

**Childhood Trauma, Negative Schemas, and Trust:  
An Exploration using Virtual Reality**

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**Thesis declaration form**

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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## Overview

This thesis explores the impact of childhood trauma. Part one presents a systematic review and meta-analysis of the association between childhood sexual abuse and auditory hallucinations. The results suggest that sexual abuse increases the likelihood of auditory hallucination development. A dose-response relationship was also observed, whereby sexual abuse of greater severity was associated with increased symptom severity. The results are discussed in the context of current theoretical understandings of childhood risk factors and auditory hallucinations.

Part two reports on an empirical study that used virtual reality to explore the impact of childhood interpersonal trauma and negative schemas on trust. Seventy participants from the general population interacted with a virtual avatar. Lower ratings of this avatar's trustworthiness, as well as a preference for greater interpersonal distance, were shown to be associated with increased experiences of particular forms of childhood trauma. The majority of these associations were found to be mediated by negative beliefs about the self and others. The potential mechanisms underlying these specific associations and the clinical implications are discussed. This study was a joint research project completed with Emilie Bourke, a fellow D.Clin.Psy Trainee at University College London. The findings of this researcher's thesis are presented separately.

Part three is a critical appraisal, providing thoughts and personal reflections regarding the research process as a whole. It discusses the difficulties of recruiting a clinical sample, considers the complexities of the study of trauma, and remarks upon the bi-directional relationship between research and clinical practice.

## **Impact Statement**

Childhood trauma is widespread and has far-reaching consequences for psychological development and adult mental health outcomes. This thesis focused upon two particular adverse outcomes: auditory hallucinations and difficulties with trusting others. Both were found to be more common in those who had experienced certain forms of childhood maltreatment.

The findings of this research are intended for dissemination in relevant psychological journals. The results provide additional support for the well-established role of trauma in contributing to adult psychopathology. They also build upon existing research, firstly, by quantitatively analysing and reviewing the heterogeneous literature on the relationship between childhood sexual abuse and auditory hallucinations, and secondly, by using virtual reality as a novel tool in the experimental study of trauma, negative schemas, and trust. This study is the first to apply virtual reality to the study of trauma and trust. Through doing so it has been able to provide objective real-time data, control for safety behaviours, and avoid exclusive reliance on self-report. This research was also able to reveal the mediating role of negative schemas, therefore providing a deeper understanding of this complex relationship.

Across both papers, the current theoretical gaps in our understanding of the intrapersonal and interpersonal effects of trauma are explored. The methodological difficulties of studying a phenomenon as complex and idiosyncratic as trauma is also discussed and future research directions proposed in line with these observations. These considerations may help to inform the design of future research in this area.

The results of this thesis may also help to inform psychological practice. The findings suggest that professionals working therapeutically with young people who are known to have experienced trauma, may encounter more difficulties with building trusting relationships. Furthermore, those who have experienced child sexual abuse may be at particular risk of developing auditory hallucinations in the future. This insight could inform the way a client's difficulties are formulated. Considerations of the presenting problems in the context of historical traumatic and abusive experiences allows for a more compassionate and meaningful understanding of symptoms. Additionally, this contextualised understanding could serve to tailor effective interventions.

Finally, the findings of this research serve to emphasise the utmost importance of protecting children, who are one of the most vulnerable groups within our society. The reported associations between preventable childhood risk factors and negative adult outcomes highlight the necessity of early and accurate detection of maltreatment. The results suggest that trauma-informed practices, such as the use of systematic, high quality screening and assessment tools, amongst agencies and professionals involved in the care of children could help to safeguard those at risk.

## Table of Contents

<b>List of Tables</b> .....	9
<b>List of Figures</b> .....	10
<b>Acknowledgements</b> .....	11
<b>Part One: Literature Review</b> .....	13
<b>Abstract</b> .....	14
<b>1. Introduction</b> .....	15
1.1. Auditory hallucinations.....	15
1.2. Aetiology of auditory hallucinations .....	16
1.3. Childhood trauma and psychosis.....	19
1.4. Current review .....	22
1.5. Review questions .....	23
<b>2. Method</b> .....	24
2.1. Literature search .....	24
2.2. Eligibility criteria.....	24
2.3. Search strategy .....	25
2.4. Search procedure and study selection.....	26
2.5. Quality assessment of studies.....	28
2.6. Description of study characteristics.....	29
2.7. Planned analysis .....	34
2.8. Heterogeneity of effect sizes .....	36
2.9. Publication bias .....	37
<b>3. Results</b> .....	37
3.1. Prevalence of sexual abuse.....	37
3.2. Prevalence of auditory hallucinations.....	40
3.3. Sexual abuse and risk of auditory hallucinations .....	42
3.4. Severity of abuse and risk of auditory hallucinations.....	48
3.5. Severity of abuse and severity of auditory hallucinations .....	49
3.6. Summary of meta-analyses .....	50
<b>4. Discussion</b> .....	52
4.1. Continuum of auditory hallucinations .....	52
4.2. Theoretical underpinnings of results .....	54

4.3. Equifinality .....	56
4.4. Multifinality.....	57
4.5. Limitations of studies.....	60
4.6. Review limitations .....	63
4.7. Strengths of review .....	64
4.8. Implications of findings .....	64
4.9. Further research .....	66
<b>5. Conclusions .....</b>	<b>67</b>
<b>6. References .....</b>	<b>68</b>
<b>Part Two: Empirical Study .....</b>	<b>87</b>
<b>Abstract.....</b>	<b>88</b>
<b>1. Introduction .....</b>	<b>89</b>
1.1. Childhood interpersonal trauma.....	89
1.2. Childhood trauma and mental health outcomes.....	90
1.3. Negative schemas.....	92
1.4. The study of trust .....	94
1.5. Study aims .....	95
1.6. Hypotheses .....	98
<b>2. Method .....</b>	<b>99</b>
2.1. Design.....	99
2.2. Procedure.....	101
2.3. Measures.....	107
2.4. Planned data analysis .....	110
<b>3. Results .....</b>	<b>114</b>
3.1. Descriptives .....	114
3.2. Differences between abused and non-abused groups .....	121
3.3. Associations between trauma and trust.....	121
3.4. Mediating role of negative schemas.....	123
<b>4. Discussion .....</b>	<b>133</b>
4.1. Summary of findings.....	133
4.2. Trauma and trust: A complex relationship.....	133
4.3. Specificity of effect.....	135
4.4. Negative schemas: A central role .....	139

4.5. Other contributing factors .....	142
4.6. Study strengths and limitations .....	142
4.7. Clinical implications and future research .....	148
<b>5. Conclusions</b> .....	150
<b>6. References</b> .....	151
<b>Part Three: Critical Appraisal</b> .....	173
<b>1. Introduction</b> .....	174
<b>2. Recruitment</b> .....	174
2.1. Ethical approval and recruitment of a clinical sample .....	174
2.2. Recruitment of a non-clinical sample .....	177
<b>3. The Study of Trauma</b> .....	178
3.1. Ethical considerations .....	179
3.2. Methodological considerations .....	181
<b>4. The Bi-Directional Relationship</b> .....	182
4.1. The impact of clinical work on research .....	183
4.2. The impact of research on clinical work .....	184
<b>5. Conclusions</b> .....	185
<b>6. References</b> .....	187
<b>Appendices</b> .....	189

## **List of Tables**

<b>Table</b>	<b>Part One: Literature Review</b>	<b>Page</b>
Table 1	Childhood adversity and risk of psychosis	20
Table 2	Three-component search strategy for systematic literature search	25
Table 3	Characteristics of included studies	30
Table 4	Summary of meta-analytic results	51
<b>Table</b>	<b>Part Two: Empirical Study</b>	<b>Page</b>
Table 1	Overview of the experimental procedure	103
Table 2	Contingency mapping: Participant behaviours and avatar responses	105
Table 3	Summary statistics: Key demographic features	115
Table 4	Summary statistics: Childhood trauma and schemas	116
Table 5	Associations between trauma variables	117
Table 6	Summary statistics: Sense of Presence and PANAS questionnaires	119
Table 7	Associations between childhood trauma, negative schemas, and trust variables	122
Table 8	Summary of mediation analyses	131

## List of Figures

<b>Figure</b>	<b>Part One: Literature Review</b>	<b>Page</b>
Figure 1	PRISMA flowchart of study selection process	27
Figure 2	Meta-analytic output: Prevalence of child sexual abuse in those who experience auditory hallucinations	38
Figure 3	Meta-analytic output: Prevalence of auditory hallucinations in those who have a history of child sexual abuse	41
Figure 4	Meta-analytic output: Risk of developing auditory hallucinations in those who have experienced child sexual abuse	44
Figure 5	Meta-analytic output: Risk of developing auditory hallucinations in those who have experienced childhood rape	47
Figure 6	Meta-analytic output: Association between child sexual abuse severity and auditory hallucination severity	49
<b>Figure</b>	<b>Part Two: Empirical Paper</b>	<b>Page</b>
Figure 1	Images of the virtual reality paradigm in use	107
Figure 2	Diagrammatic representation of the mediating role of negative beliefs about others in the relationship between emotional abuse and subjective trust	124
Figure 3	Diagrammatic representation of the mediating role of negative beliefs about others in the relationship between emotional neglect and subjective trust	126
Figure 4	Diagrammatic representation of the mediating role of negative beliefs about others in the relationship between physical neglect and subjective trust	127
Figure 5	Diagrammatic representation of the non-significant mediating role of negative beliefs about self in the relationship between sexual abuse and interpersonal distance	128
Figure 6	Diagrammatic representation of the mediating role of negative beliefs about self in the relationship between emotional neglect and interpersonal distance	130

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**Part One: Literature Review**

**Childhood Sexual Abuse and Auditory Hallucinations:**

**A Systematic Review and Meta-Analysis**

## Abstract

**Aims:** This meta-analysis aimed to explore the relationship between childhood sexual abuse (CSA) and auditory hallucinations (AH).

