Early Intervention in Psychiatry

Severe Childhood Trauma and Emotion Recognition in Males and Females with First-Episode Psychosis

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Abstract

Aim. Childhood trauma increases social functioning deficits in first-episode psychosis (FEP) and is negatively associated with higher-order social cognitive processes such as emotion recognition (ER). We investigated the relationship between childhood trauma severity and ER capacity, and explored sex as a potential factor given sex differences in childhood trauma exposure.

Methods. Eighty-three FEP participants (52 males, 31 females) and 69 nonclinical controls (49 males, 20 females) completed the CogState Research Battery. FEP participants completed the Childhood Trauma Questionnaire. A sex × group (FEP, controls) ANOVA examined ER differences and was followed by two-way ANCOVAs investigating sex and childhood trauma severity (none, low, moderate, severe) on ER and global cognition in FEP.

Results. FEP participants had significantly lower ER scores than controls (p = .035). No significant sex × group interaction emerged for ER $F(3, 147) = .496$, p = .438 [95% CI = -1.20-0.57], partial η^2 = .003. When controlling for age at psychosis onset, a significant interaction emerged in FEP between sex and childhood trauma severity $F(3, 71) = 3.173$, p = .029, partial η^2 = .118. Males (n=9) with severe trauma showed ER deficits compared to females (n=8) (p = .011 [95% CI = -2.90 - -0.39]). No significant interaction was observed for global cognition $F(3, 69) = 2.410$, p = .074, partial η^2 = .095.

Conclusions. These preliminary findings provide support for longitudinal investigations examining whether trauma severity differentially impacts ER in males and females with FEP.

Keywords child abuse, child neglect, psychoses, cognition, sex difference

Introduction

Longitudinal population-based investigations suggest that childhood trauma is a causal risk factor in psychosis development (e.g., Misiak et al., 2017; Stanton et al., 2020). Childhood trauma is characterized by exposure to situations that typically involve a breach of trust, and include physical, sexual, and emotional abuse, as well as physical and emotional neglect (Teicher & Samson, 2013). Individuals with childhood trauma histories exhibit a more severe form of illness, including debilitating psychotic and other clinical symptoms (e.g., visual, auditory, and tactile hallucinations, delusions, negative symptoms, depressive symptoms) (Bailey et al., 2018; Bentall et al., 2012; Garcia et al., 2016; Shevlin et al., 2007) and increased social functioning deficits (Cotter et al., 2014; Cotter et al., 2015; Lysaker et al., 2001; Stain et al., 2014). Social functioning is particularly relevant for youth, as deficits negatively impact social inclusion and vocational development, which can become harder to attain if not fostered during this critical period (Gardner et al., 2019; Killackey et al., 2006).

Social functioning is intrinsically linked with social cognition, which includes the neurocognitive processes that enable individuals to recognize, interpret, and use social information to form judgments and make decisions (Penn et al., 1997). A recent systematic review and meta-analysis observed a significant association between psychosocial function and social cognition, even once duration of untreated psychosis, length of illness, and symptom severity were accounted for (Cowman et al., 2021). Deficits are observed in all social cognitive sub-domains in individuals with first-episode psychosis (FEP) (Healey et al., 2016). Specific deficits in facial emotion recognition (ER), are considered a core feature of psychotic disorders and are evident during FEP (Barkl et al., 2014). Such deficits negatively impact quality of life and social/functional outcomes, and are associated with negative symptoms and poorer social

skills in more enduring phases of the illness (Couture et al., 2006; Fett et al., 2011; Irani et al., 2012; Maat et al., 2012).

Sex differences are also increasingly recognized across the psychosis spectrum as a determinant of clinical trajectory and outcome, though there is limited research examining sex or gender differences in the prevalence and potential effect of childhood trauma. Results from a recent narrative review (Comacchio et al., 2019) suggest that compared to males, females appear to be at greater risk of exposure to sexual abuse, and those with histories of childhood abuse tend to experience more suicide attempts, and increased positive and mood symptoms. Females with childhood abuse histories also appear to have an earlier age of psychosis onset compared to females without exposure to abuse. This relationship was not observed in males. Males, on the other hand, tend to display increased negative symptoms and substance abuse. According to Comacchio et al. (2019), there have been mixed results with respect to associations between sex or gender and cognition in psychosis; some studies have failed to observe significant associations while others have observed a decrease in males' cognitive performance compared to females.

With respect to ER capacity, deficits are reported compared to nonclinical controls (Andric Petrovic et al., 2019), however similarities are typically observed among the sexes across the psychosis spectrum (Mote & Kring, 2016). This is in contrast to findings in nonclinical populations, where males typically show ER deficits with respect to females (see review by Forni-Santos & Osório, 2015).

Taken together, the potential association between childhood trauma and ER capacity in FEP becomes an interesting research target. Additionally, though sex differences are largely unapparent in ER, given sex-specific experiences in childhood trauma (Comacchio et al., 2019), it remains to be clarified whether trauma impacts on ER differentially for males and females with FEP. Further, while traumatic events can vary in terms of severity, this is rarely considered in

research (Dauvermann & Donohoe, 2019). Considering that trauma severity is likely to differentially impact on brain function in individuals with major depressive disorder, posttraumatic stress disorder (PTSD), schizophrenia, and healthy individuals (Teicher et al., 2016), the influence of severity levels on cognition warrants investigation.

To our knowledge, at least six studies have investigated associations between childhood trauma and social cognition across the psychosis spectrum. Garcia et al. (2016) reported that in FEP, cumulative childhood trauma was negatively associated with emotion management capacity in both sexes when compared to healthy participants. Schalinski et al. (2018) observed that global social cognition was negatively associated with physical neglect experienced at age 11, and to cumulative adverse childhood experiences. Palmier-Claus et al. (2016) failed to observe a significant association between childhood trauma and theory of mind (ToM) ability. Authors instead observed that depression partially mediated the relation between adversity and social functioning. Mansueto et al. (2019) observed that in males only, ToM ability partially mediated the relationship between childhood neglect and negative symptoms, and fully mediated the association between childhood neglect and disorganization. Tognin et al. (2020) recently observed that in those at clinical high risk for psychosis (CHR), the presence of emotional abuse was associated with a decrease in ER performance. Participants also exhibited impaired recognition of neutral stimuli, while bullying was associated with increased ER performance. Finally, Quidé et al. (2021) found that decreased grey matter covariation in brain regions associated with ToM ability (i.e., posterior cingulate cortex/precuneus) was associated with increased inflammation in individuals with schizophrenia and low levels of childhood trauma exposure.

Only the study conducted by Tognin et al. (2020) examined the association between ER capacity and childhood trauma, and in a CHR sample. The current thus study aims to expand

upon these previous findings by exploring whether sex and trauma severity might be factors in the potential association between facial affect ER capacity and childhood trauma, following transition to a first-episode of psychosis. We first examined potential differences in FEP participants compared to non-clinical controls on ER capacity to establish a potential baseline ER deficiency. Non-clinical control participants were healthy individuals recruited from the local catchment area. Then, our primary objective was to conduct a preliminary investigation on associations between sex, childhood trauma severity level, and ER capacity in FEP. We hypothesized that among FEP participants, the presence of childhood trauma would be negatively associated with ER capacity and that associations would be the most pronounced in the severe trauma category. Sex was included as an exploratory variable. As a final step, we examined whether the hypothesized associations were selective to ER capacity, or present in global cognition more generally. Finally, given the paucity of research on this topic, we conducted an exploratory analysis on potential associations between sex and childhood trauma on multiple clinical dimensions.

Methods

Design and Participants

This cross-sectional study included 83 FEP participants (52 males, 31 females) recruited between 2003 and 2017 from the Prevention and Early Intervention Program for Psychosis of the Douglas Mental Health University Institute (DMHUI) located in Montréal, Canada (PEPP-Montréal; see Iyer et al., 2015 for further information). Participants were 16 to 35 years old, were within the first two years of a first episode of psychosis and had a diagnosis of nonaffective or affective psychosis. All participants had an IQ $\geq$ 70 and had not received prior neuroleptic treatment in the month preceding PEPP-Montréal admission. Exclusion criteria were traumatic brain injury and substance-induced psychosis.

Nonclinical controls (controls; 49 males, 20 females) were recruited from the same community of south-west Montréal and were matched with FEP participants on sex and age. Exclusion criteria for controls were history of an axis I disorder, traumatic brain injury or neurological disease, and first-degree family history of schizophrenia spectrum disorders.

