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Publication Date

2018-07-01

DOI

10.1016/j.schres.2018.02.026

Peer reviewed

HHS Public Access

Author manuscript

Schizophr Res. Author manuscript; available in PMC 2019 July 30.

Published in final edited form as:

Schizophr Res. 2018 July ; 197: 428–433. doi:10.1016/j.schres.2018.02.026.

Relationship between executive function, attachment style, and psychotic like experiences in typically developing youth

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Abstract

Psychotic like experiences (PLE's) are common in the general population, particularly during adolescence, which has generated interest in how PLE's emerge, and the extent to which they reflect either risk for, or resilience to, psychosis. The "attachment-developmental-cognitive" (ADC) model is one effort to model the effect of risk factors on PLEs. The ADC model proposes attachment insecurity as an early environmental insult that can contribute to altered neurodevelopment, increasing the likelihood of PLE's and psychosis. In particular, early-life attachment disruptions may negatively impact numerous aspects of executive function (EF), including behavioral inhibition and emotion regulation. Yet despite the relationship of disrupted attachment to EF impairments, no studies have examined how these factors may combine to contribute to PLE's in adolescents. Here, we examined the relative contributions of daily-life EF and attachment difficulties (avoidance and anxiety) to PLEs in typically developing youth ($N = 52$; ages 10–21). We found that EF deficits and high attachment insecurity both accounted for a significant proportion of the variance in PLE's, and interacted to predict PLE manifestation. Specifically, positive PLEs were predicted by greater trouble monitoring behavioral impact, less

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Contributors

Ms. Blair and Dr. Nitzburg proposed the included analyses, managed the literature searches, performed the statistical tests, and wrote the first draft of the manuscript. Dr. DeRosse contributed expertise on subclinical psychosis throughout the project, advised on statistical analyses, and contributed to all versions of the manuscript. Dr. Karlsgodt designed, implemented, and supervised the project from which the data are drawn, obtained funding for the project, contributed to analysis planning, and contributed to all versions of the manuscript. All authors approve the final version of the manuscript.

Conflict of interest

The authors report no conflicts of interest.

difficulty completing tasks, greater difficulty regulating emotional reactions, greater difficulty controlling impulses and higher attachment anxiety. Negative PLEs were predicted by greater difficulty in alternating attention, transitioning across situations, and regulating emotional reactions as well as higher attachment anxiety. These results are consistent with the ADC model, providing evidence that early-life attachment disruptions may impact behavioral regulation and emotional control, which together may contribute to PLEs.

Keywords

Subclinical psychosis; PLE's; Schizophrenia; Attachment; Executive function; Development; Adolescence

1. Introduction

Considerable evidence now shows continuity between clinically-significant psychotic symptoms in patient populations and psychotic-like experiences (PLE's) in the general population. PLE's are subsyndromal experiences that approximate the positive and negative symptoms of psychotic disorders (DeRosse and Karlsgodt, 2015; Kaymaz and van Os, 2010). Moreover, although schizophrenia affects only 0.4%–0.7% of the global population (Linscott and van Os, 2010), the median annual prevalence rate for adults who report PLE manifestations is approximately 7.2% (Linscott and van Os, 2013). Prevalence rates of PLEs are substantially higher in late childhood and adolescence, with estimates between 40% and 66% (Laurens et al., 2012; Wigman et al., 2012). Continuity between PLEs and psychotic disorders is supported by 1) an overlap of etiological correlates including lower education, unemployment, and family psychiatric history (Linscott and van Os, 2013), and 2) similarities between the quality and distribution of symptom profiles in patients with psychotic disorders and healthy individuals who report PLEs (Derosse et al., 2014a). Even in the absence of a psychiatric diagnosis PLE's may be associated with variation in cognition (Barnett et al., 2012; Cochrane et al., 2012; Korponay et al., 2014; Mollon et al., 2016) and social function (DeRosse et al., 2017) and may engender emotional distress (Fervaha et al., 2014). Furthermore, PLEs are associated with greater rates of psychotic disorders later in life (Cannon et al., 2002; Chapman et al., 1994; Hanssen et al., 2005; Poulton et al., 2000; Welham et al., 2009). Thus, efforts have been made to understand specific factors that contribute to the development of PLE's, including developmental disruptions (Karlsgodt et al., 2009; Weinberger and Marenco, 2003), genetic factors (Linney et al., 2003; Straub et al., 1996), and environmental factors (MacDonald 3rd et al., 2001), as well as to identify potential resilience factors that impede these symptoms from reaching clinical significance.

In addition to genetic or developmental insults, the "attachment-developmental-cognitive" (ADC) model posits that traumatic events and psychosocial stressors that impair attachment may also contribute to vulnerability to psychotic disorders by disrupting neural connectivity and structure formation in the developing brain (Rajkumar, 2014). Attachment theory proposes that child-caregiver emotional bonds form a template for future interpersonal relationships (Bowlby, 1969). Specifically, secure attachment, when the child experiences the primary caregivers as responsive, available and trustworthy, facilitates healthy adult

relationships. In contrast, insecure attachment from unreliable or neglectful caregivers, results in difficulties establishing and maintaining relationships in adulthood (Bowlby, 1980). Insecure attachment has been linked to a host of negative outcomes throughout the lifespan, including behavioral difficulties and psychopathology (Hoeve et al., 2012; Lee and Hankin, 2009). Moreover, high rates of insecure attachment, with some estimates of up to 74%, are seen in schizophrenia (Korver-Nieberg et al., 2014; MacBeth et al., 2011).

Early trauma is a significant predictor of insecure attachment (Allen et al., 1996; Styron and Janoff-Bulman, 1997) and the high prevalence of insecure attachment in schizophrenia corresponds to the higher levels of early adversity they experience relative to healthy controls (Cannon et al., 2014; Read et al., 2005). A history of childhood trauma significantly increases psychosis risk (Varese et al., 2012), and the severity and frequency of childhood maltreatment are positively related to hallucinations and delusions (Schenkel et al., 2005). Moreover, the relationship between severity of childhood trauma and severity of psychotic symptoms is the same in healthy individuals assessed for PLE's (DeRosse et al., 2014b). The strong link between insecure attachment and trauma, and their collective effect on symptom expression, provides support for the role of attachment style in the development of PLEs. In fact, insecure attachment has been related to increased PLE's, likelihood of developing maladaptive coping styles (Korver-Nieberg et al., 2014) and has been found to mediate specific childhood adversities and types of psychotic symptoms (Berry et al., 2007; Sitko et al., 2014).