**Method:** A systematic search of three databases, Pubmed, Psychinfo and Embase, identified 19 studies that quantitatively explored the association between CSA and AH in individuals from either the general or psychosis populations. Separate meta-analyses were carried out to explore prevalence rates, risk of AH development following CSA and the role of abuse severity on symptom severity.

**Results:** Prevalence rates of CSA in those with AH ranged from 2% – 38%, with a pooled proportion of 18% (95% CI = 12 to 27). Prevalence rates of AH in those with a history of CSA ranged from 8% – 60%, with a pooled proportion of 25% (95% CI = 10 to 48). CSA was found to be associated with an increased likelihood of experiencing AH, with an odds ratio of 2.37 (95% CI = 1.37 to 4.09). Childhood rape conferred a higher risk of AH development than CSA generally, with an odds ratio of 3.64 (95% CI = 1.71 to 7.77). Finally, a small but significant effect of CSA severity on AH severity was found  $r = .14$  (95% CI = .06 to .22). Relationships were found across both general and psychosis populations; however, this association appeared to be stronger among those in the clinical population.

**Conclusion:** While CSA is neither necessary nor sufficient, it increases the likelihood of AH development. A dose-effect response was observed, whereby the severity of CSA was associated with the presence of AH, and their severity. The notions of equifinality and multifinality are discussed in order to explore the differential impact of CSA across individuals. The findings are also considered in the context of methodological limitations across the included studies.

## **1. Introduction**

### **1.1. Auditory Hallucinations**

Hallucinations are sensory experiences that occur in a fully conscious state, without external stimulation (Beck & Rector, 2003). Auditory hallucinations (AH) are a particular subcategory that involves the perception of sounds in the absence of an auditory stimulus (American Psychiatric Association, 2013). The experience of hearing voices, termed auditory verbal hallucinations (AVH), is the most frequently reported type of AH, however other forms, such as hearing sounds, noises, murmurs, clicks, whispers, and music can also commonly occur (American Psychiatric Association, 2013).

AH are core features of psychotic disorders, with prevalence rates of around 60-80% (Sartorius et al., 1986), but they also occur in other psychiatric presentations, such as depression and bipolar disorder (45%), borderline personality disorder (40%), posttraumatic stress disorder (PTSD) (15%), anxiety disorders (14%), and autism (6%) (Blom & Sommer, 2010; Sommer & Kahn, 2015). AH are complex phenomena that are considered to exist on a spectrum, varying in their frequency, intensity, and vividness (Johns et al., 2014), with experiences ranging from unaccountable transient noises, to hypnagogic or hypnopompic false auditory perceptions, to full blown voice hearing (de Leede-Smith & Barkus, 2013). AH are frequently, but not necessarily, associated with distress, functional disability, and increased risk of suicidality (Braham, Trower, & Birchwood, 2004; McCarthy-Jones, 2012).

AH are not exclusive to clinical groups and are experienced by those in the general population (Beavan, Read, & Cartwright, 2011; Johns et al., 2014), with a recent meta-analysis calculating that one in ten individuals will experience AH in

their lifetime (Maijer, Begemann, Palmen, Leucht, & Sommer, 2018). AH in this group of non-help-seeking individuals are often more transient and sporadic in nature (Hanssen, Bak, Bijl, Vollebergh, & Os, 2005), although they can be recurrent and persistent in a minority (4%) (McGrath et al., 2015). In line with this, dimensional conceptualisations propose that AH lie on a continuum with normal experience (Badcock & Hugdahl, 2012; Baumeister, Sedgwick, Howes, & Peters, 2017; Bentall, 2006; Claridge, 1994).

## **1.2. Aetiology of Auditory Hallucinations**

The mechanisms underlying the development and maintenance of AH are unclear and multifaceted (Maijer et al., 2018). In the past bio-medical explanatory models have dominated, however psychological and social factors such as attachment, dissociation, cognitive biases, behavioural sensitisation, psychodynamic defences, problematic coping resources, social support, and social deprivation have received increased research attention over recent decades (Read, Fosse, Moskowitz, & Perry, 2014). With an increased focus in the literature upon the influence of psychosocial factors, there has also been a growing interest as to whether experiences of childhood trauma could contribute to the presence of specific symptoms of psychosis, such as AH. Alongside a number of studies setting out to investigate this potential association, several trauma-focused explanatory models have also been proposed.

**1.2.1. Trauma focused explanatory models.** Early life is a time of unique sensitivity and neuroplasticity, with excess stress in this period capable of creating long-lasting implications for the brain, behaviour, and mental health (Gee & Casey,

2015; Kays, Hurley, & Taber, 2012). A multitude of theories have tried to conceptualise how childhood trauma could impact neurobiological, cognitive, affective, and memory pathways and result in the development of psychotic symptoms such as AH.

The traumagenic neurodevelopmental model is one such framework. Seeking to integrate biological, psychological, and social research, it aims to account for how childhood adversity increases an individual's risk of developing psychiatric symptoms. The model proposes that prolonged stressful experiences in childhood result in changes to the brain and body during critical periods of development (Read, Perry, Moskowitz, & Connolly, 2001). It draws upon a body of research which has shown neurological and biological changes in those who have undergone prolonged distress during childhood (Read, Bentall, & Fosse, 2009). In particular, it stresses the importance of heightened glucocorticoid release during periods of intense distress and the associated changes to the hypothalamic-pituitary-adrenal (HPA) axis and striatal dopamine levels, which have in turn been linked to psychotic symptoms such as AH (Bentall, 2006).

More cognitively focused explanations have also been put forward to bridge the gaps between childhood trauma and hallucinations. Source monitoring deficits and cognitive disturbances are hypothesised to result in AH via an individual mistakenly appraising an internal experience as coming from an external agent (Brookwell, Bentall, & Varese, 2013; Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001). However, poor source monitoring has also been documented in patients no longer experiencing hallucinations, suggesting that this may be a vulnerability factor rather than a proximal cause (Varese, Barkus, & Bentall, 2011). Another prominent cognitive explanation proposes that traumatic incidents

contribute to the development of maladaptive schematic models of the self and others, resulting in hypervalent cognitions which can exceed the perceptual threshold and be experienced as hallucinations (Paulik, 2012). These hallucinations are then said to be maintained by an individual's underlying negative core beliefs, which influence the way that AH are experienced (Beck & Rector, 2003).

Memory based explanatory models have also been suggested and are in keeping with psychological understandings of PTSD symptoms. It has been theorised that during times of high distress, the amygdala, a region critical for emotion, is activated and serves to encode memories rather than the hippocampus (Brewin, 2001). Bypassing of the hippocampus allows for quicker processing; however, the deviation prevents the hippocampus from performing its typical role of integrating information within a spatial and temporal context (Steel, 2015). Consequently, it is thought that traumatic experiences are not properly processed, resulting in the unintentional activation of trauma memories. These can then be experienced as unwanted and uncontrollable inner experiences (e.g. AH) that are not recognised because of the absence of contextual cues that would normally facilitate recognition (Alsawy, Wood, Taylor, & Morrison, 2015; LeDoux, Iwata, Cicchetti, & Reis, 1988; Priebe et al., 2013; Steel, 2015). Research that has documented commonalities between the type of trauma experiences and the content of hallucinations (e.g. hearing a voice that sounds like the perpetrator) is supportive of such theories (Hardy et al., 2005; Read & Argyle, 1999). However, the relationship remains unclear with recent research reporting that posttraumatic avoidance, numbing, and hyperarousal, but not intrusive trauma memories are involved in mediating the relationship between trauma and AH (Hardy et al., 2016).

Other researchers have argued that dissociation could account for the development of AH after experiencing trauma (Anketell, Dorahy, & Curran, 2010). Dissociative states have been shown to be a common reaction to trauma (Longden, Madill, & Waterman, 2012; Moskowitz & Corstens, 2008) and their role as a potential mediator has received empirical support from several studies (Gómez & Freyd, 2017; Perona-Garcelan et al., 2012; Varese et al., 2012), with one finding that reports of dissociation reliably preceded the onset of hallucinatory voices (Varese et al., 2011).

In recognition of the breadth of co-existing explanations, a Levels of Explanation (LoE) approach has been proposed. This posits that mental phenomena such as AH, can be understood at different levels of understanding, including cultural, clinical, cognitive, brain imaging, cellular, and molecular (Hugdahl & Sommer, 2017). The LoE framework acknowledges the lack of synthesis across the literature and stresses the importance of unifying data from different levels in order to best explain the aetiology of AH.

### **1.3. Childhood Trauma and Psychosis**

Childhood trauma is a common occurrence; with some prevalence estimates suggesting that up to a third of the general population may be affected (Kessler et al., 2010). Childhood adversity has been implicated as a risk factor for most adult mental health disorders, including: PTSD, depression, anxiety, eating disorders, substance abuse, personality disorders, and dissociative disorders (Read, van Os, Morrison, & Ross, 2005). Experiences of trauma have also been shown to have a casual role in the development of psychosis, with traumatic life events reported to be the most robust environmental risk factor for the development of psychotic disorders (Bendall,

Alvarez-Jimenez, Nelson, & McGorry, 2013; Morgan & Fisher, 2006). Various forms of interpersonal childhood abuse (including sexual, physical and emotional) have been found to be associated with an increased risk of psychosis. A meta-analysis reported odds ratios ranging from: 2.38 to 3.40 across different forms of abuse, as well as a dose-response effect, whereby more severe adversity was associated with greater psychotic symptom severity (see Table 1 for the results of meta-analysis by Varese et al., 2012).

