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Date:

2019-06-01

Citation:

Peach, N., Alvarez-Jimenez, M., Cropper, S. J., Sun, P. & Bendall, S. (2019). Testing models of post-traumatic intrusions, trauma-related beliefs, hallucinations, and delusions in a first episode psychosis sample. *British Journal of Clinical Psychology*, 58 (2), pp.154-172. <https://doi.org/10.1111/bjc.12206>.

Persistent Link:

<https://hdl.handle.net/11343/284778>

**Title: Testing models of post-traumatic intrusions, trauma-related beliefs, hallucinations and delusions in a first episode psychosis sample**

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**Word count**

4413

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/bjc.12206](https://doi.org/10.1111/bjc.12206)

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Received Date:

Revised Date:

Accepted Date:

Article Type: Full Article

Abstract

**Objective.** There is increasing evidence that childhood trauma may play a role in the aetiology of psychosis. Cognitive models implicate trauma-related symptoms, specifically post-traumatic intrusions and trauma-related beliefs as primary mechanisms, but these models have not been extensively tested. This study investigated relationships between childhood trauma, psychotic symptoms (hallucinations and delusions), post-traumatic intrusions and trauma-related beliefs while accounting for comorbid symptoms.

**Methods.** Sixty-six people with first episode psychosis aged between 15 and 24 years were assessed for hallucinations, delusions, childhood trauma, post-traumatic intrusions, post-traumatic avoidance, and trauma-related beliefs.

**Results.** Fifty-three percent of the sample had experienced childhood trauma, and 27% met diagnostic criteria for post-traumatic stress disorder. Both post-traumatic intrusions and trauma-related beliefs mediated the relationships between childhood trauma and hallucinations, and childhood trauma and delusions. Multiple regression analyses revealed that post-traumatic intrusions (but not childhood trauma, post-traumatic avoidance, or trauma-related beliefs) were independently associated with hallucination severity ( $\beta = .53, p = .01$ ). Post-traumatic intrusions and trauma-related beliefs (but not childhood trauma or post-traumatic avoidance) were independently associated with delusion severity ( $\beta = .67, p < .01$  and  $\beta = .34, p < .01$  respectively).

**Conclusions.** These findings support cognitive models that implicate post-traumatic intrusions in hallucination aetiology, and post-traumatic intrusions and trauma-related beliefs in delusion aetiology. The results suggest that trauma and PTSD, including trauma-related beliefs, should be addressed in the assessment and treatment of people with early psychosis.

**Keywords:** trauma/psychosis/intrusion/avoidance/schema/PTSD

Practitioner Points

- Trauma and PTSD, including trauma-related beliefs, should be addressed in the assessment and treatment of people with early psychosis
- Routine assessment of childhood trauma and PTSD in clinical services dealing with young people with first episode psychosis is needed.
- These findings support cognitive models of trauma and hallucinations and delusions.

#### Limitations

- The study requires replication with a larger sample.
- The cross-sectional design prevents drawing conclusions about causality

#### Introduction

Increasing evidence implicates adverse childhood events in the aetiology of psychosis, and it is now well established that many people with psychosis have experienced trauma in childhood, particularly victimisation trauma (Bendall et al. 2008; Kelleher et al. 2013; Murray, 2017; Trauelsen et al. 2015). Findings from large, methodologically strong studies consistently suggest that childhood trauma as a risk factor for psychosis (Matheson et al. 2013; Varese et al. 2012). Increased research attention on psychotic symptom dimensions rather than psychotic disorder diagnostic categories has led to growing evidence for particular associations between childhood victimisation trauma and positive psychotic symptoms (Ajnakina et al. 2016; van Dam et al. 2015; van Nierop et al. 2014). A recent meta-analysis found correlations between childhood trauma and hallucinations and delusions in groups with psychotic disorder, although these correlations were small to moderate (0.17 – 0.20) (Bailey et al. 2018). There is also high prevalence of post-traumatic stress disorder (PTSD) in people with psychotic disorders relative to the general population (de Bont et al. 2015; Steel et al. 2017).