Additionally, insecure attachment may be linked to cognitive impairments that make one vulnerable to the development of PLEs. Individuals with a history of early trauma show neuropsychological impairments (DePrince et al., 2009; Mezzacappa et al., 2001; Perez and Widom, 1994) that mirror those in psychosis patients, specifically in executive functions (e.g. cognitive control, working memory, decision making). (Heaton et al., 2001; Heinrichs and Zakzanis, 1998). Despite evidence that developmental stressors may be risk factors for psychosis by interrupting critical neurodevelopment, the interaction between attachment disruptions, executive functioning and PLE's is unclear. Neuropsychological functioning has been examined in adults who experience PLEs, but little research has been conducted in child or adolescent samples. Adolescence is particularly important stage for executive function development and establishment of social relationships (Blakemore, 2008), as well as a risk period for conversion of subclinical PLEs into clinically significant disorders (Murray and Jones, 2012; Trotman et al., 2013). Thus, the relationship of insecure attachment to PLEs may be especially relevant for this age group.

Our present study aims to understand the relationship between attachment style, executive functioning (EF), and PLE's in a sample of healthy children and adolescents. Continued efforts to understand the etiology of PLE's during this key social, cognitive, and neuropsychological development period are important for creating targeted interventions to prevent the development of serious psychopathology.

2. Experimental materials and methods

2.1. Participants

Our community sample consisted of 52 healthy volunteers aged 10 to 21 (mean = 17.09 ± 2.95) recruited for a longitudinal study via posted flyers, advertisements and referrals from previous study participants. Data utilized for the present analyses was collected at participant's baseline study visit. Our sample was 51.9% female (n = 27) and 61.5% Caucasian (n = 32), 23.1% African-American (n = 12), 5.8% Asian (n = 3), and 9.6% "Other" (n = 5). All participants over age 18 provided written informed consent and minors provided assent alongside parental written consent; the protocol was approved by the Northwell Health Institutional Review Board. Participants were excluded if they had any Axis-I diagnosis, any intellectual disability, any incidence of head injury with loss of consciousness, any medical illnesses that could affect brain functioning, or were taking any medications with known cognitive effects.

2.2. Clinical assessments

2.2.1. Diagnostic interviews—To rule out present and lifetime Axis-I disorders, all participants were administered the Structured Clinical Interview for the DSM-IV, Non-Patient Version (SCID-NP) (First et al., 1997). Participants aged 10–15 were also administered supplemental sections of the Kiddie-Schedule for Affective Disorders and Schizophrenia – Present and Lifetime Version (K-SADS-PL) to rule out additional child-onset disorders. Assessments were conducted by trained graduate-level raters, with diagnosis confirmed by a consensus of at least two faculty psychologists. Diagnostic interviews were supplemented with family informants whenever possible.

2.2.2. Subclinical psychosis—Subclinical psychosis was assessed using the Community Assessment of Psychic Experiences (CAPE) (Stefanis et al., 2002), a 42-item, self-report questionnaire that measures three dimensions of subclinical psychopathology including positive, negative and depressive symptoms. Because depressive symptoms fell outside the scope of the present study, we only examined the positive (CAPE-p) and negative (CAPE-n) subscales and did not include depressive items in our CAPE total score. The CAPE-p and CAPE-n showed good reliability in the present sample, with Cronbach's alpha estimates of α = 0.84 and 0.85, respectively.

2.2.3. Executive functioning behaviors—EF behaviors were measured using the 80-item self-report form of the Behavior Rating Inventory of Executive Function (BRIEF-SR, (O'Doherty and Nguyen, 2004)). This self-report measure asks participants to rate real-world behaviors that would be adversely affected in childhood and adolescence by EF deficits. The BRIEF-SR contains 8 sub-scales: 1) Working Memory, 2) Plan/Organize, 3) Organization of Materials, 4) Task Completion, 5) Inhibit, 6) Shift, 7) Emotional Control, and 8) Monitor. All of these scales demonstrated acceptable reliability in this sample, with Cronbach's alpha estimates for all subscales ranging from 0.60-to-0.87 and 0.95 for the BRIEF Total score.

2.2.4. Attachment insecurity—Attachment was assessed using a 20-item measure, the Experiences in Close Relationship Scale – Revised – General Short Form (ECR-R-GSF), which includes two 10-item subscales measuring attachment anxiety and attachment avoidance (Wilkinson, 2011). Attachment insecurity is conceptualized as the degree of difficulty with developing and maintaining a stable sense of intimacy and trust in close relationships, including the degree to which intimate relationships are avoided altogether (attachment avoidance) and the degree to which existing intimate relationships generate anxiety about whether trust might result in potential abandonment (attachment anxiety). Attachment style is established as a relatively stable construct over the lifespan, with early attachment styles correlated with adolescent and adult attachment styles (Hamilton, 2000; Waters et al., 2000. The ECR-R-GSF is a modified version of the Experiences in Close Relationships– Revised Scale (Fraley et al., 2000), which measured attachment insecurity via its proximal effects on adult romantic relationships (Sibley et al., 2005). The revised version is generalized to include non-romantic relationships by changing the wording from "romantic partners" to "other people," thereby making the scale applicable for youth 11–22 years old (Wilkinson, 2011). In our sample, the attachment anxiety and avoidance subscales, as well as the attachment insecurity total summed score, showed good to excellent reliability with Cronbach's alpha estimates of 0.85, 0.87, and 0.90, respectively.