Table 1  
*Childhood Adversity and Risk of Psychosis*

Type of adversity	Risk of psychosis (OR, 95% CI)
Overall childhood adversity	2.78 (2.34 to 3.31)
Sexual abuse	2.38 (1.98 to 2.87)
Physical abuse	2.95 (2.25 to 3.88)
Emotional abuse	3.40 (2.06 to 5.62)

*Note.* Abbreviations: OR = odds ratio, 95% CI = 95% confidence intervals.

*Note.* Data is taken from a meta-analysis by Varese et al. (2012).

**1.3.1. Specificity between trauma and symptoms.** As evidence has accumulated on the psychological mechanisms underlying the transition from trauma to symptoms of psychosis, a body of research has hypothesised that some degree of specificity should be expected (Bebbington, 2009; Bentall & Fernyhough, 2008). It has been hypothesised that whilst the impact of specific types of trauma will vary between individuals, the effects are likely to overlap in terms of the particular symptoms they are associated with (Bentall, Wickham, Shevlin, & Varese, 2012). However, evidence is inconsistent as to whether such specificity is indeed present,

with some large-scale studies finding symptom specificity (Bentall et al., 2012) and others not (Janssen et al., 2004). The most consistently reported finding is that a history of childhood trauma increases the severity of positive symptoms of psychosis, including hallucinations and delusions (Duhig et al., 2015; Read et al., 2005). A recent systematic review (Bailey et al., 2018) provided further support, showing that among individuals with psychosis, childhood trauma is significantly correlated with severity of hallucinations ( $r = .199, p < .001$ ), and delusions ( $r = .172, p < .001$ ), but not with negative symptoms ( $r = .049, p = .095$ ).

Within this specificity-focused literature, childhood sexual abuse (CSA) has been a form of trauma that has received a great deal of research attention (Janssen et al., 2004). This focus upon sexual abuse is unsurprising, with prevalence rates in the general population as high as 1 in 20 children (Radford et al., 2011). This figure is higher still among those with psychosis-spectrum disorders, with prevalence rates of self-reported sexual abuse estimated at 26% (Bonoldi et al., 2013). Alongside being highly prevalent, the impact of CSA upon quality of life has been shown to be far reaching (Spataro, Mullen, Burgess, Wells, & Moss, 2004). Those with a mental health diagnosis and a history of CSA have been shown to have earlier first admissions, more frequent hospitalisations, longer periods in seclusion, are prescribed higher doses of medication, and are at increased risk of suicide (Lange, Kooiman, Huberts, & Van Oostendorp, 1995).

It has been suggested that a unique association exists between CSA and AH, with a critical review by McCarthy-Jones (2011) having explored this notion. This review of prevalence data showed that, overall, those with AVH were more likely to be survivors of CSA than individuals without AVH and survivors of CSA were more likely to report AVH than individuals without CSA. McCarthy-Jones (2011) also

examined data from four studies utilising a control group methodology to better infer causality, the review commented upon the lack of control in these studies for confounding variables and the lack of reliable quantitative evidence of a causal relation. McCarthy-Jones (2011) concluded that whilst a majority of studies found that those with a history of CSA were more likely to report AVH than individuals without CSA, large-scale and well-designed studies controlling for confounding variables were needed in order to assign a causal role.

Evidence for the association between CSA and AH also comes from qualitative research which has highlighted the links between sexually abusive experiences and AH using first-person testimonies (Read et al., 2005, Romme, Escher, Dillon, Corstens, & Morris, 2009) and case study approaches (Bahn & Lee, 2007; Lysaker, Buck, & LaRocco, 2007). Further to this, several studies have documented thematic associations between CSA and the content of AH (e.g. voices talking about the abuse or sounding like abuse perpetrators) (Corstens & Longden, 2013; Hardy et al., 2005; Read & Argyle, 1999; Reiff, Castille, Muenzenmaier, & Link, 2012).

#### **1.4. Current Review**

This review will aim to synthesise current research and quantitatively summarise the association between CSA and AH. To date, aside from McCarthy-Jones' (2011) calculation of prevalence data, there has yet to be a meta-analysis examining the strength of the association between CSA and AH. Furthermore, since the previous review the relationship between CSA and AH has been explored through more and more rigorously controlled studies, this should therefore allow for a deeper exploration. While the previous review (McCarthy-Jones, 2011) focused specifically on AVH, the current review will include studies that focus on both AH

generally and AVH specifically. This decision has been made in line with a dimensional and spectrum-based understanding of auditory hallucinations. As research has reported that childhood adversities may also increase the risk of psychotic experiences in those without psychosis (Lataster et al., 2006; Sommer et al., 2010; Varese et al., 2012), studies including both psychosis and general population samples will be included in the review.

### **1.5. Review Questions**

This review will systematically search the literature and use the resulting studies to answer the following questions:

#### ***Prevalence of CSA and AH***

- i: What is the prevalence of CSA in people with AH?
- ii: What is the prevalence of AH in people who have experienced CSA?

#### ***Risk of AH development***

- iii: What is the likelihood of experiencing AH in those who have a history of CSA?

#### ***Dose-response relationship***

- iv: Is the severity of CSA associated with presence and severity of AH?

## **2. Method**

### **2.1. Literature Search**

A systematic literature search was carried out to identify papers suitable for the review and meta-analysis.

### **2.2. Eligibility Criteria**

Studies were included if they met all of the following criteria:

- a) Used a quantitative measurement of auditory hallucination experiences.
- b) Used a quantitative measurement of childhood sexual abuse.
- c) Participants had a diagnosis of a psychosis spectrum disorder or were members of the general population.
- d) Reported an index of the prevalence and/or association between childhood sexual abuse and auditory hallucinations.
- e) Were published in a peer-reviewed journal, in the English language.

Studies were excluded if they met any of the following criteria:

- a) Examined hallucinations, positive symptoms, or psychotic symptoms generally (not auditory hallucinations specifically).
- b) Examined childhood trauma/abuse generally (not childhood sexual abuse specifically).
- c) Examined other diagnostic groups (e.g. PTSD or personality disorder) or included mixed psychiatric groups (e.g. 'inpatients') where different diagnostic presentations (i.e. psychosis) were not analysed separately.

### 2.3. Search Strategy

Three bibliographic databases were deemed to be most relevant to this review: Pubmed, Psychinfo, and Embase. After initial scoping searches, the key topic concepts were combined to create a three-component strategy (see Table 2) which was then used to search each database (see Appendix 1). The databases were searched between the dates of 1987 and July 31<sup>st</sup>, 2017.

Table 2

*Three-Component Search Strategy for Systematic Literature Search*

Childhood	AND	Sexual abuse	AND	Auditory hallucinations
Child*		Abuse*		Hallucin*
		Trauma*		“Positive symptoms”
		Maltreat*		“Psychotic symptoms”
		Exploit*		“Symptoms of psychosis”
		Adversit*		“Psychotic experiences”
		Assault*		“Voice hearing”
		Victimi?ation		“Hearing voices”
		CSA		AH
				AVH

*Note.*

1. Terms within columns combined with OR, columns combined with AND.
2. The key conceptual terms ‘sexual abuse’ and ‘auditory hallucinations’ were not specifically included as these concepts were captured through the inclusion of the broader search terms ‘abuse\*’ and ‘hallucin\*’; this allowed for the greatest balance of sensitivity and specificity.
3. The term adolescence was not included as its inclusion resulted in a high volume of false positives and omitting it allowed for the greatest balance of sensitivity and specificity.

## 2.4. Search Procedure and Study Selection

The search procedure was in line with the Cochrane protocol for the identification of papers for systematic review (Higgins & Green, 2011) and used the software program EndNote X5 (Reuters, 2011). The search across all three databases yielded a total of 1660 results; this was reduced to 925 once duplicates were removed. These 925 papers were then screened, firstly by title and subsequently by abstract. Papers that appeared to still meet inclusion criteria ( $n = 87$ ) were then read in full to ensure eligibility. Following this, the references of all included studies and the papers that had since cited these, were hand searched, which yielded seven additional studies. References of the newly identified papers were then also checked to ensure that all relevant papers were included. A total of 19 papers were deemed suitable for the final review and meta-analysis. The authors of two studies were contacted and asked to supply additional information in order to be included (Abajobir et al., 2017; Üçok & Bikmaz, 2007), both authors provided the required data. Figure 1 shows a PRISMA diagram (Moher, Liberati, Tetzlaff, & Altman, 2009) outlining the process of study screening and selection.