The consistent findings showing significant associations between childhood trauma, psychotic symptoms and PTSD have led to the development of trauma-informed cognitive-behavioural models of the aetiology and maintenance of hallucinations and delusions (Freeman et al. 2002; Garety et al. 2001; Hardy, 2017; Morrison, 2001; Morrison et al. 2003; Waters et al. 2006). There is general consensus among proponents of these models that post-traumatic intrusions

from memory play a key role in hallucination development. Post-traumatic intrusions are conceptualised as poorly contextualised sensory information that is prone to involuntary recall due to arousal and dissociation during trauma (Brewin et al. 2010; Ehlers & Clark, 2000). Hallucinations are proposed to be phenomenologically similar to post-traumatic intrusions, both being involuntary sensory-perceptual intrusions experienced as happening in the present and often associated with fear and threat (Morrison, 2001; Morrison et al. 2003). These models suggest that delusional thinking arises from the subsequent search for an explanation for these intrusions, which is influenced by underlying trauma-related beliefs about the self and others, as well as negative emotion and arousal (Freeman et al. 2002; Garety et al. 2001; Morrison et al. 2003). It is argued that in a person with a biopsychosocial predisposition for psychosis, early trauma leads to a basic cognitive disturbance (e.g., intrusions from memory, difficulties monitoring intentions and actions), and then to anomalous conscious experiences that include subclinical psychotic symptoms (Garety et al., 2001). The resulting emotional changes (e.g., anxiety, depression, stress) and trauma-related beliefs about the self as vulnerable and others as hostile are proposed to play a key role in the person's tendency to make external and often catastrophic/fear-based attributions of intrusions and other events, leading to delusions (particularly paranoia), and maintenance of hallucinations.

Several studies have investigated aspects of these models. There is mixed evidence regarding the link between post-traumatic intrusions and hallucinations. Four of five studies (three clinical and one non-clinical) found relationships (Alsawy et al. 2015; Bendall et al. 2013; Gracie et al. 2007; Lysaker & LaRocco, 2008) including a dose-response relationship (Alsawy et al. 2015). However, the most comprehensive study to date (n =228) did not find intrusive trauma memory to be a mediator between childhood sexual abuse and auditory hallucinations (Hardy et al. 2016).

Factors contributing to inconsistent findings between these studies may include the wide range of measures (primarily through self-report) in the assessment of post-traumatic intrusions, with no study using a consistent, well-validated, clinician-administered measure. There is also inconsistency between studies in terms of the extent to which comorbid psychotic and other symptoms are controlled for. Furthermore, clinical studies have primarily used samples with chronic psychosis, where potential confounds such as illness chronicity, protracted medication use, hospitalisations and variations in treatment may have diluted the association between intrusions

and psychotic symptoms. Only one study has investigated psychotic symptoms and post-traumatic intrusions with a first episode psychosis sample (Bendall et al., 2013). Research with first episode samples is important as the effects of these confounds are minimised.

There is, however, more consistent evidence for an association between post-traumatic intrusions and delusions (Alsawy et al. 2015; Bendall et al. 2013; Gracie et al. 2007; Lysaker & LaRocco, 2008), including evidence of a dose-response relationship (Alsawy et al. 2015).

Consistent findings also have been found in studies of negative beliefs and delusions using measures of a broad range of negative beliefs (Fisher et al. 2012; Gracie et al. 2007; Hardy et al. 2016), and in the context of attachment style (Sitko et al. 2014; van Dam et al. 2014). However, negative beliefs and delusions may be overlapping constructs, which may partially account for some of these relationships. To our knowledge both steps in the intrusions plus beliefs model have not been tested together, the previous study with first episode psychosis patients having only examined the relationship between intrusions and psychotic symptoms (Bendall et al., 2013). Thus the independent contribution of intrusions and beliefs to hallucination and delusion severity have not yet been tested.

The primary objective of this study is to test predictions of cognitive behavioural models of psychosis from trauma by investigating the role of post-traumatic intrusions and trauma-related beliefs in the experience of hallucinations and delusions. It was hypothesised that 1) post-traumatic intrusions would be independently associated with hallucinations, and 2) post-traumatic intrusions and trauma-related beliefs would be independently associated with delusions, when taking into account the effects of other comorbid symptoms.

## Method

This study was part of a larger study investigating relationships between psychotic symptoms, dissociation, PTSD and symptom content in a group with first episode psychosis (Reference to be provided after anonymous review). The data reported here forms part of the primary analyses. Ethics approval for this study was obtained from the XXXXX Ethics Committee (Project number XXXXX) on 25/03/2014.

## Participants

Seventy young people with first episode psychosis were recruited for the study. Four participants completed less than 50% of the overall assessment and were excluded from the analysis, leaving a final sample size of 66. All participants attended a specialised clinical program providing early intervention and treatment for people aged 15 to 25 years experiencing a first episode of psychosis. This was a convenience sample, where participants were referred to the study through their case managers.

The inclusion criterion was having a DSM-IV diagnosis of schizophrenia, schizophreniform disorder, schizoaffective disorder, delusional disorder, psychotic disorder not otherwise specified, or an affective disorder with psychotic features. Exclusion criteria were inability to speak fluent English, having an intellectual disability (IQ < 70), and evidence of an organic brain disease. Socio-demographic and diagnostic information for the sample are presented in Table 1.