2.3. Data analysis

We examined whether positive and negative PLE's were associated with the BRIEF Total Score and the ECR-R-GSF Attachment Insecurity Total Score and whether BRIEF and ECR-R-GSF total scores interacted when being linked to positive and negative PLE's. We next examined which specific BRIEF and ECR-R-GSF subscales most strongly influenced positive and negative PLE's. First, we tested the CAPE-p and CAPE-n, the BRIEF total score, all of the BRIEF subscales, and the ECR-R-GSF total score and the avoidance and anxiety subscales for normality. Since the lifetime prevalence of PLE's has been shown to differ by sex and race (McGrath et al., 2015), sex and race had the potential to impact our other measures. Thus, we also tested if CAPE, BRIEF, and ECR-R-GSF scores differed based on sex or race. The BRIEF total score and the ECR-R-GSF Total Attachment Insecurity score variables were both centered prior to regression analyses and an interaction term was calculated by multiplying the centered BRIEF Total Score with the centered ECR-R-GSF Attachment Insecurity score. Two hierarchical multiple regression models were conducted to evaluate whether the BRIEF Total interacted with ECR-R-GSF Attachment Insecurity Total to separately predict positive versus negative PLE's. Specifically, each of these two hierarchical regressions had two steps, where the centered Brief Total Score and centered Attachment Insecurity Total Score were entered in the first step and the interaction term was entered in the second step. Next, two separate stepwise regression models including all the uncentered subscales from the BRIEF and ECR-R-GSF were conducted to assess their contributions to positive and negative PLE levels.

3. Results

Consistent with previous work in young samples, the CAPE-p and CAPE-n and summed score were all non-normally distributed (DeRosse et al., 2015). In addition, the BRIEF total

score and all of the BRIEF subscales, with the exceptions of working memory and planning/organization, were not normally distributed. Finally, the avoidance and anxiety subscales as well as the total score of the ECR-R-GSF were not normally distributed. Thus, the ECR-R-GSF Avoidance and Anxiety subscales and the BRIEF subscales of working memory and planning/organization were examined for sex and race differences using *t*-tests and for age differences using Pearson's r, while the CAPE-p; and CAPE-n, the CAPE psychotic symptoms summed score, the BRIEF total score and all other BRIEF subscales were examined for sex and race differences using Mann–Whitney *U* tests and for age differences using Spearman's rho. No significant sex, race, or age differences were found for any variables (all p's > 0.05). As a result, we excluded age, race, and sex from subsequent regression analyses.

The multiple regression model examining the effect of EF difficulties and insecure attachment on the CAPE-p resulted in a significantly predictive model accounting for 57.1% of the variance in positive PLE's ($F(3,51) = 21.32$, $p < 0.001$), where greater difficulties with EF behaviors ($\beta = 0.27$, $p < 0.05$) and higher attachment insecurity ($\beta = 0.35$, $p < 0.01$) significantly predicted higher endorsement of positive PLE's, with these two variables also significantly interacting to predict positive PLE's ($\beta = 0.42$, $p < 0.001$). Similarly, the multiple regression examining the effect of EF difficulties and insecure attachment on the CAPE-n resulted in a significantly predictive model accounting for 66.2% of the variance in negative PLE's ($F(3,51) = 31.27$, $p < 0.001$), where greater difficulties with EF behaviors ($\beta = 0.36$, $p < 0.01$) and higher attachment insecurity ($\beta = 0.44$, $p < 0.001$) significantly predicted higher endorsement of negative PLE's, with these two variables also significantly interacting to predict negative PLE's ($\beta = 0.27$, $p < 0.01$). (Table 1; Figs. 1 and 2).

As linear regressions remain valid for non-normal data given adequate sample size (Lumley et al., 2002) and normal distribution of the residuals (Verran and Ferketich, 1987) normality of each regression's unstandardized residuals was assessed. Unstandardized residuals for the regression model on the CAPE-n were normally distributed ($D = 0.11$, $p > 0.05$); however the CAPE-p model was not ($D = 0.15$, $p < 0.05$). Thus, to confirm that results were not due to skew, we used a median split to examine the relationships between the CAPE-p, the BRIEF total score and ECR-R-GSF Insecurity total score. Specifically, differences between CAPE-p high or low scorers were assessed using Mann-Whitney *U* tests for the BRIEF total score and a *t*-test for the ECR-R-GSF Insecurity total score. Consistent with the regression model, those with high CAPE-p scores had greater EF difficulties ($U = 184.0$, $p < 0.01$) and greater attachment insecurity ($t(2,52) = -3.47$, $p < 0.01$), indicating that results were not the direct effect of CAPE-p skew (Table 2).

Two separate follow-up stepwise regressions were conducted to identify specific aspects of attachment insecurity and EF behavior difficulties that most impacted positive and negative PLE's. The stepwise regression for the CAPE-p resulted in a significantly predictive model accounting for 63.2% of the variance in positive PLE's ($F(5,51) = 15.82$, $p < 0.001$), where greater difficulties with monitoring how one's own behaviors impact others ($\beta = 0.31$, $p < 0.05$), greater difficulty regulating emotional reactions ($\beta = 0.25$, $p < 0.05$), less difficulty completing tasks ($\beta = -0.51$, $p < 0.001$), greater difficulty controlling impulses ($\beta = 0.35$, $p < 0.01$), and higher attachment anxiety ($\beta = 0.37$, $p < 0.01$) significantly predicted higher

positive PLE levels. All other aspects of executive dysfunction were not significant in their relationship to positive PLE's, including the ability to alternate between activities or shift attention (i.e. shift), the ability to hold and manipulate information in one's mind (i.e. working memory), the ability to keep materials in order (i.e. organization of materials), or the ability to set and carry out plans and goals (i.e. plan/organize). The follow-up stepwise regression for the CAPE-n resulted in a significantly predictive model accounting for 63.3% of the variance in negative PLE's ($F(3,51) = 27.64$, $p < 0.001$), where greater difficulty smoothly alternating attention and transitioning across situations ($\beta = 0.34$, $p < 0.01$), greater difficulty regulating emotional reactions ($\beta = 0.24$, $p < 0.05$) and higher attachment anxiety ($\beta = 0.36$, $p < 0.01$) significantly predicted higher negative PLE levels. All other aspects of executive dysfunction were not significant in their relationship to negative PLE's, including all the aforementioned abilities in addition to the ability to complete assignments and chores in a timely fashion (i.e. task), the ability to control one's own impulses (i.e. inhibit) or the ability to keep track of the effect that one's behavior has on other people (i.e. monitor). The unstandardized residuals for the two above-mentioned stepwise regression models were examined and were both found to be normally distributed (CAPE-p: $D = 0.08$, $p > 0.05$; CAPE-n: $D = 0.10$, $p > 0.05$) (Table 3).