All participants (FEP, control) completed an exhaustive demographic, diagnostic, and neurocognitive assessment. FEP participants additionally completed a clinical and functional assessment to better categorize the sample and to assess for potential confounding variables. All measures were administered approximately three months following entry to PEPP-Montréal (baseline). All participants provided written informed consent adhering to the DMHUI's research ethics board policies. A detailed methodology and assessment procedure is included in the online Supplement. Main study variables are described below.

Emotion Recognition Assessment

Cognition was assessed using the computerized CogState Research Battery (CRB). The primary cognitive outcome of interest was the Social Emotional Cognition Task (SECT) of the CRB. The SECT is a performance accuracy-based task assessing facial affect ER, or the emotional processing aspects of social cognition (**eFigure 1**, Supplement). The SECT contains 48 trials and represents three different types of stimuli, each conveying emotion for 15 seconds. The first consists of computer-generated male faces that portray various facial expressions. The second depicts pictures (at close range) of female and male eyes that are displaying typical emotions, and the third is a control task depicting eye gaze. Some trials involve discrimination between facial affect intensity for the same emotion (e.g., mild vs extreme fear), while others involve discrimination of facial affect presentations for different emotions (e.g., fear versus neutral expressions). Control average z-scores were employed as normative data to transform FEP participant data into z-scores and were computed for each cognitive domain. Negative

values represented a deficit with respect to controls. ER was represented by SECT z-scores and a global cognitive index was represented by averaging z-scores for the six remaining cognitive domains. The CRB has been validated for use in schizophrenia (Pietrzak et al., 2009). Convergent validity has been established between the SECT and the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) Consensus Cognitive Battery (MCCB) (Nuechterlein et al., 2008) social cognition domain (Lees et al., 2015). All participants (FEP, control) completed the CRB.

Childhood Trauma Assessment

The 28-item version of the Childhood Trauma Questionnaire (CTQ) (Bernstein et al., 2003) retrospectively assessed childhood trauma history. The CTQ is a self-report measure containing five subscales each with five items representing childhood abuse (emotional, sexual, physical) and neglect (emotional, physical) plus one minimizing subscale (three items). Items are rated on a five-point scale ranging from 1 ‘never true’ to 5 ‘very often true’. Items were recoded according to the scale’s instructions and summed to represent global scores for each abuse/neglect subscale, ranging from 5 to 25. The total score represents the sum of all five abuse/neglect subscales. Subscales were classified based on trauma severity (**eTable 2**, Supplement), where none represented ‘none to minimal’, low ‘low to moderate’, moderate ‘moderate to severe’, and severe ‘severe to extreme’ using established cut-offs (Bernstein & Fink, 1998). Overall trauma severity was then represented by the highest classification across each subscale. The CTQ has good internal consistency (Cronbach’s alpha (α) ranges from = .79-.94) (Bernstein et al., 1994), good test-retest reliability (ICCs = .88, .81) (Bernstein et al., 1994; Simpson et al., 2019), and is widely used in clinical populations (Bernstein et al., 2003). Internal consistency for the current study was acceptable (α = .65). Childhood trauma scores were

positively skewed and were log transformed to facilitate analyses. Only FEP participants completed the CTQ as control participants did not complete clinical assessment measures.

Statistical Analysis

Means, medians, standard deviations, percentages, and differences between males and females were calculated for demographic, clinical, and functional variables (**eTable 1** in the Supplement lists study variables). Analyses were performed using SPSS 26. Assumptions were verified, alpha levels were set at .05, and tests were two-tailed when appropriate.

Three preparatory steps were executed in anticipation of the main analyses investigating sex, ER capacity, and childhood trauma severity in FEP. In step 1, FEP participants were separated into two groups: 1) a none/minimal childhood trauma group (noCT), per the 'none to minimal' severity cut-off established by Bernstein and Fink (1998) (**eTable 2** displays severity cut-off ranges), and 2) a childhood trauma present group (CT), which included participants reporting low to severe levels of childhood trauma, per the three remaining severity cut-offs (low, moderate, severe). Step 1 was executed to assess for potential sex differences in demographic and clinical variables among FEP participants in the CT group. Chi-square tests, independent samples t-tests, and Mann-Whitney *U* tests were employed to this end.

In step 2, we ran correlational analyses between the SECT and the variables with significant sex differences (i.e., those identified in step 1). Correlational analyses were limited to the CT group and were run separately for males and females. Step 2 was executed to identify potential covariates (i.e., variables associated with ER capacity that may influence results in the main analyses). Variables were not required to survive Bonferroni correction to be considered a covariate (see statistical analyses, Supplement). The variable significantly correlating with the SECT (i.e., psychosis age at onset) was included in the main analyses.

In step 3, a two-way analysis of variance (ANOVA) assessed the potential effects of sex (male, female) and group (FEP, control) on ER capacity per the SECT. Step 3 was executed to examine whether ER deficits were present in the FEP group compared to the non-clinical control group. Then, in the FEP-only main analyses, childhood trauma severity was entered into a two-way analysis of covariance (ANCOVA) with the significant covariate (age at psychosis onset) to investigate the association between childhood trauma and ER capacity, with sex and trauma severity (none, low, moderate, severe) as factors. A second and final ANCOVA was then run using a global index of cognition as a control measure to examine whether associations were selective to ER capacity. Post-hoc simple effects tests were conducted to explore significant interactions. Bonferroni's correction for multiple comparisons was used for all tests when appropriate.

Results

Demographic data for the total sample is reported in **Table 1**. Data for all variables for FEP participants in the noCT and CT groups is presented in **Table 2**. Significant sex differences observed in the CT group are also displayed in **Table 2** (also see Supplementary results). Age at psychosis onset significantly correlated with the SECT for males only (*rho* = -.364, p = .048), and was considered a covariate (**eTable 3**, Supplement). **Table 3** reports percentages and differences in childhood trauma prevalence between male and female FEP participants per the CTQ subscales and total trauma scores. Nearly half (48.4%) of females and 59.6% of males reported some form of moderate-to-severe childhood trauma. Females reported significantly higher rates of sexual abuse (X^2 = 4.445, p = .035), which did not survive Bonferroni correction (.05/8 = .006). Results from independent samples t-tests revealed no statistically significant mean differences between males and females on any of the CTQ subscale scores or total score (all p's >.067).

An ANOVA evaluated sex and group (FEP, control) differences on ER capacity. A significant main effect emerged only for group, revealing ER impairment in FEP participants with respect to controls (p = .035). No significant sex × group interaction emerged for ER $F(3, 147) = .496$, $p = .438$ [95% CI = -1.20-0.57], partial $\eta^2 = .003$. An ANCOVA examining sex × childhood trauma severity in FEP revealed a statistically significant interaction for ER while controlling for age at psychosis onset, $F(3, 71) = 3.173$, $p = .029$, partial $\eta^2 = .118$. The interaction was decomposed as a function of childhood trauma severity; SECT group means were significantly different in males (n= 9) and females (n = 8) in the severe trauma group (p = .011 [95% CI = -2.90 - -0.39]), such that males exhibited ER deficits compared to females. No significant sex × childhood trauma severity interaction was observed for the global index of cognition when controlling for age at psychosis onset $F(3, 69) = 2.410$, $p = .074$, partial $\eta^2 = .095$. Post hoc analyses did not reveal significant main effects for sex and trauma severity groups (all p's > .47). ANCOVA results are presented in **Figure 1**.

Discussion

Associations between Sex, Childhood Trauma Severity, and ER Capacity

This study presents a novel association between sex and childhood trauma severity on ER capacity in individuals with FEP. Our results, while preliminary given the cross-sectional nature of the study design, suggest that severe trauma may effect ER capacity in males and females differently. We first assessed whether male and female FEP participants display ER deficits compared to nonclinical controls. We observed ER deficits in FEP compared to nonclinical controls, though no sex differences emerged, which replicates previous findings (Andric Petrovic et al., 2019). Concerning our primary hypotheses, the presence of childhood trauma was negatively associated with ER capacity, with the most pronounced deficits observed in the severe trauma category. We specifically observed an interaction effect between sex and trauma severity,

such that males with severe childhood trauma exhibited poorer ER capacity compared to females. Importantly, this interaction effect may be selective to ER given null findings across severity levels for the global index of cognition. A main limitation of this finding, however, is the very small number of males and females across trauma severity groups, though the overall sample size is comparable to similar studies (e.g., Garcia et al., 2016; Palmier-Claus et al., 2016).