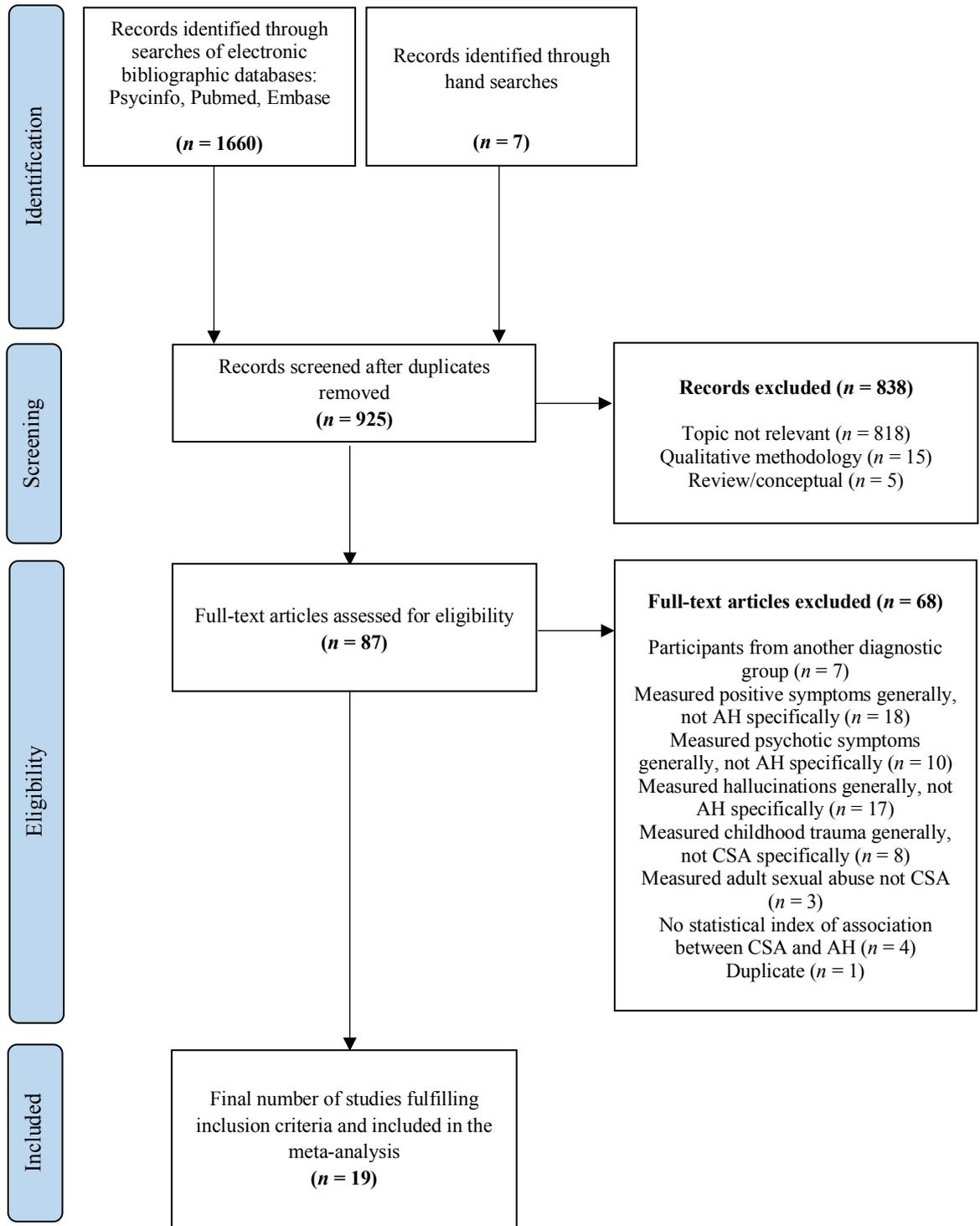


Figure 1. PRISMA flowchart of study selection process (Moher, et al., 2009).

## 2.5. Quality Assessment of Studies

The 19 included studies were assessed using a quality assessment scale (QAS) based on an adapted version of the Standard Quality Assessment Criteria for Evaluating Primary Research Papers (Kmet, Lee, & Cook, 2004) (see Appendix 2 for the original version). The QAS included 14 criteria to rate journal articles against, with ratings of: 2 (fulfilled completely), 1 (partially fulfilled), and 0 (not fulfilled at all). Four questions regarding randomisation were excluded, as these were not relevant to the research methodologies being investigated. Three additional questions specific to the current review were instead added: (1) “Was the measure of childhood sexual abuse validated and appropriate?” (2) “Was the measure of auditory hallucinations validated and appropriate?” (3) “Does the method of analysis make direct comparison between the two variables?” (See Appendix 3 for the full version of the scale and Table 3 for scores).

Scores on the QAS ranged from 15 (Andrew, Grey, & Snowden, 2008; Honig et al., 1998) to 25 (Bentall et al., 2012; Daalman et al., 2012; Sommer et al., 2010) of a possible 26 points. Higher scoring studies utilised validated measures of CSA and gathered first person accounts of childhood trauma (as opposed to using patient records/clinician accounts only). Higher rated studies also used validated measures of AH, controlled for confounding factors in their analyses, and reported findings more fully and in context. The standard across studies was generally high ( $M = 22$ ). The lowest score of 15 was not judged to be sufficiently sub-standard to exclude, therefore all 19 studies were included in the analysis.

## 2.6. Description of Study Characteristics

Details of the included studies are shown in Table 3. Across studies there were 35,322 unique participants (general population:  $n = 33,743$ ; psychosis population:  $n = 1579$ ). All 19 studies were carried out in developed countries. Five studies took place in England (Bentall et al., 2012; Freeman & Fowler, 2009; Hardy et al., 2016; Offen, Waller, & Thomas, 2003; Pilton et al., 2016), four in the Netherlands (Daalman et al., 2012; Honig et al., 1998; Sommer et al., 2010; van Nierop et al., 2014), three in the USA (Sheffield, Williams, Blackford, & Heckers, 2013; Shevlin, Dorahy, & Adamson, 2007; Shevlin et al., 2011), three in Australia (Abajobir et al., 2017; Goldstone, Farhall, & Ong, 2012; McCarthy-Jones et al., 2014), one in Norway (Berg et al., 2015), one in Wales (Andrew, et al., 2008), one in Turkey (Üçok & Bikmaz, 2007), and one in Poland (Misiak, Moustafa, Kiejna, & Frydecka, 2016).

Studies ranged from a small sample size of 26 (Offen et al., 2003), to a large sample of 13,722 (van Nierop et al., 2014). Six studies recruited solely from the general population, seven recruited from psychosis-spectrum populations, and six recruited a mixed sample of psychosis and general population samples.

Table 3: *Characteristics of Included Studies*

Study (date) <i>country</i>	Participants	<i>n</i>	Age mean ( <i>SD</i> )	CSA measurement	CSA construct	AH measure	Data type			QAS
							Prevalence of CSA	Prevalence of AH	Risk of AH Association	
<b><u>General population studies</u></b>										
<b>Abajobir et al.</b> (2017) <i>Australia</i>	General population	3751	20.6 (np)	Consultation of child protection records for substantiated reports before the age of 14 of “exposing a child to, or involving a child in, inappropriate sexual activities.”	CSA	YASR	✓	✓	✓	22
<b>Bentall et al.</b> (2012) <i>England</i>	General population	7266	np	Three yes/no questions: 1. “Before the age of 16, did anyone talk to you in a sexual way that made you feel uncomfortable?” 2. “Before the age of 16, did anyone touch you, or get you to touch them, in a sexual way without your consent?” 3. “Before the age of 16, did anyone have sexual intercourse with you without your consent?”	CSA <sup>talk</sup> CSA <sup>touch</sup> CSA <sup>rape</sup>	PSQ	✓	✓	✓	25
<b>Freeman &amp; Fowler,</b> (2009) <i>England</i>	General population	200	37.5 (13.3)	One yes/no question from the Life Stressor Checklist: “Before age 16, did you ever have sex (oral, anal, genital) when you didn't want to because someone forced you in some way or threatened to harm you if you didn't?” Only events that reached the severity criterion related to PTSD diagnosis were scored as occurring.	CSA <sup>rape</sup>	CAPS	✓	✓	✓	23
<b>Shevlin et al.</b> (2007) <i>USA</i>	General population	5877	32.0 (10.6)	Two yes/no questions: 1. “You were raped (someone had sexual intercourse with you when you did not want to by threatening you or using some degree of force).” 2. “You were sexually molested (someone touched or felt your genitals when you did not want them to).”	CSA <sup>touch</sup> CSA <sup>rape</sup>	CIDI	✓	✓	✓	23
<b>Shevlin et al.</b> (2011) <i>USA</i>	General population	2353	44.4 (17.3)	Two yes/no questions: 1. “Did anyone have sexual intercourse with you or penetrate your body with a finger or object when you did not want them to?” 2. “Other than rape, were you ever sexually assaulted where someone touched you inappropriately, or when you did not want them to?”	CSA <sup>touch</sup> CSA <sup>rape</sup>	CIDI	✓		✓	22

Table 3 continued...

Study (date) <i>country</i>	Participants	<i>n</i>	Age mean ( <i>SD</i> )	CSA measurement	CSA construct	AH measure	Data type				QAS
							Prevalence of CSA	Prevalence of AH	Risk of AH	Association	
<b>van Nierop et al.</b> (2014) <i>Netherlands</i>	General population	13,722	42.6 (12.5)	One yes/no question asked by an interviewer: “Have you had any unwanted sexual experience before the age of 16?”	CSA	CIDI			✓		22
<b>Psychosis population studies</b>											
<b>Berg et al.</b> (2015) <i>Norway</i>	Psychotic disorder	454	30.1 (10.5)	Sexual abuse section of Childhood Trauma Questionnaire.	CSA	SCID-5				✓	23
<b>Hardy et al.</b> (2016) <i>England</i>	Relapsing psychotic disorder	228	38.2 (11.1)	Trauma History Questionnaire. Sexual abuse was coded from two items pertaining to child abuse (under age 13 and under age 18).	CSA	SAPS	✓	✓	✓		24
<b>McCarthy-Jones et al.</b> (2014) <i>Australia</i>	Schiz. spectrum disorders	333	39.9 (11)	One yes/no item on the Childhood Adversity Questionnaire: “I was sexually abused by a parent.”	CSA	DIP	✓		✓		22
<b>Misiak et al.</b> (2016) <i>Poland</i>	First episode psychosis	94	26.4 (5.3)	Sexual abuse scale of the Early Trauma Inventory Self-Report. To be classified as occurring two criteria had to be met: 1. Experienced emotions of intense fear, horror or helplessness. 2. The subject had an out-of-body experience/felt like being in a dream.	CSA	OPCRIT				✓	24
<b>Offen et al.</b> (2003) <i>England</i>	Psychotic disorder	26	34 (np)	One yes/no question: “Did you have any frightening experiences of a sexual nature as you were growing up?”	CSA	Identified by clinicians	✓				16

Table 3 continued...