4. Discussion

The primary aim of our study was to understand whether the interaction of attachment security and real-life EF was predictive of PLEs. Overall, we found that greater EF deficits and high attachment insecurity predicted increased endorsement of both positive and negative PLEs. The secondary aim was to elucidate the specific EF deficits and sub-type of attachment insecurity that would differentially impact positive or negative PLEs. We found that higher levels of positive PLEs were predicted by greater trouble monitoring behavioral impact, less difficulty completing tasks, greater difficulty regulating emotional reactions, greater difficulty controlling impulses and higher attachment anxiety. Higher levels of negative PLEs were predicted by greater difficulty alternating attention and transitioning across situations, greater difficulty regulating emotional reactions and higher attachment anxiety.

Our results align with previous findings of the negative influence of insecure attachment on EF (Bernier et al., 2012). As early caregiving relationships provide fundamental models for cognitive development; poor or inconsistent parenting can adversely impact a child's attention (Belsky et al., 2007), inhibition, and self-regulation capacities (Bernier et al., 2010; Nelson and Bloom, 1997). Indeed, impaired EF has been found to mediate the relationship between disorganized attachment and later behavioral problems (Low and Webster, 2016; NICHD, 2003). This is also consistent with findings of similar EF deficits in individuals with early life trauma and schizophrenia patients (Heaton et al., 2001). Both populations exhibit parallel disruptions in inhibition, attention (DePrince et al., 2009; Hutton et al., 1998; Kerns et al., 2008), EF and emotional dysregulation (Perez and Widom, 1994; Suzuki et al., 2014; Tremeau, 2006). Impaired EF, as measured by the BRIEF, has also been seen in prodromal psychosis. Specifically, the ability to shift, inhibit and regulate emotions has been correlated to the severity of positive symptoms, suggesting the significant influence EF impairments can have on susceptibility to symptoms (Niendam et al., 2007b). Our finding

that greater difficulty controlling emotional reactions specifically contributed to symptom endorsement is consistent with the previously established relationship between attachment insecurity and emotional dysregulation (Mikulincer and Shaver, 2008). Taken together, these results imply that insecure attachment can negatively impact executive, behavioral and emotional control, combining to create a vulnerability to both subthreshold and threshold psychotic symptoms.

It is of particular interest that, unlike in individuals with schizophrenia, it is attachment *anxiety* rather than attachment *avoidance* that predicts PLEs. This may indicate that the difference between attachment anxiety and avoidance, partly explains why symptoms remain sub-threshold rather than becoming a full psychotic disorder. Negative symptoms of schizophrenia (e.g. asociality) often present as “avoidant” types of behaviors and result in a lack of meaningful interpersonal relationships (Horan and Blanchard, 2003). In contrast, though people with anxious attachment styles may have maladaptive interpersonal patterns, their continued engagement in social relationships may act as a buffer against symptoms becoming clinically significant. This is consistent with data showing that when intact, social function may act to moderate functional decline in psychosis (Niendam et al., 2007a).

There are several limitations to the current study. First, these findings might not be specific to psychosis but could reflect a general combination of behavioral difficulties in children with increased early adversities. Children exposed to trauma are more likely to develop a variety of behavioral disorders characterized by difficulty controlling impulses and emotions, such as ADHD, and oppositional-defiant disorder (Yung et al., 2005), which may be related to their EF deficits. Secondly, our study included a large age range, although we did not find significant effects of age in any of our measures of interest. Third, while all participants underwent a clinical interview to rule-out a present or lifetime diagnosis of a psychotic disorder, a formal assessment of personality disorders was not administered to participants which reduces the ability to rule-out that PLEs were caused by underlying paranoid or schizotypal personality traits. Fourth, PLEs, executive functioning and attachment were all measured at the same time point and thus, suggestions of a causal relationship between these variables is limited.

Overall, these findings suggest a unique contribution of insecure attachment and EF deficits to the presence of PLE’s. Temperament, (Nitzburg et al., 2014), cognitive schema (Gaweda et al., 2015), anxiety (Reeves et al., 2014), and stress sensitivity (Gibson et al., 2014) have all been associated with likelihood of exhibiting subthreshold psychosis. However, the interaction between developmental stressors and neuropsychological functioning, and PLE’s, particularly in child and adolescent samples is unknown. Adolescence is a risk period for the conversion of subthreshold symptoms to clinically significant psychotic disorders (Murray and Jones, 2012; Trotman et al., 2013) as well as a period of increased importance of social relationships (Blakemore, 2008) and ongoing maturation of EF (Crone and Dahl, 2012; Somerville and Casey, 2010). Thus, this increased understanding of how insecure attachment interacts with EF offers an especially promising advance toward further understanding the factors contributing to PLEs in this age group.

Acknowledgments

This work was funded by NIMH R01 MH101506 to K.H.K.

Role of the funding source

The funding source (MH101506) provided support for study staff (including M.A.B. and K.H.K.), participant recruitment, participant transportation, participant reimbursement for assessments, equipment and materials, and all other aspects of the study.

References

Allen JP, Hauser ST, Borman-Spurrell E. 1996; Attachment theory as a framework for understanding sequelae of severe adolescent psychopathology: an 11-year followup study. J Consult Clin Psychol. 64(2):254–263. [PubMed: 8871409]

Barnett JH, McDougall F, Xu MK, Croudace TJ, Richards M, Jones PB. 2012; Childhood cognitive function and adult psychopathology: associations with psychotic and non-psychotic symptoms in the general population. Br J Psychiatry J Ment Sci. 201:124–130.