This main finding broadly corroborates previous investigations suggesting that a history of childhood trauma negatively effects social cognition across the psychosis spectrum (Garcia et al., 2016; Schalinski et al., 2018; Tognin et al., 2020). We assessed whether trauma severity and sex might be factors in this association. Our results were in line with our hypotheses, and may more precisely describe the impact of this interaction on ER capacity, though this remains to be verified given the small sample size and cross-sectional nature of our study. Interestingly, while Garcia et al. (2016) observed that childhood trauma negatively affected social cognitive performance, no sex differences emerged. While the authors did not investigate the potential impact of trauma severity, this null finding may be related to other factors such as the assessment of emotion management in lieu of emotion recognition. Finally, our results were obtained while controlling for participants' age at psychosis onset, which presented as a potential confounding variable given its significant association with ER capacity. Males specifically had a younger age at psychosis onset, which is a routinely identified sex difference in the illness course of psychosis (e.g., Angermeyer & Kühnz, 1988). Males also showed significantly poorer childhood premorbid functioning and increased negative symptoms, which are also consistently reported (e.g., McGrath et al., 2004; Ochoa et al., 2012). These variables were not, however, included as covariates as they were not significantly associated with ER capacity.

The literature on social cognition in PTSD can perhaps help to clarify the sex difference we observed in ER capacity. A recent meta-analysis (Stevens & Jovanovic, 2019) identified

three studies examining ER deficits in females with childhood and other trauma types. Fonzo et al. (2010) reported that females with intimate partner violence-related PTSD showed hyperactivity and disconnection in affective and limbic sensory systems while processing threating emotional cues. They argued this hyperactivity of cognitive-appraisal networks in abuse-related PTSD may promote hypervigilance through an exaggerated sensitivity to contextual cues relating to past trauma. Comparably, Steuwe et al. (2014) found that in females with PTSD, a character's direct gaze, regardless of the expressed emotion, led to sustained activation within the superior colliculus/periaqueductal gray and locus coeruleus, a subcortical route of eye-contact processing, which can be interpreted as persistent activation of an inborn alarm system. Further, Nazarov et al. (2014) found that ER reaction time was not negatively affected by childhood trauma history in females. Finally, though research in psychiatric samples is limited, Nicol et al. (2014) reported deficits only in disgust recognition in a small predominantly female sample of individuals with borderline personality disorder. Thus, one interpretation for the sex difference we observed in ER capacity among males and females with FEP and severe trauma histories might be conceptualized as a form of hypervigilance or exaggerated risk assessment in females; a history of severe trauma may lead to an increased propensity to assess and remain attentive to interpreting risk from others' ques. This 'risk assessment' potentially extends to the close monitoring of how one's own behaviors are perceived.

The ER deficits we observed in males with severe childhood trauma have been similarly reported in other psychiatric samples. Russo et al. (2015) found ER impairments in a predominately male sample of individuals with bipolar disorder and childhood neglect histories. Additionally, Poljac et al. (2011) reported ER deficits in males with predominately sexual assault-related-PTSD. In interpreting these findings, it is important to consider how the presence

of severe childhood trauma may impact other emotion-related difficulties such as emotional numbing and avoidance. Interestingly, hyperarousal symptoms have been previously identified as the most robust predictor of emotional numbing (Litz et al., 1997). Perhaps emotional numbing is a factor contributing to the ER deficits we observed in males, particularly as this may be confused with, masked by, or may even be an underlying experience of negative symptoms. Our results support the general consensus that males with FEP exhibit increased negative symptomology compared to females. As such, negative symptoms, and perhaps anhedonia more precisely, may have compounded the association we observed between trauma severity and ER in males.

Thus, once considered in the context of the distinct ways that hypervigilance is theorized to be modulated by sex, it is perhaps unsurprising that females with severe childhood trauma histories may be proficient in recognizing other people's emotions while males with similar histories might be deficient. The theoretical risk assessment we observed in females may have conceivably contributed to improved accuracy to recognize emotions, whereas this same hypervigilance may have been more associated with emotional numbing or negative symptoms in males, contributing to deficits in ER.

Strengths and Limitations

This study has some important strengths. These include a thorough assessment protocol wherein data were collected by highly-trained clinical symptoms evaluators that received on-going supervision and were subject to quality control measures. Additionally, FEP participants formed a well-characterized and representative sample from a catchment area service. First-episode psychosis participants also had limited-to-no exposure to neuroleptic medications at intake. This study also has several important limitations. We did not collect data regarding gender. Given gender is a continuous expression of socially constructed behaviors, roles, etc.,

findings pertaining to social cognition would be more representative if gender were considered. Additionally, childhood trauma was assessed using the self-report Childhood Trauma Questionnaire, and as such, our analysis does not capture important information regarding timing, such as age of onset of the traumatic experience(s), duration, and chronicity. We also did not take assess participants' current stress levels (relating to their experience(s) of childhood trauma) during the ER task. Further, trauma severity levels were limited to a small sample size and thus our study was somewhat underpowered to adequately assess differences across the various abuse/neglect subscales. Results in the severe category should also be interpreted in this context. We did not assess childhood trauma history in the nonclinical control sample, and thus were unable to assess differences between groups (control, FEP) in this context. Finally, the cross-sectional and retrospective design limits the ability to draw casual inferences.

Implications and Conclusion

Social functioning is critical for young people and is drastically interrupted with the transition to psychosis. An ultimate goal of early intervention services is to improve such outcomes. Our novel results may inspire future examinations regarding whether the hypervigilance resulting from severe childhood trauma may moderate or mediate the association between trauma severity and emotion recognition capacity differentially for males and females. Such findings would contribute to the personalization of social cognitive and trauma-focused therapeutic services in first episode psychosis.

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Conference Presentations: This work was presented at the 29th European Congress of Psychiatry https://doi.org/10.1192/j.eurpsy.2021.443 and the 2021 Virtual Congress of the Schizophrenia International Research Society.

Declarations

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics Approval: This study and all of its associated procedures comply with the Research Ethics Board policies and standards of the Douglas Mental Health University Institute on human experimentation, and with the Helsinki Declaration of 1964 and its later amendments.

Consent to participate: All participants provided written informed consent adhering to the Douglas Mental Health University Institute's Research Ethics Board Policies. Additional written informed consent was provided by the parent/legal guardian of one minor participant.

Consent for publication: All authors have explicitly consented to publish this study

References

Andric Petrovic, S., Jerotic, S., Mihaljevic, M., Pavlovic, Z., Ristic, I., Soldatovic, I., & Maric, N. P. (2019). Sex differences in facial emotion recognition in health and psychotic disorders. *Cognitive neuropsychiatry*, *24*(2), 108-122.

Angermeyer, M. C., & Kühnz, L. (1988). Gender differences in age at onset of schizophrenia. *European archives of psychiatry and neurological sciences*, *237*(6), 351-364.

Bailey, T., Alvarez-Jimenez, M., Garcia-Sanchez, A. M., Hulbert, C., Barlow, E., & Bendall, S. (2018). Childhood trauma is associated with severity of hallucinations and delusions in psychotic disorders: a systematic review and meta-analysis. *Schizophrenia bulletin*, *44*(5), 1111-1122.

Barkl, S. J., Lah, S., Harris, A. W., & Williams, L. M. (2014). Facial emotion identification in early-onset and first-episode psychosis: a systematic review with meta-analysis. *Schizophrenia research*, *159*(1), 62-69.

Bentall, R. P., Wickham, S., Shevlin, M., & Varese, F. (2012). Do specific early-life adversities lead to specific symptoms of psychosis? A study from the 2007 the Adult Psychiatric Morbidity Survey. *Schizophrenia bulletin*, *38*(4), 734-740.

Bernstein, D., & Fink, L. (1998). Manual for the childhood trauma questionnaire. *New York: The Psychological Corporation*.

Bernstein, D., Fink, L., Handelsman, L., Foote, J., Lovejoy, M., Wenzel, K., . . . Ruggiero, J. (1994). Initial reliability and validity of a new retrospective measure of child abuse and neglect. *The American journal of psychiatry*.

Bernstein, D. P., Stein, J. A., Newcomb, M. D., Walker, E., Pogge, D., Ahluvalia, T., . . . Desmond, D. (2003). Development and validation of a brief screening version of the Childhood Trauma Questionnaire. *Child abuse & neglect*, *27*(2), 169-190.

Comacchio, C., Lasalvia, A., & Ruggeri, M. (2019). Current evidence of childhood traumatic experiences in psychosis–focus on gender differences. *Psychiatry research*, *281*, 112507.

Cotter, J., Drake, R. J., Bucci, S., Firth, J., Edge, D., & Yung, A. R. (2014). What drives poor functioning in the at-risk mental state? A systematic review. *Schizophrenia research*, *159*(2-3), 267-277.