Study (date) <i>country</i>	Participants	<i>n</i>	Age mean ( <i>SD</i> )	CSA measurement	CSA construct	AH measure	Data type				QAS
							Prevalence of CSA	Prevalence of AH	Risk of AH	Association	
<b>Pilton et al.</b> (2016) <i>England</i>	Psychotic disorder	55	42.2 (11.3)	Sexual abuse section of Childhood Trauma Questionnaire.	CSA	PSYRATS				✓	24
<b>Üçok &amp; Bikmaz,</b> (2007) <i>Turkey</i>	First episode psychosis	57	np	Childhood Abuse Questionnaire: The patients were asked, before 18 years of age, whether they experienced an adult exposing themselves and whether an adult had threatened them with intercourse, touched their genitals or had had intercourse with them. Severity of CSA assessed using Childhood Trauma Questionnaire (CTQ)	CSA	SAPS				✓	22
<b><u>Group comparison studies</u></b>											
<b>Andrew et al.</b> (2008) <i>Wales</i>	Non-clinical VH	21	50.7 (11.3)	Sexual abuse items of Post-Traumatic Diagnostic Scale.	CSA	PSYRATS	✓				15
<b>Daalman et al.</b> (2012) <i>Netherlands</i>	Non-clinical VH	127	42.4 (12.6)	Sexual abuse section of Childhood Trauma Questionnaire. Only scores < 8 (equivalent to 'moderate to severe' childhood sexual abuse) were classed as actually occurring.	CSA	PSYRATS	✓		✓		24
	Non-clinical NVH	124	43.1 (14.4)								
<b>Goldstone et al.</b> (2012) <i>Australia</i>	Psychotic VH	100	38 (11.5)	Items in the Early Trauma Inventory Self-Report were deemed by case managers to be potentially distressing to patients. Therefore, three questions were asked: 1. "Were you ever sexually abused?" 2. "About how many times did you experience sexual abuse?" 3. "How distressed were you at the time of the abuse?"	CSA	LSHS-R				✓	23
	Non-clinical	133	np								

Table 3 continued...

Study (date) <i>country</i>	Participants	<i>n</i>	Age mean ( <i>SD</i> )	CSA measurement	CSA construct	AH measure	Data type			QAS
							Prevalence of CSA	Prevalence of AH	Risk of AH Association	
<b>Honig et al.</b> (1998) <i>Netherlands</i>	Schizophrenia	18	np	Clinician interview: Sexual abuse was deemed present when the subject reported having been sexually abused before the age of 16 by an intimate older person or raped by a stranger.	CSA	AHI	✓			15
	Non-clinical VH	15	np							
<b>Sheffield et al.</b> (2013) <i>USA</i>	Psychotic disorder NVH	27	35.5 (14.1)	Sexual abuse section of Childhood Trauma Questionnaire.	CSA	SCID-5			✓	23
	Psychotic disorder VH	87	37.9 (12.1)							
<b>Sommer et al.</b> (2010) <i>Netherlands</i>	Non-clinical VH	94	44 (13)	Sexual abuse section of Childhood Trauma Questionnaire.	CSA	CASH PSYRATS			✓	25
	Non-clinical NVH	60	46 (15)							

*Note.* Abbreviations: *SD* = Standard deviation; QAS = Quality assessment scale; np = Not provided; CPS = Child protection services; VH= Voice hearers, NVH= Non-voice hearers. CSA<sup>talk</sup> = sexual talk; CSA<sup>touch</sup> = sexual touch; CSA<sup>rape</sup> = childhood rape. CSA measures: Life Stressor Checklist (LSC: Wolfe & Kimerling, 1997); Childhood Trauma Questionnaire (CTQ: Bernstein et al., 2003); The Trauma History Questionnaire (THQ: Green, 1996); Childhood Adversity Questionnaire (ACE: Rosenman & Rodgers, 2004); Early Trauma Inventory Self-Report (ETISR: Bremner, Bolus, & Mayer, 2007); Post-traumatic Diagnostic Scale (PDS: Foa, Cashman, Jaycox, & Perry 1997). Auditory hallucination measures: Young Adult Behavioural Checklist (YABC: Achenbach, 1997); Psychosis Screening Questionnaire (PSQ: Bebbington & Nayani, 1995); Cardiff Anomalous Perceptions Scale (CAPS: Bell, Halligan, & Ellis, 2006); Composite International Diagnostic Interview (CIDI: Kessler, Andrews, Mroczek, Ustun, & Wittchen, 1998); The Structured Clinical Interview (SCID-5, First, Williams, Karg, & Spitzer 2011); Scales for the Assessment of Positive Symptoms (SAPS: Andreasen, 1984); Diagnostic Interview for Psychosis (DIP: Castle et al., 2005); Operational Criteria Checklist for Psychotic Illness and Affective Illness (OPCRIT+: McGuffin, Farmer, & Harvey, 1991); Psychotic Symptom Rating Scales (PSYRATS: Haddock, McCarron, Tarrier, & Faragher 1999); Launay Slade Hallucinations Scale (LSHS-R: Larøi, Marczewski, & Van der Linden, 2004); The Auditory Hallucination Interview (AHI: Romme & Alexandre, 1989); Comprehensive Assessment of Symptoms and History (CASH: Andreasen, Flaum, & Arndt, 1992).

## **2.7. Planned Analysis**

**2.7.1. Analytic procedure.** The DerSimonian and Laird random effects model (1986) was adopted a priori for all meta-analyses. This was deemed to be more appropriate than a fixed effects model, as it was expected that the true effect would vary from study to study due to differences in measures, clinical features, and demographics of each sample. The studies included in the meta-analyses were assumed to be a random sample of the relevant distribution of effects and the combined effect estimates the mean effect in this distribution (Borenstein, Hedges, Higgins, & Rothstein, 2009).

The studies included in this review measured and conceptualised different aspects of childhood sexual abuse (e.g. abuse overall, sexual touch, rape). In some cases, these groups were not mutually exclusive (i.e. participants may have belonged to more than one group, having undergone multiple forms of abuse). The reporting of multiple effect sizes from the same population infringes the meta-analytic principle of assuming independence between the effect sizes included (Borenstein et al., 2009). Therefore, in such cases where multiple sub-groups were reported upon, only one group was chosen for inclusion in the meta-analysis. Where this was the case this is stated, and the implications of group choice discussed.

**2.7.2. Prevalence data.** Prevalence data was meta-analysed using the “metafor” (Viechtbauer, 2010) statistical package for R (R Core Team, 2012). Proportions (%) and 95% confidence intervals were calculated, as well as a pooled proportion across studies. Where multiple groups are reported upon (i.e. sexual talk, sexual touch, and rape), the more severe form of CSA data (i.e. rape) was included in the analysis. This decision was made in line with previous research, which has

shown a dose-response relationship between trauma and hallucinations (Bailey et al., 2018) and CSA and psychosis (Varese et al., 2012).

**2.7.3. Risk of auditory hallucinations.** In order to explore whether experiencing any episode of CSA is associated with any presence of AH in later life, data utilising dichotomous variables was meta-analysed using Review Manager (The Cochrane Collaboration, 2014). As only seven out of nine studies provided full 2x2 contingency data for the rates of CSA and AH, the Generic Inverse Variance Outcome Method was used. This method allowed for the inclusion of a final two studies (Shevlin et al., 2011; van Nierop et al., 2014) that provided only odds ratio and confidence interval data. In line with the Generic Inverse Variance Outcome Method, all odds ratios and confidence intervals were first subject to logarithm transformations (Borenstein et al., 2009). Standard error was then calculated for each sample using the logarithm of the upper and lower confidence interval data. For two studies (Daalman et al., 2009; McCarthy-Jones et al., 2014), confidence interval and/or odds ratios were not given, these were therefore first calculated using a 2x2 contingency table in Review Manager. These processes allowed for the inclusion of all nine suitable studies within the analysis.

**2.7.4. Dose-response relationship.** Three studies (Daalman, et al., 2012; Sheffield et al., 2013; Sommer et al., 2010) explored whether CSA severity is associated with the presence of AH, however these studies could not be combined due to a lack of necessary data (means and standard deviations). Therefore, the results of these studies are discussed, but were not meta-analysed.

To explore whether CSA severity is associated with AH severity, a meta-analysis using correlational data was carried out using the “metafor” (Viechtbauer, 2010) statistical package for R (R Core Team, 2012). The meta-analytic model automatically weights studies based on sample size. All studies included reported correlational effects, therefore Pearson’s  $r$  was selected to be the effect size metric included within the analyses. Correlation coefficients have a skewed standard error formulation, so effect sizes were transformed to Fisher’s  $Z$  scores (Cooper, Hedges, & Valentine, 2009) and the analysis then carried out on the transformed data before being converted back to Pearson’s  $r$  (Borenstein et al., 2009).