Belsky J, Pasco Fearon RM, Bell B. 2007; Parenting, attention and externalizing problems: testing mediation longitudinally, repeatedly and reciprocally. J Child Psychol Psychiatry. 48(12):1233–1242. [PubMed: 18093029]

Bernier A, Carlson SM, Whipple N. 2010; From external regulation to self-regulation: early parenting precursors of young children's executive functioning. Child Dev. 81(1):326–339. [PubMed: 20331670]

Bernier A, Carlson SM, Deschenes M, Matte-Gagne C. 2012; Social factors in the development of early executive functioning: a closer look at the caregiving environment. Dev Sci. 15(1):12–24. [PubMed: 22251288]

Berry K, Band R, Corcoran R, Barrowclough C, Wearden A. 2007; Attachment styles, earlier interpersonal relationships and schizotypy in a non-clinical sample. Psychol Psychother. 80(Pt 4): 563–576. [PubMed: 17535544]

Blakemore SJ. 2008; Development of the social brain during adolescence. Q J Exp Psychol. 61(1):40–49.

Bowlby, J. Attachment and Loss. Vol. 1. Basic Books; New York: 1969.

Bowlby, J. Attachment and Loss. Vol. 3. Basic Books; New York: 1980.

Cannon M, Caspi A, Moffitt TE, Harrington H, Taylor A, Murray RM, Poulton R. 2002; Evidence for early-childhood, pan-developmental impairment specific to schizophreniform disorder: results from a longitudinal birth cohort. Arch Gen Psychiatry. 59(5):449–456. [PubMed: 11982449]

Cannon TD, Chung Y, He G, Sun D, Jacobson A, van Erp TG, McEwen S, Addington J, Bearden CE, Cadenhead K, Cornblatt B, Mathalon DH, McGlashan T, Perkins D, Jeffries C, Seidman LJ, Tsuang M, Walker E, Woods SW, Heinssen R. 2014; Progressive reduction in cortical thickness as psychosis develops: a multisite longitudinal neuroimaging study of youth at elevated clinical risk. Biol Psychiatry. 77(2):147–157. [PubMed: 25034946]

Chapman LJ, Chapman JP, Kwapil TR, Eckblad M, Zinser MC. 1994; Putatively psychosis-prone subjects 10 years later. J Abnorm Psychol. 103(2):171–183. [PubMed: 8040487]

Cochrane M, Petch I, Pickering AD. 2012; Aspects of cognitive functioning in schizotypy and schizophrenia: evidence for a continuum model. Psychiatry Res. 196(2–3):230–234. [PubMed: 22424907]

Crone EA, Dahl RE. 2012; Understanding adolescence as a period of social-affective engagement and goal flexibility. Nat Rev Neurosci. 13(9):636–650. [PubMed: 22903221]

DePrince AP, Weinzierl KM, Combs MD. 2009; Executive function performance and trauma exposure in a community sample of children. Child Abuse Negl. 33(6):353–361. [PubMed: 19477515]

DeRosse P, Karlsgodt KH. 2015; Examining the psychosis continuum. Curr Behav Neurosci Rep. 2(2): 80–89. [PubMed: 26052479]

DeRosse P, Ikuta T, Peters BD, Karlsgodt KH, Szeszko PR, Malhotra AK. 2014a; Adding insult to injury: childhood and adolescent risk factors for psychosis predict lower fractional anisotropy in

the superior longitudinal fasciculus in healthy adults. Psychiatry Res. 224(3):296–302. [PubMed: 25277095]

DeRosse P, Nitzburg GC, Kompancaril B, Malhotra AK. 2014b; The relation between childhood maltreatment and psychosis in patients with schizophrenia and non-psychiatric controls. Schizophr Res. 155(1–3):66–71. [PubMed: 24704218]

DeRosse P, Nitzburg GC, Ikuta T, Peters BD, Malhotra AK, Szeszko PR. 2015; Evidence from structural and diffusion tensor imaging for frontotemporal deficits in psychometric schizotypy. Schizophr Bull. 41(1):104–114. [PubMed: 25392520]

DeRosse P, Ikuta T, Karlsgodt KH, Peters BD, Gopin CB, Szeszko PR, Malhotra AK. 2017; White matter abnormalities associated with subsyndromal psychotic-like symptoms predict later social competence in children and adolescents. Schizophr Bull. 43(1):152–159. [PubMed: 27190281]

Fervaha G, Zakzanis KK, Jeffay E, Graff-Guerrero A, Foussias G, Agid O, Remington G. 2014; Amotivation as central to negative schizotypy and their predictive value for happiness. Personal Individ Differ. 68:37–42.

First, MB, Spitzer, R, Gibbon, M, Williams, J. Structured Clinical Interview for DSM-IV Axis I Disorders. Biometrics Research Department, New York State Psychiatric Institute; New York: 1997.

Fraley RC, Waller NG, Brennan KA. 2000; An item response theory analysis of self-report measures of adult attachment. J Pers Soc Psychol. 78(2):350–365. [PubMed: 10707340]

Gaweda L, Prochwicz K, Cella M. 2015; Cognitive biases mediate the relationship between temperament and character and psychotic-like experiences in healthy adults. Psychiatry Res. 225(1–2):50–57. [PubMed: 25453635]

Gibson LE, Anglin DM, Klugman JT, Reeves LE, Fineberg AM, Maxwell SD, Kerns CM, Ellman LM. 2014; Stress sensitivity mediates the relationship between traumatic life events and attenuated positive psychotic symptoms differentially by gender in a college population sample. J Psychiatr Res. 53:111–118. [PubMed: 24631196]

Hamilton CE. 2000; Continuity and discontinuity of attachment from infancy through adolescence. Child Dev. 71(3):690–694. DOI: 10.1111/1467-8624.00177 [PubMed: 10953935]

Hanssen M, Bak M, Bijl R, Vollebergh W, van Os J. 2005; The incidence and outcome of subclinical psychotic experiences in the general population. Br J Clin Psychol. 44(Pt 2):181–191. [PubMed: 16004653]

Heaton RK, Gladsjo JA, Palmer BW, Kuck J, Marcotte TD, Jeste DV. 2001; Stability and course of neuropsychological deficits in schizophrenia. Arch Gen Psychiatry. 58(1):24–32. [PubMed: 11146755]

Heinrichs RW, Zakzanis KK. 1998; Neurocognitive deficit in schizophrenia: a quantitative review of the evidence. Neuropsychology. 12(3):426–445. [PubMed: 9673998]