Cotter, J., Kaess, M., & Yung, A. (2015). Childhood trauma and functional disability in psychosis, bipolar disorder and borderline personality disorder: a review of the literature. *Irish Journal of Psychological Medicine*, *32*(1), 21-30.

Couture, S. M., Penn, D. L., & Roberts, D. L. (2006). The functional significance of social cognition in schizophrenia: a review. *Schizophrenia bulletin*, *32*(suppl_1), S44-S63.

Cowman, M., Holleran, L., Lonergan, E., O'Connor, K., Birchwood, M., & Donohoe, G. (2021). Cognitive predictors of social and occupational functioning in early psychosis: A systematic review and meta-analysis of cross-sectional and longitudinal data. *Schizophrenia bulletin*, *47*(5), 1243-1253.

Dauvermann, M. R., & Donohoe, G. (2019). The role of childhood trauma in cognitive performance in schizophrenia and bipolar disorder–A systematic review. *Schizophrenia Research: Cognition*, *16*, 1-11.

Fett, A.-K. J., Viechtbauer, W., Penn, D. L., van Os, J., & Krabbendam, L. (2011). The relationship between neurocognition and social cognition with functional outcomes in schizophrenia: a meta-analysis. *Neuroscience & Biobehavioral Reviews*, *35*(3), 573-588.

Fonzo, G. A., Simmons, A. N., Thorp, S. R., Norman, S. B., Paulus, M. P., & Stein, M. B. (2010). Exaggerated and disconnected insular-amygdalar blood oxygenation level-dependent response to threat-related emotional faces in women with intimate-partner violence posttraumatic stress disorder. *Biological psychiatry*, *68*(5), 433-441.

Forni-Santos, L., & Osório, F. L. (2015). Influence of gender in the recognition of basic facial expressions: A critical literature review. *World Journal of Psychiatry*, *5*(3), 342.

Garcia, M., Montalvo, I., Creus, M., Cabezas, Á., Solé, M., Algora, M. J., . . . Labad, J. (2016). Sex differences in the effect of childhood trauma on the clinical expression of early psychosis. *Comprehensive psychiatry*, *68*, 86-96.

Gardner, A., Cotton, S. M., Allott, K., Filia, K. M., Hester, R., & Killackey, E. (2019). Social inclusion and its interrelationships with social cognition and social functioning in first-episode psychosis. *Early intervention in psychiatry*, *13*(3), 477-487.

Healey, K. M., Bartholomeusz, C. F., & Penn, D. L. (2016). Deficits in social cognition in first episode psychosis: a review of the literature. *Clinical psychology review*, *50*, 108-137.

Irani, F., Seligman, S., Kamath, V., Kohler, C., & Gur, R. C. (2012). A meta-analysis of emotion perception and functional outcomes in schizophrenia. *Schizophrenia research*, *137*(1-3), 203-211.

Iyer, S., Jordan, G., MacDonald, K., Joober, R., & Malla, A. (2015). Early intervention for psychosis: a Canadian perspective. *The Journal of nervous and mental disease*, *203*(5), 356-364.

Killackey, E. J., Jackson, H. J., Gleeson, J., Hickie, I. B., & McGorry, P. D. (2006). Exciting career opportunity beckons! Early intervention and vocational rehabilitation in first-episode psychosis: employing cautious optimism. *Australian & New Zealand Journal of Psychiatry*, *40*(11-12), 951-962.

Lees, J., Applegate, E., Emsley, R., Lewis, S., Michalopoulou, P., Collier, T., . . . Drake, R. J. (2015). Calibration and cross-validation of MCCB and CogState in schizophrenia. *Psychopharmacology*, *232*(21-22), 3873-3882.

Litz, B. T., Schlenger, W. E., Weathers, F. W., Caddell, J. M., Fairbank, J. A., & LaVange, L. M. (1997). Predictors of emotional numbing in posttraumatic stress disorder. *Journal of Traumatic Stress*, *10*(4), 607-618.

Lysaker, P. H., Meyer, P. S., Evans, J. D., Clements, C. A., & Marks, K. A. (2001). Childhood sexual trauma and psychosocial functioning in adults with schizophrenia. *Psychiatric Services*, *52*(11), 1485-1488.

Maat, A., Fett, A.-K., Derks, E., & Investigators, G. (2012). Social cognition and quality of life in schizophrenia. *Schizophrenia research*, *137*(1-3), 212-218.

Mansueto, G., Schruers, K., Cosci, F., van Os, J., Alizadeh, B. Z., Bartels-Velthuis, A. A., . . . de Haan, L. (2019). Childhood adversities and psychotic symptoms: the potential mediating or moderating role of neurocognition and social cognition. *Schizophrenia research*, *206*, 183-193.

McGrath, J., Saha, S., Welham, J., El Saadi, O., MacCauley, C., & Chant, D. (2004). A systematic review of the incidence of schizophrenia: the distribution of rates and the influence of sex, urbanicity, migrant status and methodology. *BMC medicine*, *2*(1), 13.

Misiak, B., Krefft, M., Bielawski, T., Moustafa, A. A., Sąsiadek, M. M., & Frydecka, D. (2017). Toward a unified theory of childhood trauma and psychosis: a comprehensive review of epidemiological, clinical, neuropsychological and biological findings. *Neuroscience & Biobehavioral Reviews*, *75*, 393-406.

Mote, J., & Kring, A. M. (2016). Facial emotion perception in schizophrenia: Does sex matter? *World journal of psychiatry*, *6*(2), 257.

Nazarov, A., Frewen, P., Parlar, M., Oremus, C., MacQueen, G., McKinnon, M., & Lanius, R. (2014). Theory of mind performance in women with posttraumatic stress disorder related to childhood abuse. *Acta Psychiatrica Scandinavica*, *129*(3), 193-201.

Nicol, K., Pope, M., & Hall, J. (2014). Facial emotion recognition in borderline personality: an association, with childhood experience. *Psychiatry research*, *218*(1-2), 256-258.

Nuechterlein, K. H., Green, M. F., Kern, R. S., Baade, L. E., Barch, D. M., Cohen, J. D., . . . Gold, J. M. (2008). The MATRICS Consensus Cognitive Battery, part 1: test selection, reliability, and validity. *American Journal of Psychiatry*, *165*(2), 203-213.

Ochoa, S., Usall, J., Cobo, J., Labad, X., & Kulkarni, J. (2012). Gender differences in schizophrenia and first-episode psychosis: a comprehensive literature review. *Schizophrenia research and treatment*, *2012*.

Palmier-Claus, J., Berry, K., Darrell-Berry, H., Emsley, R., Parker, S., Drake, R., & Bucci, S. (2016). Childhood adversity and social functioning in psychosis: exploring clinical and cognitive mediators. *Psychiatry research*, *238*, 25-32.

Penn, D. L., Corrigan, P. W., Bentall, R. P., Racenstein, J., & Newman, L. (1997). Social cognition in schizophrenia. *Psychological bulletin*, *121*(1), 114.

Pietrzak, R. H., Olver, J., Norman, T., Piskulic, D., Maruff, P., & Snyder, P. J. (2009). A comparison of the CogState Schizophrenia Battery and the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) Battery in assessing cognitive impairment in chronic schizophrenia. *Journal of Clinical and Experimental Neuropsychology*, *31*(7), 848-859. https://doi.org/10.1080/13803390802592458

Poljac, E., Montagne, B., & de Haan, E. H. (2011). Reduced recognition of fear and sadness in post-traumatic stress disorder. *Cortex*, *47*(8), 974-980.

Quidé, Y., Bortolasci, C. C., Spolding, B., Kidnapillai, S., Watkeys, O. J., Cohen-Woods, S., . . . Green, M. J. (2021). Systemic inflammation and grey matter volume in schizophrenia and bipolar disorder: moderation by childhood trauma severity. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *105*, 110013.

Russo, M., Mahon, K., Shanahan, M., Solon, C., Ramjas, E., Turpin, J., & Burdick, K. E. (2015). The association between childhood trauma and facial emotion recognition in adults with bipolar disorder. *Psychiatry research*, *229*(3), 771-776.

Schalinski, I., Teicher, M. H., Carolus, A. M., & Rockstroh, B. (2018). Defining the impact of childhood adversities on cognitive deficits in psychosis: an exploratory analysis. *Schizophrenia research*, *192*, 351-356.

Shevlin, M., Dorahy, M., & Adamson, G. (2007). Childhood traumas and hallucinations: an analysis of the National Comorbidity Survey. *Journal of psychiatric research*, *41*(3-4), 222-228.

Simpson, S., Phillips, L., Baksheev, G., Garner, B., Markulev, C., Phassouliotis, C., . . . Bendall, S. (2019). Stability of retrospective self-reports of childhood trauma in first-episode psychosis. *Early intervention in psychiatry*, *13*(4), 908-913.