## **2.8. Heterogeneity of Effect Sizes**

Heterogeneity statistics (Cochran’s  $Q$  test and  $I^2$ ) are reported in order to show the amount of variance between studies. Cochran’s  $Q$  statistic assesses for heterogeneity due to sampling error, however it has been found to have low power to detect true heterogeneity when analyses only include a small number of studies (Higgins, 2008). Therefore, the  $I^2$  statistic, which calculates the amount of variance in effect sizes that is accounted for by between-study variance, was also reported (Higgins & Thompson, 2002). Higgins (2008) has argued that heterogeneity is to be expected in meta-analyses and therefore any amount of heterogeneity is acceptable, provided that the predefined eligibility criteria are met and the data is correct. In line with this, in instances where an individual study was significantly contributing to increased heterogeneity, this study was not removed from the analysis. However, where heterogeneity was high, this is commented upon and the implications discussed.

## 2.9. Publication Bias

Publication bias was not assessed as there were an inadequate number of included studies per meta-analysis to properly judge this using a funnel plot or more advanced regression-based assessment (e.g. Begg's rank test or Egger's regression test). These tests have been shown to be unreliable when used on meta-analyses of low numbers, particularly when heterogeneity is high (Sterne, Egger, & Davey-Smith, 2001). Results should be interpreted with this caveat in mind.

## 3. Results

### 3.1. Prevalence of Sexual Abuse

A total of 11 studies reported the frequency of CSA history in people with AH or provided sufficient data for this to be calculated (see Figure 2). Six studies collected data from a general population sample, three from a psychosis sample, and two studies collected data from both populations (Daalman et al., 2012; Honig et al., 1998). Three studies (Bentall et al., 2012; Shevlin et al., 2007; Shevlin et al., 2011) reported prevalence data for separate sexual abuse subcategories (i.e. rape, sexual touch, and sexual talk). In line with meta-analytic assumptions of independent groups, data from only one group (childhood rape) was entered into the analyses.

As shown in Figure 2, the meta-analysis found that across samples, prevalence rates of CSA ranged from 2% (95% CI = 1 to 4) to 38% (95% CI = 20 to 59) (Abajobir et al., 2017 and Offen et al., 2003, respectively). The random effects model calculated the pooled proportion to be 18% (95% CI = 12 to 27). There was significant heterogeneity between studies:  $Q (df= 12) = 20.2, p = <.001, I^2 = 77\%$ .  $I^2$  was greater than 75% which can be considered indicative of high heterogeneity between studies (Higgins & Thompson, 2002).

**Study (Population)**

**Proportion (95% Confidence Intervals)**

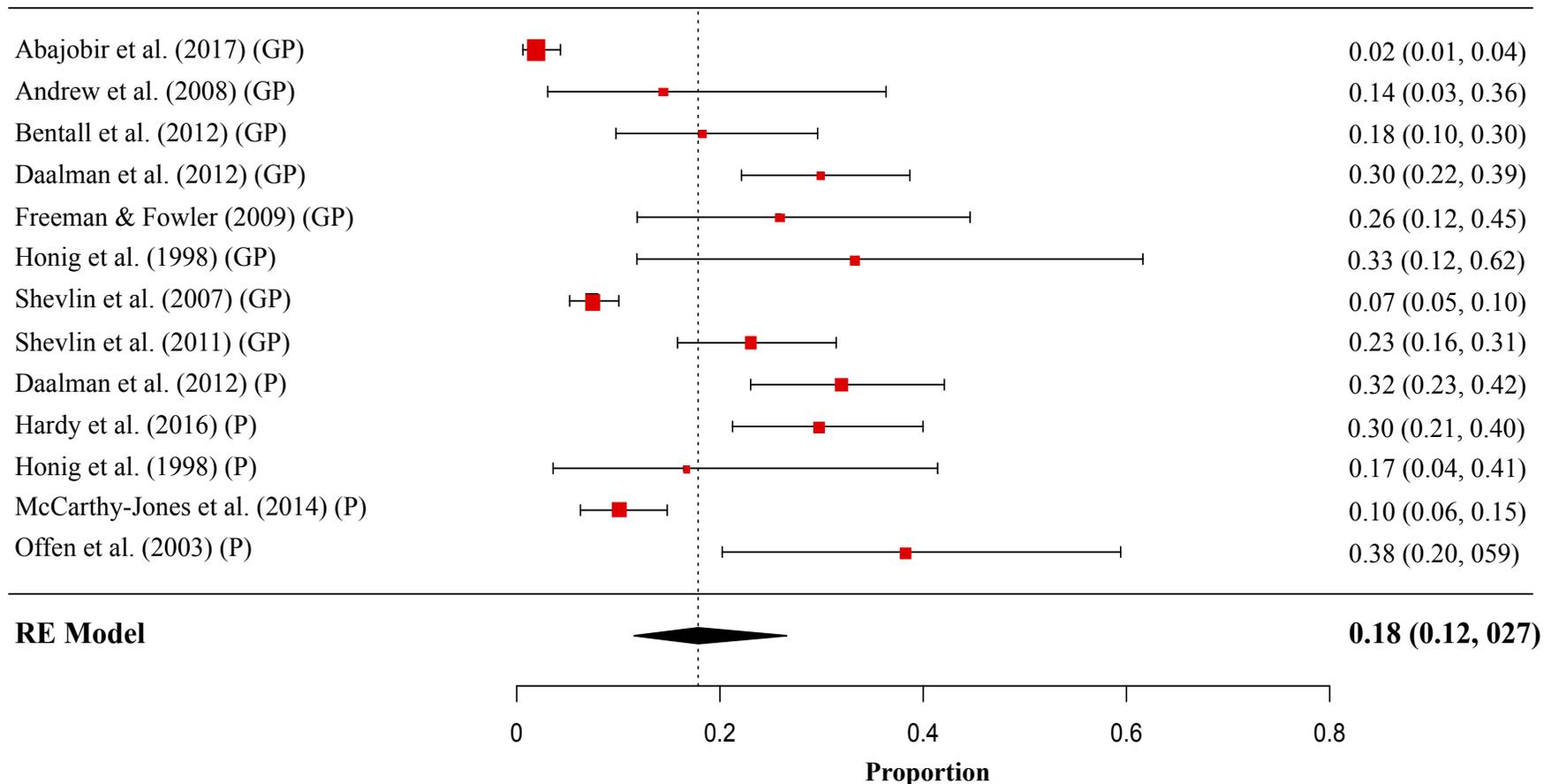


Figure 2. Meta-analytic output detailing the individual proportions and pooled effect size of studies measuring the prevalence of CSA in those who experience AH. Note. Abbreviations: (P) = psychosis population sample; (GP) = general population sample; RE Model = random effects model.

When meta-analysed separately, the psychosis population group was shown to have a pooled proportion of 23% (95% CI = 14 to 36), with rates ranging from 10% (95% CI = 6 to 15) to 38% (95% CI = 20 to 59) (McCarthy-Jones et al., 2014 and Offen et al., 2003, respectively). The general population was found to have a lower pooled proportion of 15% (95% CI = 8 to 26), with prevalence rates ranging from 2% (95% CI = 1 to 4) to 33% (95% CI = 12 to 62) (Abajobir et al., 2017 and Honig et al., 2003, respectively).

There was significant heterogeneity between studies and the range between prevalence estimates was high. This may be indicative of biases in sampling and/or a lack of reliability/validity in measurements of CSA and/or AH. All but one study (Honig et al., 1998) scored a maximum of 2 points on the QAS for the criterion: “Was the measure of auditory verbal hallucinations validated and appropriate?” However, only three out of the 11 studies (Daalman et al., 2012; Hardy et al., 2016; McCarthy-Jones et al., 2014) scored a maximum of 2 points on the QAS for the criterion: “Was the measure of childhood sexual abuse validated and appropriate?” This is reflective of the lack of validated measures of CSA that were used in this selection of included studies and may explain some of the variance in prevalence rates.

The highest prevalence rate of 38% was reported by Offen et al. (2003), which was given the third lowest QAS score (16/26) of the included studies. In this study CSA was measured by asking the question “Did you have any frightening experiences of a sexual nature as you were growing up?” This question is less specific than those used by other studies, as such, it may have set the threshold for sexual abuse lower, which could partially account for the higher prevalence rates. Participants were also only chosen to participate in this study if their key worker

thought that they were “able to talk about those experiences without distress”. This may have led to a biased sample, whereby the participants were more willing or able to disclose abuse compared to those recruited via random sampling in other studies. This method of sampling may also have resulted in the recruitment of individuals who had experienced less severe CSA or were less emotionally distressed by these experiences.

Across populations, the three studies with the largest samples (McCarthy-Jones et al., 2014; Abajobir et al., 2017; Shevlin et al., 2007) had the lowest prevalence rates. The lowest prevalence rate of 2% was recorded by Abajobir et al. (2017). This low prevalence could be explained by the methodology of the study. Only those with “substantiated reports” of CSA in their child protection records were deemed to have undergone CSA, with no participants being asked directly about their experiences. As CSA is highly underreported to professionals, it is likely that this is a vast underestimation of true prevalence. This study also only measured experiences of CSA between the ages of 0-14. This would have resulted in children older than 14 who had experienced CSA not being recognised by the methodology of this study, which may also have contributed to the observed lower rate.