Hoeve M, Stams GJ, van der Put CE, Dubas JS, van der Laan PH, Gerris JR. 2012; A meta-analysis of attachment to parents and delinquency. J Abnorm Child Psychol. 40(5):771–785. [PubMed: 22278802]

Horan WP, Blanchard JJ. 2003; Neurocognitive, social, and emotional dysfunction in deficit syndrome schizophrenia. Schizophr Res. 65(2–3):125–137. [PubMed: 14630305]

Hutton SB, Puri BK, Duncan LJ, Robbins TW, Barnes TR, Joyce EM. 1998; Executive function in first-episode schizophrenia. Psychol Med. 28(2):463–473. [PubMed: 9572103]

Karlsgodt KH, Niendam TA, Bearden CE, Cannon TD. 2009; White matter integrity and prediction of social and role functioning in subjects at ultra-high risk for psychosis. Biol Psychiatry. 66(6):562–569. [PubMed: 19423081]

Kaymaz N, van Os J. 2010; Extended psychosis phenotype–yes: single continuum– unlikely. Psychol Med. 40(12):1963–1966. [PubMed: 20236570]

Kerns JG, Nuechterlein KH, Braver TS, Barch DM. 2008; Executive functioning component mechanisms and schizophrenia. Biol Psychiatry. 64(1):26–33. [PubMed: 18549874]

Korponay C, Nitzburg GC, Malhotra AK, DeRosse P. 2014; Positive and negative sub-clinical symptoms and Mccb performance in non-psychiatric controls. Schizophr Res Cogn. 1(4):175–179. [PubMed: 25530948]

Korver-Nieberg N, Berry K, Meijer CJ, de Haan L. 2014; Adult attachment and psychotic phenomenology in clinical and non-clinical samples: a systematic review. Psychol Psychother. 87(2):127–154. [PubMed: 23818184]

Laurens KR, Hobbs MJ, Sunderland M, Green MJ, Mould GL. 2012; Psychotic-like experiences in a community sample of 8000 children aged 9 to 11 years: an item response theory analysis. Psychol Med. 42(7):1495–1506. [PubMed: 21999924]

Lee A, Hankin BL. 2009; Insecure attachment, dysfunctional attitudes, and low self-esteem predicting prospective symptoms of depression and anxiety during adolescence. J Clin Child Adolesc Psychol. 38(2):219–231. [PubMed: 19283600]

Linney YM, Murray RM, Peters ER, MacDonald AM, Rijsdijk F, Sham PC. 2003; A quantitative genetic analysis of schizotypal personality traits. Psychol Med. 33(5):803–816. [PubMed: 12877395]

Linscott RJ, van Os J. 2010; Systematic reviews of categorical versus continuum models in psychosis: evidence for discontinuous subpopulations underlying a psychometric continuum. Implications for DSM-V, DSM-VI, and DSM-VII. Annu Rev Clin Psychol. 6:391–419. [PubMed: 20192792]

Linscott RJ, van Os J. 2013; An updated and conservative systematic review and meta-analysis of epidemiological evidence on psychotic experiences in children and adults: on the pathway from proneness to persistence to dimensional expression across mental disorders. Psychol Med. 43(6): 1133–1149. [PubMed: 22850401]

Low JA, Webster L. 2016; Attention and executive function as mediators of attachment and behavior. Soc Dev. 25(3):646–664.

Lumley T, Diehr P, Emerson S, Chen L. 2002; The importance of the normality assumption in large public health data sets. Annu Rev Public Health. 23:151–169. [PubMed: 11910059]

MacBeth A, Gumley A, Schwannauer M, Fisher R. 2011; Attachment states of mind, mentalization, and their correlates in a first-episode psychosis sample. Psychol Psychother-T. 84(1):42–57.

MacDonald AW 3rd, Pogue-Geile MF, Debski TT, Manuck S. 2001; Genetic and environmental influences on schizotypy: a community-based twin study. Schizophr Bull. 27(1):47–58. [PubMed: 11215549]

McGrath JJ, Saha S, Al-Hamzawi A, Alonso J, Bromet EJ, Bruffaerts R, Florescu S. 2015; Psychotic experiences in the general population: a cross-national analysis based on 31 261 respondents from 18 countries. JAMA Psychiat. 72(7):697–705.

Mezzacappa E, Kindlon D, Earls F. 2001; Child abuse and performance task assessments of executive functions in boys. J Child Psychol Psychiatry. 42(8):1041–1048. [PubMed: 11806686]

Mikulincer, M, Shaver, PR. Adult attachment and affect regulation. In: Cassidy, J, Shaver, PR, editors. Handbook of Atachment; Theory, Research, and Clinical Applications. 2nd. Guilford Press; New York, Ny: 2008.

Mollon J, David AS, Morgan C, Frissa S, Glahn D, Pilecka I, Hatch SL, Hotopf M, Reichenberg A. 2016; Psychotic experiences and neuropsychological functioning in a population-based sample. JAMA Psychiat. 73(2):129–138.

Murray GK, Jones PB. 2012; Psychotic symptoms in young people without psychotic illness: mechanisms and meaning. Br J Psychiatry. 201(1):4–6. [PubMed: 22753849]

Nelson TA, Bloom FE. 1997; Child development and neuroscience. Child Dev. 68(5):970–987. [PubMed: 29106726]

NICHD. 2003; Do children's attention processes mediate the link between family predictors and school readiness. Dev Psychol. 39:581–593. [PubMed: 12760525]

Niendam TA, Bearden CE, Zinberg J, Johnson JK, O'Brien M, Cannon TD. 2007a; The course of neurocognition and social functioning in individuals at ultra high risk for psychosis. Schizophr Bull. 33(3):772–781. [PubMed: 17420177]

Niendam TA, Horwitz J, Bearden CE, Cannon TD. 2007b; Ecological assessment of executive dysfunction in the psychosis prodrome: a pilot study. Schizophr Res. 93(1–3):350–354. [PubMed: 17467957]

Nitzburg GC, Malhotra AK, DeRosse P. 2014; The relationship between temperament and character and subclinical psychotic-like experiences in healthy adults. Eur Psychiatry. 29(6):352–357. [PubMed: 24439515]