Stain, H. J., Brønnick, K., Hegelstad, W. T., Joa, I., Johannessen, J. O., Langeveld, J., . . . Larsen, T. K. (2014). Impact of interpersonal trauma on the social functioning of adults with first-episode psychosis. *Schizophrenia bulletin*, *40*(6), 1491-1498.

Stanton, K. J., Denietolis, B., Goodwin, B. J., & Dvir, Y. (2020). Childhood trauma and psychosis: an updated review. *Child and Adolescent Psychiatric Clinics*, *29*(1), 115-129.

Steuwe, C., Daniels, J. K., Frewen, P. A., Densmore, M., Pannasch, S., Beblo, T., . . . Lanius, R. A. (2014). Effect of direct eye contact in PTSD related to interpersonal trauma: an fMRI study of activation of an innate alarm system. *Social cognitive and affective neuroscience*, *9*(1), 88-97.

Stevens, J. S., & Jovanovic, T. (2019). Role of social cognition in post-traumatic stress disorder: A review and meta-analysis. *Genes, Brain and Behavior*, *18*(1), e12518.

Teicher, M. H., & Samson, J. A. (2013). Childhood maltreatment and psychopathology: A case for ecophenotypic variants as clinically and neurobiologically distinct subtypes. *American journal of psychiatry*, *170*(10), 1114-1133.

Teicher, M. H., Samson, J. A., Anderson, C. M., & Ohashi, K. (2016). The effects of childhood maltreatment on brain structure, function and connectivity. *Nature Reviews Neuroscience*, *17*(10), 652.

Tognin, S., Catalan, A., Modinos, G., Kempton, M. J., Bilbao, A., Nelson, B., . . . Barrantes-Vidal, N. (2020). Emotion Recognition and Adverse Childhood Experiences in Individuals at Clinical High Risk of Psychosis. *Schizophrenia bulletin*, *46*(4), 823-833.

Table 1

Sociodemographic Characteristics and Emotion Recognition in Nonclinical Controls and FEP Participants

	Nonclinical Controls, N=69		FEP Participants, N=83		Diff. Controls & FEP	
Variable	Males, N=49	Females, N=20	Males, N=52	Females, N=31	Statistic	*p*
Mean (SD)						
Age	24.98 (6.81)	24.55 (5.90)	24.04 (5.15)	24.87 (5.30)	U = 5336.000	.655
Education (yrs.)	13.49 (2.05)	13.47 (1.87)	11.92 (2.72)	13.10 (2.24)	t = -3.726	.000
IQ	114.59 (12.47)	105.45 (13.40)	102.38 (13.25)	100.00 (12.43)	t = -6.452	.000
Social Emotional Cognition Task [a]	-.00 (1.07)	-.21 (1.29)	-.64 (1.46)	-.53 (1.27)	f = 4.506	.035
N (%)						
Socioeconomic status [b]		n = 19	n = 43	n = 26	X^2 = 28.14	.000
Upper	6 (12.3)	1 (5)	2 (4.7)	0 (0)		
Upper-Middle	15 (30.6)	2 (15)	1 (2.3)	2 (7.7)		
Middle	15 (30.6)	9 (45)	12 (27.9)	4 (15.4)		
Lower-Middle	11 (22.4)	5 (25)	20 (46.5)	9 (34.6)		
Lower	2 (4.1)	2 (10)	8 (18.6)	11 (42.3)		

Note. IQ = per the Wechsler Abbreviated Scale of Intelligence/abbreviated Wechsler Adult Intelligence Scale; Diff. Controls and FEP: males and females were combined to assess differences in demographic variables and emotion recognition; [a] = z-scores per the CogState Research Battery, [b] socioeconomic status, subsamples are reported for female nonclinical controls and for FEP participants due to incomplete data.

Table 2

FEP Participant Characteristics With and Without Childhood Trauma, and Sex Differences in Childhood Trauma

Variable	α	*n* noCT M(F)	Males noCT N=21	Females noCT N=16	*n* CT M(F)	Males CT N=31	Females CT N=15	Sex Diff. CT Group Statistic	*p*
M (SD)									
Age		21 (16)	24.33 (6.00)	25.00 (4.69)	31 (15)	23.84 (4.60)	24.73 (6.05)	U = 221.000	.786
Education (y)		21 (16)	12.24 (2.68)	12.94 (2.29)	31 (15)	11.71 (2.77)	13.27 (2.25)	t = -1.892	.065
Age at onset [a]		21 (16)	21.21 (3.68)	21.96 (6.33)	30 (14)	21.66 (5.02)	25.17 (5.34)	X^2 = 123.000	.028[c]
SAPS	.91	18 (15)	3.11 (4.02)	1.80 (2.57)	29 (15)	4.21 (3.43)	3.33 (3.18)	U = 179.000	.873
SANS	.90	18 (15)	8.28 (3.83)	5.27 (2.96)	29 (15)	8.59 (3.41)	5.07 (3.64)	t = 3.163	.003[c]*
CDS	.79	18 (15)	2.72 (2.76)	1.80 (2.43)	28 (15)	2.29 (3.18)	2.20 (2.98)	U = 204.000	.873
HAM-A	.84	17 (13)	4.29 (5.48)	6.08 (7.10)	25 (13)	4.48 (5.09)	6.15 (5.54)	U = 140.000	.496
Childhood PAS		14 (10)	.19 (.08)	.16 (.08)	17 (9)	.26 (.14)	.13 (.08)	U = 29.000	.010[c]*
Early Ado PAS		13 (9)	.30 (.10)	.22 (.14)	14 (10)	.30 (.17)	.18 (.11)	U = 37.500	.055
GAF		18 (15)	54.83 (18.63)	65.73 (9.70)	29 (15)	51.34 (14.76)	58.80 (12.65)	t = -1.664	.104
SOFAS		20 (15)	39.85 (11.09)	39.40 (8.94)	30 (15)	40.70 (14.36)	43.00 (10.78)	U = 187.500	.365
Full-scale IQ		21 (16)	104.67 (14.76)	97.75 (14.45)	31 (15)	100.84 (12.13)	102.40 (9.78)	t = -.434	.666
SECT		21 (16)	-.30 (1.92)	-.88 (1.28)	31 (15)	-.86 (1.04)	-.15 (1.17)	t = -2.077	.044[c]
Global Cog		21 (16)	-.45 (.46)	-.71 (.66)	31 (15)	-.61 (.49)	-.37 (.48)	t = -1.619	.113
Median (SD)									
DUP		18 (15)	30.31 (69.61)	20.07 (105.83)	29 (15)	21.43 (101.20)	18.29 (239.92)	U = 209.000	.833
DUI		18 (15)	256.86 (341.59)	256.64 (239.33)	29 (15)	296.86 (280.85)	386.00 (322.74)	U = 188.000	.697
N (%) [b]									
Visible minority		21 (16)	13 (61.9)	9 (56.2)	27 (14)	10 (32.2)	6 (40)	X^2 = 5.424	.491
SES		16 (12)						X^2 = 3.343	.342
Upper			2 (12.5)	0 (0)		0 (0)	0 (0)		

Upper-Middle		0 (0)	0 (0)		1 (3.7)	2 (14.3)		
Middle		3 (18.8)	2 (16.7)		9 (33.3)	2 (14.3)		
Lower-Middle		9 (56.3)	4 (33.3)		11 40.7)	5 (35.7)		
Lower		2 (12.5)	6 (50)		6 (22.2)	5 (35.7)		
Psychosis	21 (16)			30 (15)			X^2 = .054	.816
Nonaffective		16 (76.2)	14 (87.5)		21 (70)	11 (73.3)		
Affective		5 (23.8)	2 (12.5)		9 (30)	4 (26.7)		
Drug abuse	20 (15)	11 (55)	3 (20)	30 (15)	10 (33.4)	2 (13.3)	X^2 = 7.000	.072
Alcohol abuse	20 (15)	3 (15)	0 (0)	31 (15)	3 (10.3)	2 (13.3)	X^2 = .623	.732
Antipsychotic	20 (16)	20 (100)	15 (93.8)	31 (15)	27 (87.1)	12 (80)	X^2 = .395	.530
Antidepressant	18 (11)	3 (15.8)	3 (27.3)	27 (11)	6 (22.2)	1 (9.1)	X^2 = .897	.344