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Table 1 about here

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#### Measures

The Structured Clinical Interview for DSM-IV Axis I Disorders - Patient Edition (SCID-I; First et al. 2001) is a semi-structured interview measure used to diagnose DSM-IV Axis I disorders. The SCID-I was used to establish primary diagnosis for the participants in the study.

The Positive and Negative Syndrome Scale (PANSS; Kay et al. 1987) is a widely utilised, 30-item semi-structured interview assessing the presence of both positive and negative psychotic symptoms as well as general psychopathological symptoms occurring over the last two weeks. Items are scored on a 7-point scale (1 = absent to 7 = extreme). Scores on the hallucinations item (P3) were used as an index of hallucination severity. Summed scores on the delusions item (P1) and the suspiciousness item (P6) were used as an index of delusion severity.

The Childhood Trauma Questionnaire- Short Form (CTQ; Bernstein et al. 2003) is a 28-item, self-report inventory of childhood victimisation trauma. Items on five subscales pertain to

abuse (physical, emotional and sexual) and neglect (physical and emotional) and are scored on a five-point Likert scale. A childhood trauma severity score was created for each participant by summing their scores on all five trauma subtypes. Childhood trauma was determined to be present if the participant scored in the moderate or severe range of at least one of the five trauma subtypes.

The Clinician-Administered PTSD Scale (CAPS; Blake et al. 1995) assesses PTSD diagnosis, symptom clusters (intrusive re-experiencing, avoidance/numbing, and hyperarousal) as well as symptom severity. The CAPS is a semi-structured interview and is considered the gold standard in PTSD assessment. It assesses symptom severity in two dimensions (frequency and intensity) each scored on a 5-point scale (0 to 4). Post-traumatic intrusion and post-traumatic avoidance severity scores were determined by summing the frequency and intensity scores from the relevant subscales.

The Post-Traumatic Cognitions Inventory (PTCI; Foa et al, 1999) is a 36-item self-report scale measuring trauma-related thoughts and beliefs. Items are rated on a 7-point Likert scale (1 = totally disagree to 7 = totally agree). The PTCI consists of items pertaining to three factors: negative cognitions about the self (e.g., 'I have permanently changed for the worse'), negative cognitions about the world (e.g., 'The world is a dangerous place'), and self-blame for the trauma (e.g., 'The event happened because of the way I acted'). The PTCI was used in this study as a measure of trauma-related beliefs, a score for which was calculated by summing all item scores.

## Procedure

After providing informed consent, participants completed the assessment which included the clinician administered interviews (SCID-I, PANSS and CAPS), self-report questionnaires (CTQ and PTCI) and providing demographic information.

## Data Analysis

All analyses were performed using SPSS 22 for Windows (IBM Corp., 2013). All data was tested for normality according to the assumptions of parametric analyses. Several of the variables

were positively skewed. To reduce skewness square root, log and reciprocal transformations were applied, however these were not successful in normalising the data. Non-parametric correlations were therefore used for the bivariate analyses. To examine whether post-traumatic intrusions and trauma-related beliefs were mediators in the relationships between childhood trauma and 1) hallucinations and 2) delusions, four simple mediation analyses were performed using the PROCESS macro version 2.16, available for SPSS (Hayes, 2013). Mediation was determined by examining the statistical significance of the indirect effect ( $a \times b$ ) of the independent variable (IV) via the mediator (M). The indirect effect is quantified as the product of the effect of the IV on M (a), and the effect of M on the dependent variable (DV) with the effect of the IV partialled out (b). Mediation occurs if (1) there is an effect to be mediated (i.e., the IV predicts the DV, direct effect (c)  $\neq 0$ ), and (2) the indirect effect ( $a \times b$ ) is statistically significant, and occurs in the hypothesised direction. PROCESS was applied to estimate the non-standardised model coefficients, standard errors and p-values utilising ordinary least squares regression. The PROCESS macro was further used to generate a bias corrected and accelerated (BCa) 95% bootstrap confidence interval (CI) for the indirect effect using 5000 bootstrap samples to calculate the significance of the mediation. Bootstrapping is considered to be a robust method to estimate CIs when the distribution of the parameter is unknown, and can overcome violations of assumptions, such as non-normally distributed data (Bollen & Stine, 1990). Point estimates were considered significant at  $p < .05$  if the BCa CI did not contain zero. Multiple regressions were used to examine whether post-traumatic intrusions and trauma-related beliefs were uniquely associated with hallucinations and delusions. Prior to conducting multiple regressions, an examination of residuals and scatterplots indicated that the assumptions of multivariate normality, linearity and homoscedasticity were met. Untransformed data was used in the regression analyses as transformations did not correct skewness in the variables. Three cases in the dataset were identified as multivariate outliers according to Mahalanobis distance values, and were excluded from the analyses, leaving a sample size of 63. BCa 95% CIs were generated for regression coefficients using 5000 bootstrap samples.