O'Doherty RM, Nguyen L. 2004; Blunted fasting-induced decreases in plasma and CSF leptin concentrations in obese rats: the role of increased leptin secretion. Int J Obes Relat Metab Disord. 28(1):173–175. [PubMed: 14569276]

Perez CM, Widom CS. 1994; Childhood victimization and long-term intellectual and academic outcomes. Child Abuse Negl. 18(8):617–633. [PubMed: 7953902]

Poulton R, Caspi A, Moffitt TE, Cannon M, Murray R, Harrington H. 2000; Children's self-reported psychotic symptoms and adult schizophreniform disorder: a 15-year longitudinal study. Arch Gen Psychiatry. 57(11):1053–1058. [PubMed: 11074871]

Rajkumar RP. 2014; Childhood attachment and schizophrenia: the "attachment-developmental-cognitive" (ADC) hypothesis. Med Hypotheses. 83(3):276–281. [PubMed: 24957505]

Read J, van Os J, Morrison AP, Ross CA. 2005; Childhood trauma, psychosis and schizophrenia: a literature review with theoretical and clinical implications. Acta Psychiatr Scand. 112(5):330–350. [PubMed: 16223421]

Reeves LE, Anglin DM, Heimberg RG, Gibson LE, Fineberg AM, Maxwell SD, Kerns CM, Ellman LM. 2014; Anxiety mediates the association between cannabis use and attenuated positive psychotic symptoms. Psychiatry Res. 218(1–2):180–186. [PubMed: 24745470]

Schenkel LS, Spaulding WD, DiLillo D, Silverstein SM. 2005; Histories of childhood maltreatment in schizophrenia: relationships with premorbid functioning, symptomatology, and cognitive deficits. Schizophr Res. 76(2–3):273–286. [PubMed: 15949659]

Sibley CG, Fischer R, Liu JH. 2005; Reliability and validity of the revised experiences in close relationships (ECR-R) self-report measure of adult romantic attachment. Personal Soc Psychol Bull. 31(11):1524–1536.

Sitko K, Bentall RP, Shevlin M, O'Sullivan N, Sellwood W. 2014; Associations between specific psychotic symptoms and specific childhood adversities are mediated by attachment styles: an analysis of the National Comorbidity Survey. Psychiatry Res. 217(3):202–209. [PubMed: 24726818]

Somerville LH, Casey BJ. 2010; Developmental neurobiology of cognitive control and motivational systems. Curr Opin Neurobiol. 20(2):236–241. [PubMed: 20167473]

Stefanis NC, Hanssen M, Smirnis NK, Avramopoulos DA, Evdokimidis IK, Stefanis CN, Verdoux H, Van Os J. 2002; Evidence that three dimensions of psychosis have a distribution in the general population. Psychol Med. 32(2):347–358. [PubMed: 11866327]

Straub RE, MacLean CJ, Kendler KS. 1996; The putative schizophrenia locus on chromosome 6p: a brief overview of the linkage studies. Mol Psychiatry. 1(2):89–92. [PubMed: 9118328]

Styron T, Janoff-Bulman R. 1997; Childhood attachment and abuse: long-term effects on adult attachment, depression, and conflict resolution. Child Abuse Negl. 21(10):1015–1023. [PubMed: 9330802]

Suzuki H, Luby JL, Botteron KN, Dietrich R, McAvoy MP, Barch DM. 2014; Early life stress and trauma and enhanced limbic activation to emotionally valenced faces in depressed and healthy children. J Am Acad Child Adolesc Psychiatry. 53(7):800–813 e810. [PubMed: 24954829]

Tremeau F. 2006; A review of emotion deficits in schizophrenia. Dialogues Clin Neurosci. 8(1):59–70. [PubMed: 16640115]

Trotman HD, Holtzman CW, Ryan AT, Shapiro DI, MacDonald AN, Goulding SM, Brasfield JL, Walker EF. 2013; The development of psychotic disorders in adolescence: a potential role for hormones. Horm Behav. 64(2):411–419. [PubMed: 23998682]

Varese F, Smeets F, Drukker M, Lieverse R, Lataster T, Viechtbauer W, Read J, van Os J, Bentall RP. 2012; Childhood adversities increase the risk of psychosis: a meta-analysis of patient-control, prospective- and cross-sectional cohort studies. Schizophr Bull. 38(4):661–671. [PubMed: 22461484]

Verran JA, Ferketich SL. 1987; Testing linear model assumptions: residual analysis. Nurs Res. 36(2): 127–130. [PubMed: 3644259]

Waters E, Merrick S, Treboux D, Crowell J, Albersheim L. 2000; Attachment security in infancy and adulthood: a twenty-year longitudinal study. Child Dev. 71(3):684–689. DOI: 10.1111/1467-8624.00176 [PubMed: 10953934]

Weinberger, DR, Marenco, S. Schizophrenia as a neurodevelopmental disorder. In: Hirsch, SR, Weinberger, DR, editors. Schizophrenia. Second. Blackwell Science, Ltd; Oxford, UK: 2003.

Welham J, Isohanni M, Jones P, McGrath J. 2009; The antecedents of schizophrenia: a review of birth cohort studies. Schizophr Bull. 35(3):603–623. [PubMed: 18658128]

Wigman JT, Vollebergh WA, Jacobs N, Wichers M, Derom C, Thiery E, Raaijmakers QA, van Os J. 2012; Replication of the five-dimensional structure of positive psychotic experiences in young adulthood. Psychiatry Res. 197(3):353–355. [PubMed: 22364932]

Wilkinson RB. 2011; Measuring attachment dimensions in adolescents: development and validation of the experiences in close relationships-revised-general short form. Rev Relig Res Off J Relig Res Assoc. 2(01):53–62.