Note. Before conducting the main analysis assessing the association between childhood trauma severity and emotion recognition capacity in males and females with first-episode psychosis, the sample was first categorized into 'none/minimal' and 'yes' childhood trauma categories. This was done to assess for potential sex differences in demographic and clinical variables that could then be correlated with emotion recognition to identify potential confounding variables in the main analyses. Potentially confounding variables were then added as a covariate in the main analysis of variance; α = Cronbach's alpha; noCT = no/minimal childhood trauma per Childhood Trauma Questionnaire; CT = moderate to severe childhood abuse/neglect; (y) = years; [a] = age at psychosis onset; [b] = percentage rating yes; see Supplemental Table 1 for severity rating scores representing no/low and moderate to severe childhood trauma; IQ = per the Wechsler Abbreviated Scale of Intelligence/abbreviated Wechsler Adult Intelligence Scale; SECT = emotion recognition per Social Emotional Cognition Task z-scores, CogState Research Battery (CRB); Global Cog = global cognitive index per average of verbal, visual, and working memory, attention, executive functioning, processing speed z-scores, CRB; DUP/DUI = duration of untreated psychosis/illness; SES = socioeconomic status per Hollingshead Four-Factor Index of Social Status; Drug/Alcohol abuse = Drug Use Scale, Alcohol Use Scale; SAPS = Scale for the Assessment of Positive Symptoms, sum of global scores; SANS = Scale for the Assessment of Negative Symptoms, sum of global scores without attention given it does not load strongly on negative symptom clusters; CDS = Calgary Depression Scale, total score; HAM-A = Hamilton Anxiety Scale, total score; Childhood PAS = Premorbid Adjustment Scale, childhood subscale total score; Early Ado PAS = early adolescence subscale total score; GAF = Global Assessment of Functioning scale; SOFAS = Social and Occupational Functioning Assessment Scale at PEPP entry; Bonferroni correction; X^2 = .05/8 = .006, U = .05/9 = .006, t = .05/5 = .01; [c] = statistically significant sex differences; *survived Bonferroni correction.

Table 3

Sex Differences in Moderate-to-Severe Childhood Trauma Among FEP Participants

Trauma type	Total N (%)[a]	Males n (%) [a]	Females n (%) [a]	X^2	*p*	All participants M (SD) [range]	Males M (SD)	Females M (SD)	*t*	*p*
Phy Ab	11 (13.3)	8 (15.4)	3 (9.7)	.550	.458	6.78 (2.85) [5-18]	6.75 (2.84)	6.84 (2.91)	*t* = .047	.963
Sex Ab	19 (22.9)	8 (15.4)	11 (35.5)	4.445	.035[b]	6.93 (3.90) [5-25]	6.29 (3.06)	8.00 (4.99)	*t* = 1.873	.067
Em Ab	24 (28.9)	12 (23.1)	12 (38.7)	2.309	.129	10.17 (5.41) [5-25]	9.48 (4.81)	11.32 (6.19)	*t* = -1.265	.231
Phy Ng	23 (27.7)	17 (32.7)	6 (19.4)	1.725	.189	7.73 (2.75) [5-17]	7.92 (2.78)	7.42 (2.71)	*t* = .884	.401
Em Ng	18 (21.7)	12 (23.1)	6 (19.4)	.158	.691	10.82 (4.46) [5-23]	11.06 (4.25)	10.42 (4.85)	*t* = .909	.366
Total Ab	34 (41.0)	20 (38.5)	14 (45.2)	.360	.548	23.88 (10.06) [15-59]	22.52 (8.15)	26.16 (12.45)	*t* = -1.170	.246
Total Ng	38 (45.8)	25 (48.1)	13 (41.9)	.295	.587	18.55 (6.61) [10-40]	18.98 (6.45)	17.84 (6.92)	*t* = .970	.335
Total CT	46 (55.4)	31 (59.6)	15 (48.4)	.991	.319	42.43 (14.76) [25-95]	41.50 (12.66)	44.00 (17.87)	*t* = -.400	.690

Note. Total N = 83, males n= 52, females n= 31; Phy = Physical; Em = Emotional; Ab = abuse; Ng = neglect; CT = childhood trauma; assessed retrospectively per the Childhood Trauma Questionnaire, mean differences calculated and reported using log-transformed variables, means and standard deviations = untransformed data; [a] = percentage moderate-severe childhood trauma; [b] = statistically significant result not surviving Bonferroni correction (.05/8 = .006).

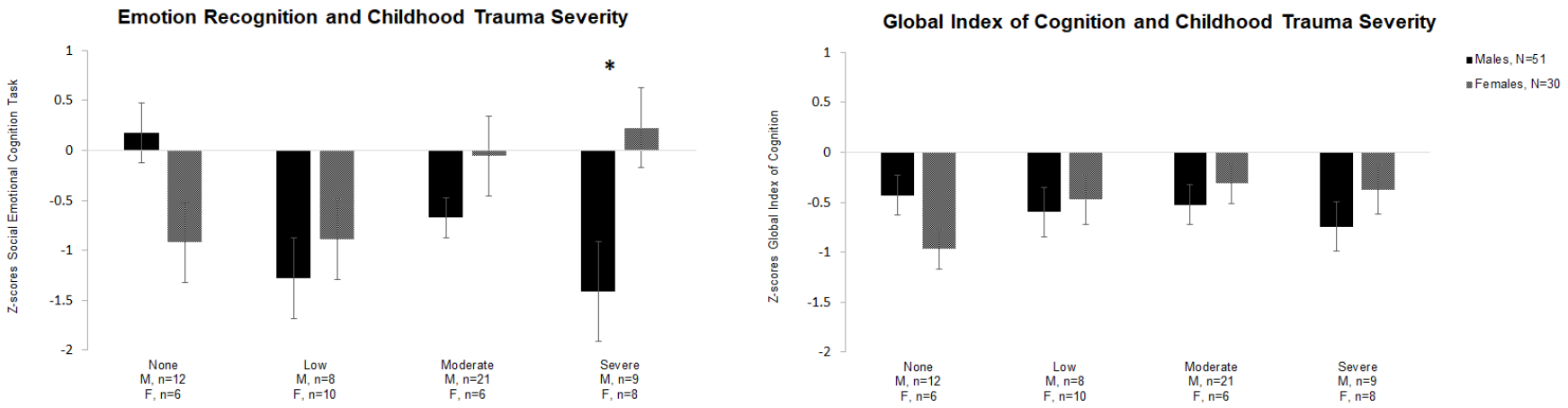


Figure Legend

Fig. 1 Significant interaction effects (*) of sex and childhood trauma severity on ER z-scores controlling for age at psychosis onset, F = 3.173; *p* = .029. Simple effects analyses surviving Bonferroni correction revealed a specific sex difference in the severe group as a function of trauma severity (*p* = .011; [95% CI = -2.90 - -0.39]). No significant interaction, F = 2.410; *p* = .074, or main effects for either sex or trauma severity emerged for the global index of cognition z-scores (all *p*'s > .47)

Online Supplement

Penney, D., Pruessner, M., Malla, A.K., et al. Severe Childhood Trauma Differentially Impacts Emotion Recognition in Males and Females with First-Episode Psychosis

Supplemental Method

Design and Participants

Participants were recruited from a larger sample receiving services from the Prevention and Early Intervention Program for Psychosis of the Douglas Mental Health University Institute (DMHUI) located in Montréal, Canada (PEPP-Montréal). PEPP-Montréal is an early intervention program servicing individuals presenting with FEP from a catchment area of 300,000 people. Embedded in the program is a naturalistic longitudinal outcome study of FEP participants, aged 16 to 35 years, with a diagnosis of nonaffective or affective psychosis, an IQ ≥ 70, no prior neuroleptic treatment in the month preceding PEPP-Montréal admission. In the current subsample of PEPP participants, all were within the first two years of a first episode of psychosis. Exclusion criteria were traumatic brain injury and substance-induced psychosis. Please see Iyer et al. (2015) for more information on Canadian Early Intervention Services such as PEPP- Montréal. FEP participant data were included if individuals had consented to research and had completed emotion recognition and childhood trauma measures. Assessments were administered as part of either a clinical or neuropsychological evaluation approximately three months following PEPP-Montréal entry (baseline). Assessments were performed by multiple research staff over the course of this 15-year period, but none were involved with treatment. All research staff received extensive training and ongoing supervision. Yearly inter-rater reliability sessions served as continuing education and were conducted to calculate intraclass correlations (ICCs). The ICCs were consistent over the course of data collection (from 0.73 - 0.80 for the assessment of positive symptoms, 0.62 - 0.71 for negative symptoms) indicating moderate-to-good reliability.