## Results

Fifty-three percent of the sample reported the experience of childhood abuse or neglect. Of those participants who reported childhood trauma on the CTQ, the majority (60%) experienced

multiple types of trauma. Of the total 66 participants, 18 met criteria for PTSD (27% of the entire sample; 51% of those with childhood trauma).

Rates of childhood victimisation trauma by type and scores on key clinical measures are shown in Table 2. The mean PANSS score of 49.62 for the sample corresponds to being clinically ‘very mildly ill’ according to Leucht et al.’s (2005) framework.

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Table 2 about here

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### Bivariate Analyses

Results of the correlation analyses for outcome variables are shown in Table 3. Both hallucinations and delusions were found to be significantly correlated with childhood trauma, post-traumatic intrusions, post-traumatic avoidance, and trauma-related beliefs, with medium to large effect sizes. See Supplementary Table 1 for full table of correlations between childhood trauma subtypes, psychotic symptoms and PTSD symptoms.

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Table 3 about here

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### Mediation Analysis

Mediation analyses were performed with post-traumatic intrusions (CAPS intrusions scores) and trauma-related beliefs (PTCI scores) as the mediating variables, childhood trauma (CTQ scores) as the independent variable, and hallucinations and delusions as the two dependent variables. Results of the mediation analyses are shown in Table 4. (For diagrams pertaining to the four simple mediation models see Figures 1-4 in the supplementary material).

In the two mediation models with hallucinations as the dependent variable, the mediated effect of childhood trauma on hallucinations via both post-traumatic intrusions and trauma-related beliefs were significant;  $\beta = .01$ , 95% BCa CI [.003, .034] and  $\beta = .01$ , 95% BCa CI [.001, .027] respectively. In the two mediation models with delusions as the dependent variable, the mediated effect of childhood trauma on delusions via both post-traumatic intrusions and trauma-related beliefs were also significant;  $\beta = .02$ , 95% BCa CI [.006, .044] and  $\beta = .02$ , 95% BCa CI [.012, .041] respectively.

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Table 4 about here

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### Independent Relationships with Hallucination Severity

A hierarchical multiple regression was performed to investigate whether childhood trauma, post-traumatic intrusions and trauma-related beliefs were independently related to hallucination severity while controlling for the effects of comorbid delusions. The effect of post-traumatic avoidance was also controlled for, due to the strong correlation between post-traumatic intrusions and post-traumatic avoidance ( $\rho = .68$ ). The first step in the regression model included delusions and post-traumatic avoidance as independent variables. It was found that post-traumatic avoidance was significantly independently associated with hallucination severity ( $\beta = .33, p = .01$ ) but delusions were not ( $\beta = .12, p > .05$ ). At Step 1, these two variables accounted for 15% of the variation in hallucination severity;  $R^2 = .15, F(2, 60) = 5.43, p < .01$ . At Step 2, adding childhood trauma, post-traumatic intrusions and trauma-related beliefs into the equation explained an additional 11% of the variation in hallucination severity, and this change in variance explained from Step 1 to Step 2 was significant;  $F(3, 57) = 2.85, p < .05$ . With all five independent variables included in Step 2, the only variable significantly independently associated with hallucination severity was post-traumatic intrusions, which accounted for 9% of the variation in hallucination severity ( $\beta = .53, p = .01$ ). The summary regression statistics for the two steps are shown in Table 5.

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Table 5 about here

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### Independent Relationships with Delusion Severity

A second hierarchical multiple regression was performed to investigate whether childhood trauma, post-traumatic intrusions and trauma-related beliefs were independently related to delusion severity, while taking into account the effects of hallucinations and post-traumatic avoidance. The first step in the regression model therefore included hallucinations and post-traumatic avoidance as independent variables. It was found that post-traumatic avoidance was significantly independently associated with delusion severity ( $\beta = .33, p = .01$ ) but hallucinations were not ( $\beta = .12, p > .05$ ).

At Step 1, it was found that these two variables accounted for 16% of the variation in delusion severity;  $R^2 = .16$ ,  $F(2, 60) = 5.54$ ,  $p < .01$ . At Step 2, adding childhood trauma, post-traumatic intrusions and trauma-related beliefs into the equation explained an additional 30% of the variation in delusion severity, and this change in variance explained from Step 1 to Step 2 was significant;  $F(3, 57) = 10.82$ ,  $p < .01$ . With all five independent variables included in Step 2, there were two variables that were independently associated with delusion severity; post-traumatic intrusions, which accounted for 17% of the variation in delusion severity ( $\beta = .67$ ,  $p < .01$ ), and trauma-related beliefs, which accounted for 7% of the variation in delusion severity ( $\beta = .34$ ,  $p < .01$ ). The summary regression statistics for the two steps are shown in Table 6.