### **3.2. Prevalence of Auditory Hallucinations**

Five studies reported the frequency of AH in people with a history of CSA or provided sufficient data for this to be calculated (see Figure 3). Four of these studies recruited from the general population and one from the psychosis population (Hardy et al., 2016). The meta-analysis showed that across both samples, prevalence rates of AH ranged from 8% (95% CI = 4 to 14) to 60% (95% CI = 45 to 74) (Bentall et al., 2012 and Hardy et al., 2016, respectively). The random effects model calculated the

pooled proportion to be 25% (95% CI = 10 to 48). Once again there was significant heterogeneity between studies:  $Q (df = 4) = 19.4, p = <.001, I^2 = 70\%$ , with  $I^2$  of a ‘moderate’ level (Higgins & Thompson, 2002).

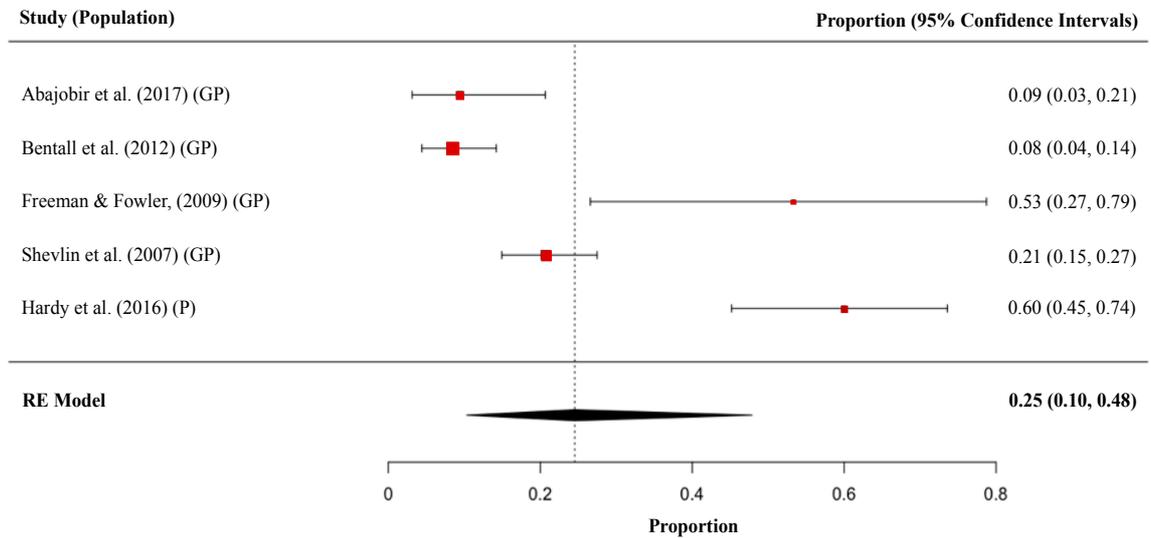


Figure 3. Meta-analytic output detailing the proportions and pooled effect size of studies measuring the prevalence AH in people who have a history of CSA.

Note. Abbreviations: (P) = psychosis population sample; (GP) = general population sample; RE Model = random effects model.

When analysed separately (without Hardy et al., 2016), the general population prevalence rates ranged from 8% (95% CI = 4 to 14) to 53% (95% CI = 27 to 79) (Bentall et al., 2012 and Freeman & Fowler, 2009, respectively) with a pooled proportion of 23% (95% CI = 14 to 36).

Heterogeneity estimates were high in this analysis, as was the range in prevalence rates between studies. Hardy et al., (2016) reported a prevalence rate of 60% among a sample presenting with relapsing psychotic disorders. This study scored highly on the QAS (24/26) and used validated measures of CSA and AH. This higher rate may therefore be indicative of actual increased rates of CSA and AH amongst those with particularly chronic or relapsing psychosis, compared to those

from the general population. This would be consistent with previous research that has highlighted that more severe abuse is associated with more positive psychotic symptoms and poorer outcomes in those with psychosis (Hassan & De Luca, 2015).

Among the general population samples, Freeman & Fowler (2009) reported a far higher prevalence (53%) than the other three studies. This higher rate may be reflective of a less representative sample due to smaller sample size ( $N = 200$ ). This study also used an experimental (virtual reality) research design, whereas the other three studies were significantly larger in scale (ranging from  $N = 3751$  to  $7266$ ), with two studies using population-wide surveys (Bentall et al., 2012; Shevlin et al., 2007) and one using data from a large longitudinal birth cohort (Abajobir et al., 2017). Alternatively, this higher prevalence could be attributable to the inclusion of only those who had experienced “severe sexual abuse” rather than all unwanted sexual experiences. It is possible that in line with hypothesised dose-response mechanisms, greater severity of sexual assault may result in a higher risk of AH, which would therefore account for this increased prevalence rate.

### **3.3. Sexual Abuse and Risk of Auditory Hallucinations**

Nine studies provided sufficient data to be included in this analysis. In these nine studies, the independent variable, of sexual abuse in childhood, was measured and conceptualised in different ways (see Table 3). Four studies (Abajobir et al., 2017; Daalman et al., 2012; Hardy et al., 2016; McCarthy-Jones et al., 2014) grouped a number of different acts of childhood sexual abuse (i.e. sexual talk, sexual touch, and rape), creating an overarching construct of ‘CSA’. Two studies analysed only those who had experienced rape during childhood (Freeman & Fowler, 2009; McCarthy-Jones, 2017). Two further studies sorted participants based on their

response to two questions, one about sexual touch and another about childhood rape (Shevlin et al., 2007; Shevlin et al., 2011). A final study broke CSA into separate components of sexual talk, sexual touch, and rape (Bentall et al., 2012). In three studies (Bentall et al., 2014; Shevlin et al., 2007; Shevlin et al., 2011) statistics were reported separately by sexual abuse type, with no total provided.

As some participants may have belonged to multiple groups, subgroups within the studies could not be assumed to be sufficiently separate populations. In order to balance the inclusion of studies with the minimisation of heterogeneity, those studies measuring overall CSA ( $n = 5$ ) and those that analysed childhood rape ( $n = 4$ ) were analysed as two separate meta-analyses.

**3.3.1. ‘CSA’ and risk of auditory hallucinations.** The five studies that had classified different forms of sexual abuse under an over-arching ‘CSA’ construct were analysed. Two studies used a general population sample (Abajobir et al., 2017; van Nierop et al., 2014), two studies used a psychosis population sample (Hardy et al., 2016; McCarthy-Jones et al., 2014), and one study provided separate data for both psychosis and non-clinical groups (Daalman et al., 2012). The analysis was first conducted across both populations in order to explore any possible transdiagnostic effect (see Figure 4).

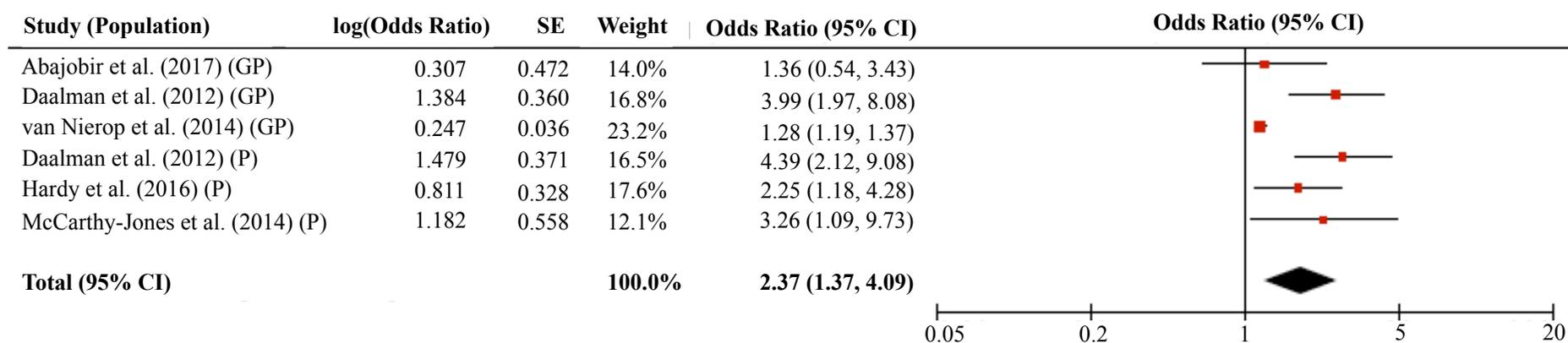


Figure 4. Meta-analytic output detailing the risk (odds ratio) of developing AH in those who have experienced CSA.

Note. Abbreviations: (P) = psychosis population sample; (GP) = general population sample; SE = standard error; (95% CI) = 95% confidence intervals; log(Odds Ratio) = logarithm transformed log odd ratios.

The test for overall effect was significant ( $Z = 3.08, p = .002$ ), with an odds ratio of 2.37 (95% CI = 1.37 to 4.09). There was significant heterogeneity between studies:  $Q (df = 5) = 25.9, p = <.001, I^2 = 81\%$ . As  $I^2$  was greater than 75% this was considered indicative of high heterogeneity between studies (Higgins & Thompson, 2002). When the study by van Nierop et al. (2014) was removed, heterogeneity was no longer significant and was reduced to  $Q (df = 4) = 5.25, p = .26, I^2 = 24\%$ . The overall effect remained significant ( $Z = 5.16, p <.001$ ) and the odds ratio increased slightly (OR: 2.89, 95% CI = 1.93 to 4.33). However, in line with Higgins (2008), as this study rated highly (QAS: 22/26), met the predefined eligibility criteria, and was not significantly different in its methodology it was not excluded from the final meta-analysis.

When the three studies using a psychosis population sample (Daalman et al., 2012; Hardy et al., 2016; McCarthy-Jones et al., 2014) were analysed separately, the test for overall effect remained significant ( $Z = 4.97, p <.001$ ). The risk of developing AH was higher among this population, with an odds ratio of 3.05 (95% CI = 1.97 to 4.75). There was no heterogeneity amongst these three studies  $Q (df = 2) = 1.84, p = 0.4, I^2 = 0\%$ .