Nonclinical controls (controls; 49 males, 20 females) were recruited via on-line, newspaper, and paper-based advertisements from the same community of south-west Montréal

and were matched with FEP participants on sex and age. Exclusion criteria for controls were history of an axis I disorder, traumatic brain injury or neurological disease, and first-degree family history of schizophrenia spectrum disorders. Given the focus of the present study is on investigating the potential relationship between emotion recognition and childhood trauma severity in first-episode psychosis, the role of control participants in the current analyses was to act as a normative sample with respect to neurocognitive measures. Thus, control participants did not complete clinical assessments nor the measure of childhood trauma.

All participants (FEP, controls) were compensated equally and received $25 CAN for each 2-hour evaluation. Control participants completed the evaluation in one session whereas FEP participants averaged two sessions. All participants provided written informed consent adhering to the DMHUI's research ethics board policies. Additional written informed consent was provided by the parent/legal guardian of one minor participant.

Research Assessment

A comprehensive list of variables of interest and their associated assessment measure is presented in **eTable 1**.

Diagnostic and Demographic Assessment

Diagnoses were established using the Structured Clinical Interview for DSM-IV-TR axis I disorders (First et al., 2002) at baseline and confirmed through consensus with two senior psychiatrists (A.M. & R.J.). Duration of untreated illness and untreated psychosis were calculated in weeks and were based, along with the age at psychosis onset, on the Circumstances of Onset and Relapse Schedule (Norman et al., 2004). Participants reported their biological sex, age, education, and ethnicity. Socio-economic status was calculated using the Hollingshead Four-Factor Index of Social Status (Hollingshead, 1975).

Neuropsychological and Cognitive Assessment

IQ was estimated using the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1997a) or an abbreviated version of the Wechsler Adult Intelligence Scale (Wechsler, 1997). Global cognition was assessed using the computerized CogState Research Battery (CRB). The CRB evaluates the same cognitive dimensions assessed by the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) Consensus Cognitive Battery (MCCB; Pietrzak et al., 2009), and includes verbal, visual and working memory, attention, executive functioning, processing speed, and social cognition (i.e., emotion recognition, see below). Control average z-scores were employed as normative data to transform FEP participant data into z-scores and were computed for each cognitive domain. Negative values represented a deficit relative to controls. A global cognitive index was created by averaging z-scores for the six cognitive domains (excluding social cognition given that emotion recognition is a primary outcome).

Emotion Recognition. The primary neurocognitive outcome of interest was the Social Emotional Cognition Task (SECT) of the CRB (see **eFigure 1**). The SECT is a performance accuracy-based task assessing the social cognitive sub-domain of emotion recognition. Four pictures are presented on the screen, with one varying slightly. Participants must identify which picture is unlike the others by 'tapping the odd one out'. More specifically, the SECT contains 48 trials represent by three different types of stimuli, each conveying an emotion for 15 seconds. The first consists of computer-generated male faces that portray various facial expressions. The second depicts pictures (at close range) of female and male eyes that are displaying typical emotions, and the third is a control task depicting eye gaze. Some trials involve discrimination between facial affect intensity for the same emotion (e.g., mild vs extreme fear), while others involve discrimination of facial affect presentations for different emotions (e.g., fear versus neutral expressions). A score is derived using an arcsine transformation of the square root of the

proportion of correct trials. Emotion recognition was represented by SECT z-scores, again where negative values represented a deficit relative to controls.

FEP participant Clinical and Functioning Assessment

FEP Participants completed an exhaustive clinical assessment; drug and alcohol dependence/abuse (yes/no) were evaluated using the Drug Use Scale (DUS) and the Alcohol Use Scale (AUS; Drake et al., 1996). Depressive symptoms were rated using total scores on the Calgary Depression Scale (CDS; Addington et al., 1990) and anxiety with total scores on the Hamilton Anxiety Scale (HAM-A; Hamilton, 1959). Psychotic symptoms were rated using global score totals on the Scale for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984b) and the Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1984a) with the global score for attention excluded given it does not load strongly on negative symptom clusters (Malla et al., 2002). Functioning was measured using the Global Assessment of Functioning (GAF) scale for DSM-IV-TR and the Social and Occupational Functioning Assessment Scale (SOFAS; Morosini et al., 2000). Premorbid functioning during childhood and early adolescence was assessed using the Premorbid Adjustment Scale (PAS; van Mastrigt & Addington, 2002).

FEP Participant Childhood Trauma Assessment

The 28-item version of the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 2003) retrospectively assessed childhood trauma history. The CTQ is a self-report measure containing five subscales each with five items representing childhood abuse (emotional, sexual, physical) and neglect (emotional, physical) plus one minimizing subscale (three items). Items are rated on a five-point scale ranging from 1 ‘never true’ to 5 ‘very often true’. Items were recoded according to the scale’s instructions and summed to represent global scores for each abuse/neglect subscale, ranging from 5 to 25. The total score represents the sum of all five

abuse/neglect subscales and ranges from 25 to 125. Subscales were classified based on trauma severity, where none represented 'none to minimal', low 'low to moderate', moderate 'moderate to severe', and severe 'severe to extreme' using established cut-offs (Bernstein & Fink, 1998). **eTable 2** provides cut off severity values for each abuse/neglect subscale. Overall trauma severity was then represented by the highest classification across each subscale. Internal consistency was acceptable at $\alpha = .65$.

Statistical Analysis

Exploration for Potential Confounds

Before categorizing the FEP sample into trauma severity categories, we separated the sample into 1) no/minimal childhood trauma (noCT), and 2) childhood trauma present (CT) groups. Chi-square tests, independent samples t-tests, and Mann-Whitney *U* tests then explored mean sex differences for all variables for FEP participants in the CT group. Variables that were significantly different between the sexes in the CT group were then correlated with the SECT, by sex, to identify variables associated with emotion recognition that could potentially influence results in the main analyses. Variables were not required to survive Bonferroni correction to be considered a covariate. The variable significantly correlating with the SECT (age at psychosis onset) was included in the main analyses investigating emotion recognition in FEP.

Results

Identification of Potential Confounds

Manuscript **Table 2** presents data for all variables for FEP participants in the noCT and CT groups. In the CT group, males showed significantly higher rates of negative symptoms ($t = 3.163$, $p = .003$), an earlier age at psychosis onset ($t = -2.118$, $p = .040$), poorer emotion recognition ($t = -2.077$, $p = .044$), and poorer childhood premorbid functioning (males, Mdn =

16.29 ; females, Mdn = 8.22, U = 29.000, p = .010) compared to females. Only the SANS variable survived Bonferroni correction (X^2 = .05/8 = .006, U = .05/9 = .006, t = .05/6 = .008). Age at psychosis onset, childhood PAS, and SANS variables were then correlated with the SECT, by sex, for the childhood trauma group to identify potential confounds (**eTable 3**). Age at psychosis onset significantly correlated with the SECT for males only (*rho* = -.364, p = .048), and was considered a covariate.

References

Addington, D., Addington, J., & Schissel, B. (1990). A depression rating scale for schizophrenics. *Schizophrenia Research*, *3*(4), 247-251. https://doi.org/10.1016/0920-9964(90)90005-r

Andreasen, N. C. (1984a). *Scale for the assessment of negative symptoms (SANS)*. Department of Psychiatry, College of Medicine, The University of Iowa.

Andreasen, N. C. (1984b). *Scale for the assessment of positive symptoms (SAPS)*. University of Iowa Iowa City.

Bernstein, D., & Fink, L. (1998). Manual for the childhood trauma questionnaire. *New York: The Psychological Corporation*.

Bernstein, D. P., Stein, J. A., Newcomb, M. D., Walker, E., Pogge, D., Ahluvalia, T., . . . Desmond, D. (2003). Development and validation of a brief screening version of the Childhood Trauma Questionnaire. *Child abuse & neglect*, *27*(2), 169-190.

Drake, R., Mueser, K., & McHugo, G. (1996). Clinician rating scales: alcohol use scale (AUS), drug use scale (DUS), and substance abuse treatment scale (SATS). *Outcomes assessment in clinical practice*, *113*(6).

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. (2002). *Structured clinical interview for DSM-IV-TR axis I disorders, research version, patient edition*.

Hamilton, M. (1959). The assessment of anxiety states by rating. *British journal of medical psychology*.

Hollingshead, A. B. (1975). Four factor index of social status.

Iyer, S., Jordan, G., MacDonald, K., Joober, R., & Malla, A. (2015). Early intervention for psychosis: a Canadian perspective. *The Journal of nervous and mental disease*, *203*(5), 356-364.

Malla, A. K., Takhar, J. J., Norman, R. M., Manchanda, R., Cortese, L., Haricharan, R., . . . Ahmed, R. (2002). Negative symptoms in first episode non-affective psychosis. *Acta Psychiatrica Scandinavica*, *105*(6), 431-439.