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Table 6 about here

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## Discussion

Fifty-three percent of the sample had experienced childhood victimisation trauma, and 27% met diagnostic criteria for PTSD. These rates are both notably higher than those in the general population (Kessler et al. 2005) and are comparable to those from previous studies assessing childhood victimisation trauma and PTSD in psychosis (Bonoldi et al. 2013; Hardy et al. 2016).

Consistent with previous research (Alsawy et al. 2015; Bendall et al. 2013; Gracie et al. 2007; Hardy et al. 2016; Lysaker & LaRocco, 2008), hallucinations and delusions were correlated with childhood trauma, post-traumatic intrusions and trauma-related beliefs, with moderate to large effect sizes. Post-traumatic intrusions and trauma-related beliefs were found to mediate the relationships between childhood trauma and both hallucinations and delusions.

We found support for our hypotheses which tested both aspects of cognitive models of psychosis together (post-traumatic intrusions and trauma-related beliefs); post-traumatic intrusions were found to be uniquely associated with hallucinations, while post-traumatic intrusions and trauma-related beliefs were found to be uniquely associated with delusions irrespective of the effects of other psychotic symptoms and post-traumatic avoidance.

Cognitive models of the aetiology of psychosis from trauma suggest that post-traumatic intrusions and trauma-related beliefs play particularly important roles in hallucination and delusion development. For hallucinations, particular emphasis is placed on post-traumatic intrusions as the primary mechanism, highlighting phenomenological similarities between hallucinations and post-

traumatic intrusions (Morrison, 2001; Morrison et al. 2003). This was supported by the results of the present study, which demonstrated that post-traumatic intrusions, but not trauma-related beliefs or childhood trauma itself, were uniquely associated with hallucinations independent of the effects of delusions and post-traumatic avoidance. This supports the theory that the processes underlying post-traumatic intrusions (i.e., disrupted encoding and involuntary recall of sensory-perceptual trauma memories; Brewin et al. 2010; Ehlers & Clark, 2000) may also be facilitating hallucination aetiology. The finding of a unique association between hallucinations and post-traumatic intrusions in the current first-episode sample is consistent with previous findings in non-clinical samples (Alsawy et al. 2015; Gracie et al. 2007) but contrasts with findings in clinical samples with chronic psychosis (Hardy et al. 2016; Lysaker & LaRocco, 2008). Taken together this may indicate that post-traumatic intrusive processes facilitate hallucination aetiology in early stages, but confounding factors may come into play later in the course of illness. All of these previous studies used self-report measures of post-traumatic intrusions; self-report measures of PTSD symptoms have been shown to be less reliable than validated PTSD interviews (McDonald & Calhoun, 2010). Alternatively, the present study may have more accurately captured post-traumatic intrusion severity in relation to hallucinations by using a comprehensive clinician administered measure of intrusions rather than a brief self-report measure.

The models propose that a key pathway in delusion aetiology is an individual's search for an explanation for trauma-induced anomalous conscious experiences, including intrusive trauma memories. Explanations are influenced by trauma-related emotion and beliefs about the self and others, which facilitate external attributions (Freeman et al. 2002; Garety et al. 2001). With regards to delusions, predictions of the cognitive models were supported by the finding that post-traumatic intrusions and trauma-related beliefs, but not childhood trauma itself, were uniquely associated with delusion severity irrespective of the effects of hallucinations and post-traumatic avoidance. This finding is comparable with previous studies investigating delusions and post-traumatic intrusions which found associations (Alsawy et al. 2015; Bendall et al. 2013; Gracie et al. 2007; Lysaker & LaRocco, 2008) and also with studies finding associations between delusions and negative beliefs/schemas about the self and others (Fisher et al. 2012; Gracie et al. 2007; Hardy et al. 2016; Sitko et al. 2014; van Dam et al. 2014).

The sample size of this study was small, which decreases the precision of our parameter estimates, as reflected in the 95% confidence intervals. The present study was hypothesis-driven

