**, 633–641.
- van Dam DS, van Nierop M, Viechtbauer W, Velthorst E, van Winkel R, Genetic Risk and Outcome of Psychosis (GROUP) investigators, Bruggeman R, Cahn W, de Haan L, Kahn RS, Meijer CJ, Myin-Germeys I, van Os J, Wiersma D** (2015). Childhood abuse and neglect in relation to the presence and persistence of psychotic and depressive symptomatology. *Psychological Medicine* **45**, 1363–1377.

M. J. H. BEGEMANN, K. DAALMAN, S. M. HERINGA,  
M. J. L. SCHUTTE AND I. E. C. SOMMER  
Department of Psychiatry, University Medical Center Utrecht and  
Brain Center Rudolf Magnus, Heidelberglaan 100, 3485 CX  
Utrecht, The Netherlands

Address for correspondence: S. M. Heringa, Psychiatry  
Department, University Medical Center Utrecht, Brain Center  
Rudolf Magnus, Heidelberglaan 100, 3485CX Utrecht, The  
Netherlands  
(Email: s.m.heringa@umcutrecht.nl)