Morosini, P. L., Magliano, L., Brambilla, L. a., Ugolini, S., & Pioli, R. (2000). Development, reliability and acceptability of a new version of the DSM-IV Social and Occupational Functioning Assessment Scale (SOFAS) to assess routine social funtioning. *Acta Psychiatrica Scandinavica*, *101*(4), 323-329.

Norman, R., Malla, A., Verdi, M., Hassall, L., & Fazekas, C. (2004). Understanding delay in treatment for first-episode psychosis. *Psychological medicine*, *34*(2), 255.

Pietrzak, R. H., Olver, J., Norman, T., Piskulic, D., Maruff, P., & Snyder, P. J. (2009). A comparison of the CogState Schizophrenia Battery and the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) Battery in assessing cognitive impairment in chronic schizophrenia. *Journal of Clinical and Experimental Neuropsychology*, *31*(7), 848-859. https://doi.org/10.1080/13803390802592458

van Mastrigt, S., & Addington, J. (2002). Assessment of premorbid function in first-episode schizophrenia: modifications to the Premorbid Adjustment Scale. *Journal of Psychiatry and Neuroscience*, *27*(2), 92.

Wechsler, D. (1997). WAIS-III administration and scoring manual (The Psychological Corporation, San Antonio, TX). *Google Scholar*.

Wechsler, D. (1997a). Wechsler Adult Intelligence Scale 3rd ed. The Psychological

Corporation, San Antonio, TX.

eTable 1

List of Variables of Interest with Corresponding Assessment Measure Used

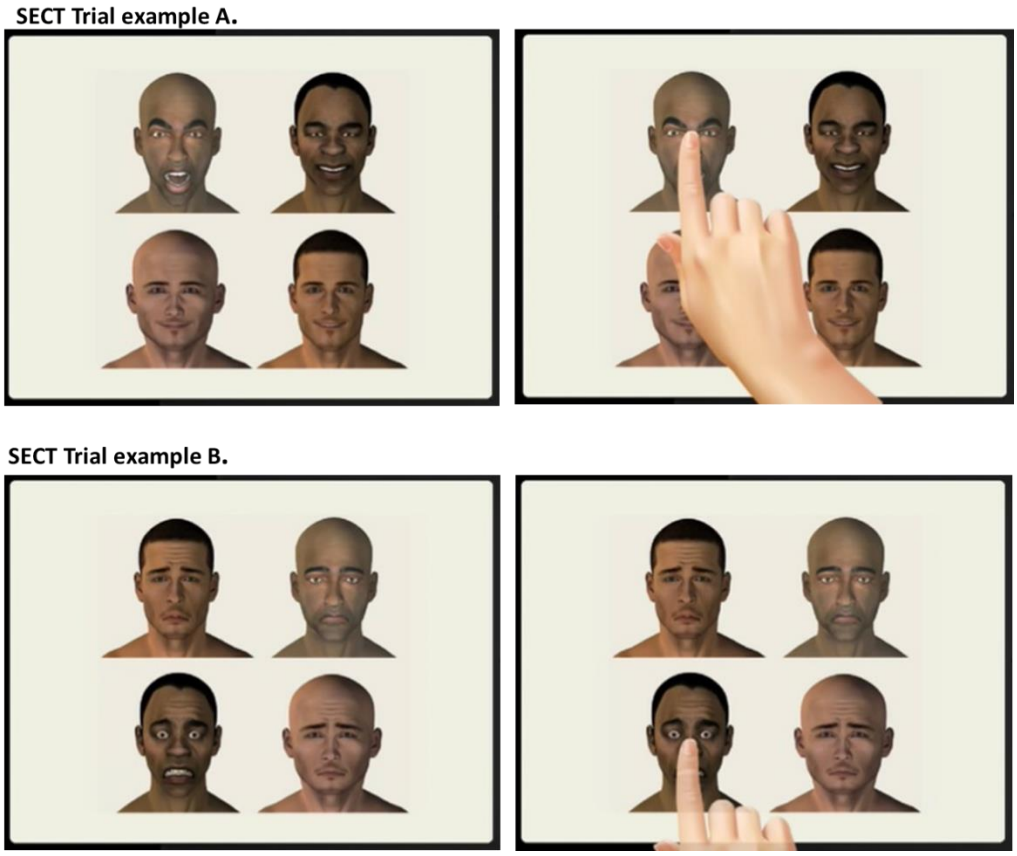
Variable of Interest	Assessment Measure	FEP	Control
Diagnostic and Demographic			
Diagnosis, schizophrenia spectrum disorders	Structured Clinical Interview for DSM-IV-TR axis I disorders	✓	✓
Duration of untreated illness (DUI)	Circumstances of Onset and Relapse Schedule; calculated in weeks	✓	-
Duration of untreated psychosis (DUP)	Circumstances of Onset and Relapse Schedule; calculated in weeks	✓	-
Age at psychosis onset	Circumstances of Onset and Relapse Schedule; calculated in weeks	✓	-
Demographic variables: biological sex, age, education, and ethnicity	Participant self-report	✓	✓
Socio-economic status (SES)	Hollingshead Four-Factor Index of Social Status	✓	✓
Neuropsychological and Cognitive			
IQ	Wechsler Abbreviated Scale of Intelligence *or* Wechsler Adult Intelligence Scale (abbreviated version)	✓	✓
Global cognition	computerized CogState Research Battery (CRB);	✓	✓
Emotion recognition	Social Emotional Cognition Task (SECT) of the CRB; arcsine transformation of the square root of the proportion of correct trials	✓	✓
Clinical and Functioning			
Drug and alcohol dependence/abuse	Drug Use Scale (DUS) and the Alcohol Use Scale (AUS); yes/no ratings	✓	-
Depressive symptoms	Calgary Depression Scale (CDS); total score	✓	-
Anxiety symptoms	Hamilton Anxiety Scale (HAM-A); total score	✓	-
Positive psychotic symptoms	Scale for the Assessment of Positive Symptoms (SAPS); global scores totals	✓	-
Negative psychotic symptoms	Assessment of Negative Symptoms (SANS); global score totals with attention removed†	✓	-
Functioning	Global Assessment of Functioning (GAF) scale; DSM-IV-TR	✓	-

Social and Occupational Functioning	Social and Occupational Functioning Assessment Scale (SOFAS)	✓	-
Premorbid functioning	Premorbid Adjustment Scale (PAS)	✓	-
Childhood trauma	Childhood Trauma Questionnaire (CTQ)	✓	-

Note. FEP = first-episode psychosis participants; controls = nonclinical control participants; a check mark indicates that the measure was administered; † = the global score for attention on the SANS was excluded given it does not load strongly on negative symptom clusters (Malla et al., 2002).

eFigure 1

Social Emotional Cognition Task Example



Note. Examples of two trial sequences of the Social Emotional Cognition Task of the CogState Research Battery (CRB). Examples depict correct identification of the "odd one out". Frames in both trial examples were retrieved from the CRB website (see: www.cogstate.com).

eTable 2

Severity Score Cut-off Ranges for the Abuse and Neglect Subscales of the Childhood Trauma Questionnaire

Scale	**Severity Categories**			
	None	**Low**	**Moderate**	**Severe**
Emotional Abuse	5-8	9-12	13-15	16-25
Physical Abuse	5-7	8-9	10-12	13-25
Sexual Abuse	5	6-7	8-12	13-25
Emotional Neglect	5-9	10-14	15-17	18-25
Physical Neglect	5-7	8-9	10-12	13-25

Note. Severity score cut-off ranges per Bernstein and Fink (1998)

eTable 3

Spearman's Rho Correlations Among Emotion Recognition and Variables of Interest in FEP Participants with Moderate-to-Severe Childhood Trauma

Males (Females)	Emotion recognition	Age at psychosis onset	Premorbid functioning	Negative symptoms
Emotion recognition	-			
Age at psychosis onset	-.364* (-.341)	-		
Premorbid functioning	-.129 (-.528)	.153 (.024)	-	
Negative symptoms	-.203 (-.407)	.112 (-.182)	.083 (.325)	-

Note. Males N = 31, females N= 15; variables of interest were identified as having sex-specific differences and were correlated with emotion recognition to assess for covariates; Emotion recognition per the Social Emotional Cognition Task; Premorbid functioning per the Premorbid Adjustment Scale, childhood subscale; negative symptoms per the Scale for the Assessment of Negative Symptoms, with attention excluded; * = a statistically significant correlation, p = .048; age at psychosis onset thus considered a covariate.