and the findings are theoretically and clinically relevant, and relevant to future studies to be conducted with larger sample sizes. We consider biases potentially introduced through the sampling method and the use of the retrospective self-report measure of childhood trauma, which risks inaccurate reporting of past traumatic experiences, to be minimal. In particular, the reliability and validity of retrospective childhood trauma self-reporting has been adequately demonstrated in people with psychosis (Fisher et al., 2011; Simpson et al., 2018). Our measurement of hallucinations and delusions was limited to the use of a small number of items on the PANSS scale (one item for hallucinations, two for delusions); more thorough measures of these symptoms would be preferable. Emotion regulation and age of onset of trauma were not factors included in this study. Increasing evidence suggests that these are important factors and the study would have benefited from their inclusion. Emotion regulation is increasingly being found to be important both empirically and theoretically in the trauma and psychosis literature (Hardy et al., 2016; Hardy, 2017; Lardinois et al., 2011). The dose and type of antipsychotic medication was not recorded, and data pertaining to the duration of untreated psychosis was not collected. Our power calculations and hypotheses were not registered in the public domain prior to conducting the study. The cross-sectional nature of the study design prevents any conclusions to be drawn about causality; future longitudinal studies may be able to determine temporal relationships between childhood trauma, trauma-related symptoms and psychotic symptoms. Temporal relationships and moment-by-moment changes in symptoms and appraisals could also be addressed in future studies with experience sampling methodology.

These findings have important clinical implications. First, the high rates of childhood trauma and PTSD found in this study highlight previous calls for routine assessment of childhood trauma and PTSD in clinical services working with young people with first episode psychosis (Bendall et al. 2012; Bendall et al. 2013; Hardy, 2017; National Institute for Health and Care Excellence (NICE), 2014). This means that clinicians should have sufficient training in conducting trauma and PTSD assessments, and be able to offer the appropriate psycho-education and support for clients affected by these issues (Gairns et al. 2015; Galletly et al., 2016; National Institute for Health and Care Excellence (NICE), 2014; Tong et al. 2017). Second, the current study found that post-traumatic intrusions and beliefs mediated the relationship between childhood trauma and hallucinations and delusions were uniquely associated with hallucinations and delusions, as theorized by important theoretical models. This would imply that targeting post-traumatic

intrusions and beliefs in treatment would lead to not only their reduction but also a reduction in hallucinations and delusions. This idea has received mixed support from three randomised controlled trials (RCTs) (de Bont et al. 2016; Mueser et al., 2015; Steel et al., 2017; van den Berg et al. 2015). Two of these RCTs used cognitive restructuring, designed to directly target trauma-related beliefs to treat PTSD, hallucinations and delusions (Mueser et al., 2015; Steel et al., 2017). One of these, which examined the effect of cognitive restructuring for PTSD in people with schizophrenia found that cognitive restructuring had no effect on reducing PTSD, hallucinations or delusions compared with the control (Steel et al., 2017). The other used cognitive restructuring for PTSD in people with severe mental illness (one third of whom had psychotic diagnoses) and found a greater reduction in PTSD symptoms in the treatment group compared to the control, but no effect of the treatment on the severity of psychotic symptoms (positive and negative symptoms analysed together) (Mueser et al., 2015). These two trials found that cognitive restructuring did not lead to a reduction in delusions, contrary to predictions from the theory and our results. However, in both studies there was no difference between treatment and control groups on their measure of trauma-related beliefs (post-traumatic cognitions) as a result of the treatment, suggesting that the cognitive restructuring did not impact trauma-related beliefs and so could not be expected to impact delusions. This suggests that there is more work needed to develop and test interventions that can target trauma-related beliefs in those with delusions.

The third RCT was large trial of exposure-based interventions for PTSD in people with psychosis and showed reductions in not only PTSD symptoms but also trauma-related beliefs and paranoia (de Bont et al. 2016; van den Berg et al. 2015). Hallucination severity was not found to be reduced, although as noted by the authors the method of measurement of hallucinations precluded many (approximately half) of their cases from inclusion in their analyses. Importantly, however, exposure treatment, a method of intervention which directly targets post-traumatic intrusions and indirectly targets post-traumatic beliefs, did reduce delusions (de Bont et al. 2016; van den Berg et al. 2015). This supports the theory and our current results in that the trial showed decreases in post-traumatic intrusions, post-traumatic beliefs and delusions.

Increasing evidence points to a particularly important role for emotion dysregulation as a mechanism in the trauma-psychosis link (Hardy et al., 2016; Hardy, 2017; Lardinois et al., 2011), which is not directly targeted in cognitive restructuring for PTSD, although is addressed with

exposure treatments. This theory and the results of the three previously described trials suggest that further trialing of exposure treatments is needed to clarifying their utility in the reduction of psychotic symptoms. With regard to hallucinations, there has been recent speculation relating to trauma-related autobiographical memories existing on a spectrum of decontextualisation, ranging from fully contextualised memory intrusions, to those somewhat lacking in contextualisation (i.e., PTSD re-experiencing symptoms), to severely decontextualised memory intrusions which may be experienced as hallucinations (Hardy, 2017). If hallucinatory experiences do represent severely decontextualised memory intrusions, the exposure treatment dose required to see a significant reduction in hallucinations may be higher than has been tested so far (seven treatment sessions involving exposure in de Bont et al. (2016) and van den Berg et al.'s (2015) trial).