Yung AR, Yuen HP, McGorry PD, Phillips LJ, Kelly D, Dell'Olio M, Francey SM, Cosgrave EM, Killackey E, Stanford C, Godfrey K, Buckby J. 2005; Mapping the onset of psychosis: the comprehensive assessment of at-risk mental states. Aust N Z J Psychiatry. 39(11–12):964–971. [PubMed: 16343296]

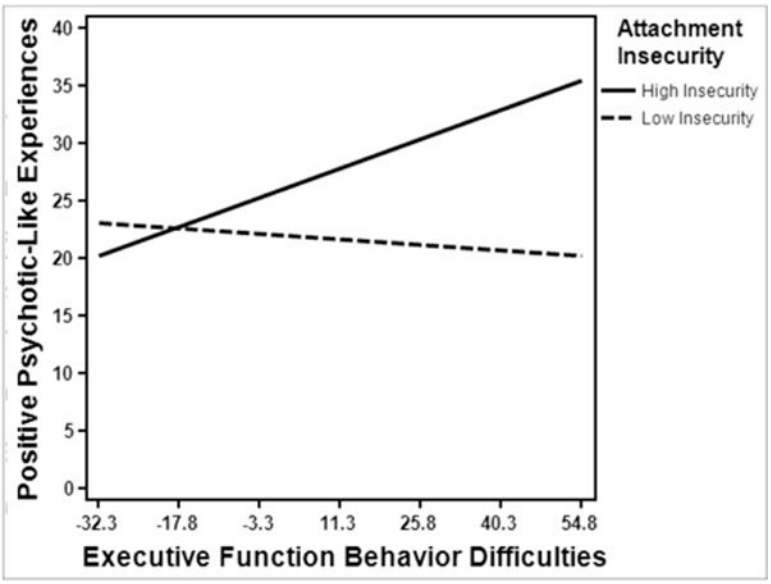

Fig. 1.

Interaction between executive function behavior difficulties and attachment insecurity predicting positive psychotic-like experiences.

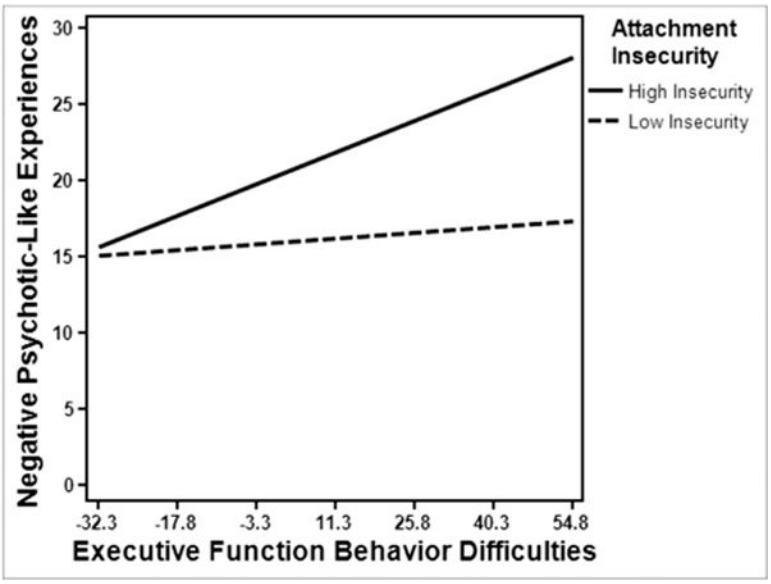

Fig. 2.

Interaction between executive function behavior difficulties and attachment insecurity predicting negative psychotic-like experiences.

Table 1

Descriptive statistics for psychotic-like experience, attachment, and executive dysfunction variables.

Variables	N	Range	M(SD)	Std. error
Executive function behavior difficulties				
BRIEF total	52	80–167	112.25 (20.52)	2.85
BRIEF subscales:				
Working memory	52	12–26	16.67 (3.48)	0.48
Plan/organize	52	13–28	18.77 (3.88)	0.54
Organization of materials	52	7–17	10.67 (2.31)	0.32
Task completion	52	10–21	13.31 (3.02)	0.42
Inhibit	52	13–33	17.60 (4.42)	0.61
Shift	52	10–23	14.03 (3.40)	0.47
Emotional control	52	10–30	14.21 (3.96)	0.55
Monitor	52	5–12	6.98 (1.84)	0.26
Psychotic-like experiences				
CAPE psychotic-like symptoms total	52	34–82	44.08 (9.76)	1.35
CAPE subscales				
Positive PLE's	52	20–48	25.25 (5.52)	0.77
Negative PLE's	52	14–34	18.83 (4.88)	0.68
Attachment insecurity				
ECR-R-GSF total	52	25–79	47.23 (12.62)	1.75
ECR-R-GSF subscales				
Attachment anxiety	52	10–37	20.29 (6.95)	0.96
Attachment avoidance	52	10–45	26.94 (7.59)	1.05

Table 2

Regressions of total executive functioning difficulties and attachment insecurity predicting positive and negative PLE's.

Regression model for positive PLE's		
	β	***p***
Step 1:		
BRIEF total	0.35	<0.05
Attachment insecurity total	0.36	<0.05
Step 2:		
BRIEF total	0.27	<0.05
Attachment insecurity total	0.35	<0.01
BRIEF total ∗ attachment total	0.42	<0.001
Regression model for negative PLE's		
	β	*p*
Step 1:		
BRIEF total	0.41	<0.001
Attachment insecurity total	0.45	<0.001
Step 2:		
BRIEF total	0.36	<0.01
Attachment insecurity total	0.44	<0.001
BRIEF total ∗ attachment total	0.27	<0.01

Note: $R^2_{\text{positive PLE's}}$ = 57.1%; $R^2_{\text{negative PLE's}}$ = 66.2%; BRIEF = behavior rating inventory for executive function; PLE's = psychotic-like experiences.

Table 3

Stepwise regressions of executive functioning behavior difficulty and attachment insecurity subscales.

Regression model for positive psychotic-like experiences		
	β	***p***
BRIEF subscales		
Monitor	0.31	<0.05
Emotional control	0.25	<0.05
Task completion	−0.51	<0.001
Inhibit	0.35	<0.01
Attachment anxiety	0.37	<0.01
Regression model for negative psychotic-like experiences		
	B	*p*
BRIEF subscales		
Shift	0.34	<0.01
Emotional control	0.24	<0.05
Attachment anxiety	0.36	<0.01

Note: R^2 positive PLE's = 63.2%; R^2 negative PLE's = 63.3%; BRIEF = behavior rating inventory for executive function.