In summary, our results lend support to theory-driven predictions of leading psychological models of psychosis from trauma. Our two variables of interest in this study, post-traumatic intrusions and trauma-related beliefs, were found to mediate the relationships between childhood trauma and hallucinations and delusions. Post-traumatic intrusions were uniquely associated with hallucinations, while post-traumatic intrusions and trauma-related beliefs were uniquely associated with delusions. Identifying trauma-related cognitive mechanisms associated with hallucinations and delusions may have clinical implications for the development of effective, targeted psychological interventions, as well as advancing our understanding of hallucinations and delusion aetiology.

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Table 1  
*Demographic and diagnostic information for sample (n = 66).*

<b>Descriptive</b>		
	<i>n</i>	Percentage (%)
Age (years)	<i>M</i> = 20.18, <i>SD</i> = 2.69	
Time in specialist early psychosis treatment (months)	<i>M</i> = 11.15, <i>SD</i> = 7.40	
Born in Australia	59	89.4
Gender identification		
Male	28	42.4
Female	36	54.5
Transgender	2	3.0
Ethnicity		
Caucasian	46	69.7
Asian	4	6.1
African	3	4.5
Aboriginal or Torres Strait Islander	3	4.5
Other	10	15.2
Years of completed education		
Year 9 or below	8	12.1
Year 10	8	12.1
Year 11	15	22.7

Year 12	35	53.0
Occupational status		
Not working/studying	25	37.9
Part-time work/study	22	33.3
Full-time work/study	19	28.8
Primary diagnosis		
Schizophrenia/Schizophreniform disorder	17	25.8
Schizoaffective disorder	19	28.8
Psychotic disorder NOS	9	13.6
Brief psychotic disorder	2	3.0
Delusional disorder	2	3.0
Substance-induced psychotic disorder	6	9.1
Bipolar I disorder with psychotic features	10	15.2
Major depressive disorder with psychotic features	1	1.5
Personality disorder		
Borderline personality disorder	5	7.6
Medication use in last 6 months		
Antipsychotic	40	60.6
Antidepressant	12	18.2
Mood stabilizer	3	4.5
Other	1	1.5
No medication	10	15.2
Family history of mental illness		
Present	39	59.1
None	15	22.7
Unknown	12	18.2
First degree relative with severe mental illness	8	12.1

Table 2  
*Frequency of childhood trauma by type and scores on psychosis and trauma measures (n = 66)*

Trauma Subtype (CTQ)	n (%)
Emotional Abuse	23 (34.8)
Physical Abuse	12 (18.2)
Sexual Abuse	16 (24.2)
Emotional Neglect	16 (24.2)
Physical Neglect	16 (24.2)
Any Trauma	35 (53.0)
Polytraumatisation*	21 (31.8)

  

Measure	M (SD)
CTQ Emotional Abuse	11.35 (5.55)
CTQ Physical Abuse	7.53 (3.46)
CTQ Sexual Abuse	7.42 (5.00)
CTQ Emotional Neglect	7.32 (5.14)
CTQ Physical Neglect	6.15 (3.80)

CTQ Total	46.77 (18.58)
PANSS-Positive	11.73 (4.02)
PANSS-Negative	11.61 (4.40)
PANSS-General	26.03 (6.97)
PANSS-Total	49.64 (13.09)
CAPS-Intrusions	5.58 (8.36)
CAPS-Avoidance	10.42 (12.40)
CAPS-Hyperarousal	7.55 (8.87)
CAPS Total	23.55 (26.52)
PTCI	113.42 (49.04)

Note. \*More than one trauma type reported.

CTQ = Childhood Trauma Questionnaire; PANSS = Positive and Negative Syndrome Scale; CAPS = Clinician Administered PTSD Scale; PTCI = Post-Traumatic Cognitions Inventory.

Table 3

Correlations (with bootstrapped 95% confidence intervals) between measures of childhood trauma, psychotic symptoms, and post-traumatic stress disorder symptoms.

Measure	1.	2.	3.	4.	5.	6.	7.	8.
<b>1. Hallucinations (PANSS)</b>	-							
<b>2. Delusions (PANSS)</b>	.33** (.10,.54)	-						
<b>3. PANSS Total</b>	.52** (.31,.70)	.64** (.44,.77)	-					
<b>4. Childhood Trauma (CTQ)</b>	.26* (.04,.51)	.33** (.10,.55)	.36* (.11,.56)	-				
<b>5. Post-Traumatic Intrusions (CAPS)</b>	.44** (.21,.65)	.47** (.23,.65)	.47** (.24,.65)	.37** (.17,.56)	-			
<b>6. Post-Traumatic Avoidance (CAPS)</b>	.43** (.19,.65)	.36** (.12,.57)	.51** (.31,.70)	.47** (.25,.63)	.68** (.50,.83)	-		
<b>7. CAPS Total</b>	.47** (.25,.67)	.50** (.30,.67)	.55** (.34,.72)	.46** (.25,.63)	.80** (.67,.89)	.92** (.84,.96)	-	
<b>8. Trauma-Related Beliefs (PTCI)</b>	.36** (.13,.58)	.48** (.28,.65)	.47** (.23,.66)	.47** (.26,.63)	.48** (.26,.65)	.49** (.28,.66)	.46** (.23,.64)	-

\*  $p < .05$ , \*\*  $p < .01$

Note. Correlation coefficients are Spearman's rho.

Table 4

Summary of the four simple mediation models. Parameter estimates for the total, direct and indirect effects of childhood trauma on hallucinations and delusions.

Dependent Variable	Mediator	a	b	c'	a x b	95% CI	c
Hallucinations	Post-traumatic intrusions	.14**	.09***	.01	.01*	[.003, .034]	.02*
Hallucinations	Trauma-related beliefs	1.28***	.01*	.01	.01*	[.001, .027]	.02*
Delusions	Post-traumatic intrusions	.14**	.13***	.01	.02*	[.006, .044]	.03*
Delusions	Trauma-related beliefs	1.28***	.02***	.01	.02*	[.012, .041]	.03*

Note. N = 63. The estimates reported are unstandardised beta coefficients based on 5000 bootstrapped iterations. Independent variable (IV) = childhood trauma (CTQ), mediator variables (MV) = post-traumatic intrusions (CAPS) and trauma-related beliefs (PTCI), dependent variables (DV) = hallucinations (PANSS) and delusions (PANSS). CI = confidence interval, a = effect of IV on MV, b = effect of MV on DV in the mediated model (with the effect of IV on DV partialled out), c' = direct effect of IV on DV in the mediated model, a x b = indirect effect, c = total effect. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

Table 5

Summary of hierarchical regression analysis for variables predicting hallucination severity (n = 63)

Variable	B	SE B	$\beta$	p	sr <sup>2</sup> (unique)	R	R <sup>2</sup>	$\Delta R^2$	Bootstrap	
									SE	BCa 95% CI
<b>Step 1</b>						.39	.15	.15		
						(.16,.58)	(.01,.29)			
Constant	1.30	.42		.00					.40	.52 - 2.11
Delusions	.11	.11	.12	.34	.01				.12	-.14 - .34
Post-Traumatic Avoidance	.05	.02	.33*	.01	.09				.02	.00 - .09
<b>Step 2</b>						.51	.26	.11		
						(.30,.67)	(.10,.43)			
Constant	1.20	.57		.04					.50	.23 - 2.10
Delusions	-.12	.13	-.14	.36	.01				.14	-.37 - .20
Post-Traumatic Avoidance	-.02	.03	-.11	.60	.00				.04	-.09 - .06
Childhood Trauma	.01	.01	.09	.54	.00				.02	-.02 - .04
Post-Traumatic Intrusions	.11	.04	.53*	.01	.09				.05	.01 - .21
Trauma-Related Beliefs	.01	.01	.18	.25	.02				.00	.00 - .01

\*p < .05

Note: The squared semipartial correlation coefficient (sr<sup>2</sup>) represents the unique amount of variance the predictor brings to the model.

Table 6

Summary of hierarchical regression analysis for variables predicting delusion severity (n = 63)

Variable	B	SE B	$\beta$	p	sr <sup>2</sup> (unique)	R	R <sup>2</sup>	$\Delta R^2$	Bootstrap	
									SE	BCa 95% CI
<b>Step 1</b>						.40	.16	.16		
						(.17,.59)	(.01,.31)			
Constant	2.92	.37		.00					.34	2.26 - 3.62
Hallucinations	.15	.15	.12	.34	.01				.17	-.20 - .49
Post-Traumatic Avoidance	.05	.02	.33*	.01	.09				.02	.00 - .09
<b>Step 2</b>						.68	.46	.30		
						(.52,.79)	(.30,.62)			
Constant	1.67	.55		.00					.50	.67 - 2.64
Hallucinations	-.12	.13	-.10	.36	.01				.15	-.42 - .14
Post-Traumatic Avoidance	-.06	.03	-.35	.06	.04				.03	-.12 - -.01
Childhood Trauma	.02	.01	.15	.23	.01				.01	-.01 - .04
Post-Traumatic Intrusions	.16	.04	.67**	.00	.17				.04	.09 - .25
Trauma-Related Beliefs	.01	.01	.34**	.00	.07				.00	.003 - .02

\*p < .05; \*\*p < .01

Note: The squared semipartial correlation coefficient (sr<sup>2</sup>) represents the unique amount of variance the predictor brings to the model.