Unlike the psychosis population, the overall effect was not significant when studies reporting data from the general population were meta-analysed separately ( $Z = 1.63, p = 0.1$ ). The risk of developing AH was shown to be lower (although still higher than 1, conveying an elevated risk), with an odds ratio of 1.85 (95% CI = 0.88 to 3.87). Heterogeneity was significant and high in this sub-set of studies and was again mainly attributable to the inclusion of van Nierop et al. (2014):  $Q (df = 2) = 9.89, p = .007, I^2 = 80\%$ .

**3.3.2. ‘Rape’ and risk of auditory hallucinations.** A meta-analysis was then conducted using the four studies (Bentall et al., 2012; Freeman & Fowler, 2009; Shevlin et al., 2007; Shevlin et al., 2011) reporting the impact of childhood rape upon risk of AH (see Figure 5). All four of these studies used a general population sample.

The test for overall effect was significant ( $Z = 3.34, p < .001$ ) and the odds ratio was 3.64 (95% CI = 1.71 to 7.77). Heterogeneity was significant and of a ‘moderate’ level (Higgins & Thompson, 2002)  $Q (df = 3) = 8.55, p = 0.04, I^2 = 65\%$ .

These results suggest that rape confers a significantly higher risk of experiencing AH in later life. The results are also suggestive of a dose-response effect, with the studies measuring ‘rape’ producing a higher odds ratio than those studies which measured ‘CSA’ (OR: 3.64 and 2.37 respectively).

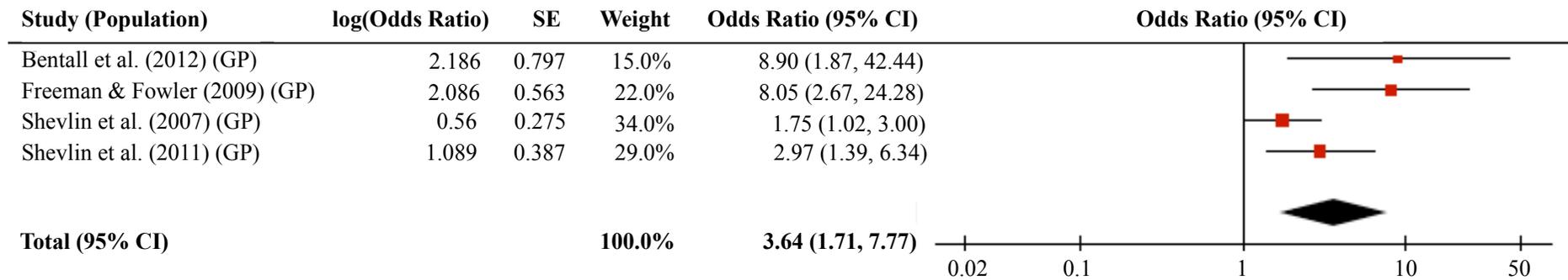


Figure 5. Meta-analytic output detailing the risk (odds ratio) of developing AH in those in those who have experienced childhood rape.

Note. Abbreviations: (GP) = general population sample; SE = standard error; (95% CI) = 95% confidence intervals; log(Odds Ratio) = logarithm transformed log odd ratios.

### 3.4. Severity of Abuse and Risk of Auditory Hallucinations

Three studies explored whether the severity of CSA is associated with the presence (as opposed to absence) of AH in later life (Daalman, et al., 2012; Sheffield et al., 2013; Sommer et al., 2010). Mean and standard deviation data was not available for two out of the three studies (Daalman et al., 2012; Sheffield et al., 2013); as such this data could not be meta-analysed.

Daalman et al. (2012) explored this association in both psychosis and general population samples. The study reported that the group with psychosis and AVH did not differ significantly in levels of CSA from those in the non-clinical and AVH group. Whereas the psychotic AVH group had significantly higher scores than the non-clinical group without AVH ( $U = 628, p = .001$ ) and similarly, the non-clinical AVH group also had significantly higher CSA scores than the non-clinical and non-AVH group ( $p = .001$ ). Sheffield et al. (2013) compared individuals with psychosis, with and without AH, those with AH scored significantly higher on a measure of CSA ( $F(1, 112) = 6.2, p = .01$ ) and this remained significant after controlling for symptoms of depression ( $F(1, 110) = 4.5, p = .04$ ). Sommer et al. (2010) compared non-clinical participants with and without AVH on levels of CSA. Those with AVH had significantly higher scores on the sexual abuse subscale of the Childhood Trauma Questionnaire (Bernstein et al., 2003) ( $M = 7.3, SD = 4.5$ ) than those without AVH ( $M = 5.7, SD = 1.3; F = 9.60, p = .002$ ).

Whilst a meta-analysis could not be performed on this data, the pattern of results across the three studies is consistent with previous research and is suggestive of an association between the severity of CSA and the presence of AH.

### 3.5. Severity of Abuse and Severity of Auditory Hallucinations

Five studies explored whether the severity of CSA is associated with the severity of AH. Figure 6 shows the correlation coefficient of each study and its sample size, as entered into the meta-analysis. Four studies reported on data taken from a psychosis sample, in one study (Goldstone et al., 2012), statistics were reported separately for two different participant groups, general population and psychosis. The meta-analysis was first conducted with all five suitable studies, with the inclusion of both datasets (psychosis and general population) from Goldstone et al. (2012). The results showed that the aggregate random effects estimate for the relationship between CSA severity and severity of AH in adulthood was  $r = .14$  (95% CI = .06 to .22;  $Z = 3.48, p < .001$ ), indicative of a small, but significant effect. Heterogeneity was found to be low amongst these studies and was not significantly greater than expected from sampling error:  $Q(df = 5) = 5.89, p = 0.32, I^2 = 18.4\%$ .

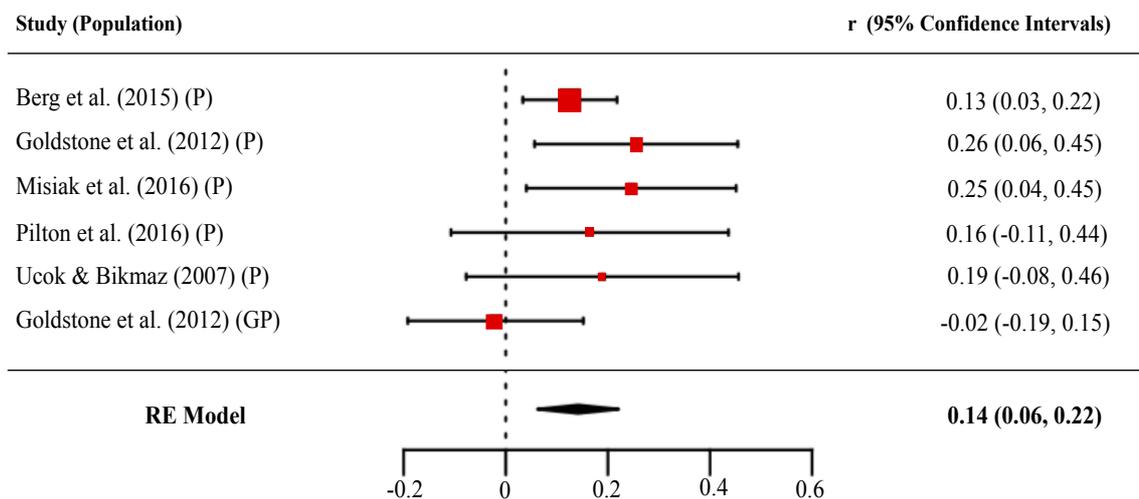


Figure 6. Meta-analytic output detailing the correlation coefficients and pooled effect size of studies measuring the association between CSA severity and AH severity.

Note. Abbreviations: (P) = psychosis population sample; (GP) = general population sample; RE Model = random effects model.

As the other samples were taken from a non-clinical sample, the meta-analysis was then re-run, excluding the Goldstone et al. (2012) psychosis group data. The meta-analysis showed that the aggregate random effects estimate in the psychosis only samples to be  $r = .16$  (95% CI = .09 to .24;  $Z = 4.49$ ,  $p < .001$ ). Heterogeneity testing was again non-significant ( $Q (df = 4) = 2.12$ ,  $p = 0.71$ ) and showed even less variance with the omission of the general population data ( $I^2 = .05\%$ ).

### **3.6. Summary of Meta-Analyses**

A tabular summary of all meta-analytic results can be seen in Table 4. The results of the analyses showed a consistent association between CSA and AH in both general and psychosis populations. Prevalence rates, odds ratios, and associations were found to be higher in the psychosis group compared to the general population sample, however it is notable that CI were shown to generally be overlapping.

Table 4

*Summary of Meta-Analytic Results*

Data type	Research questions	Meta-analytic results		
		Psychosis population	General population	Across populations
<b>Prevalence</b>	History of CSA in people with AH	23% (95% CI = 14 to 36)	15% (95% CI = 8 to 26)	18% (95% CI = 12 to 27)
	AH in people with a history of CSA	60% <sup>1</sup> (95% CI = 45 to 74)	23% (95% CI = 14 to 36)	25% (95% CI = 10 to 48)
<b>Risk of AH</b>	AH among people with a history of CSA	OR: 3.05 (95% CI = 1.97 to 4.75)	OR: 1.85 (95% CI = .88 to 3.87).	OR: 2.37 (95% CI =1.37 to 4.09)
	AH among people with a history of childhood rape	nc	OR: 3.64 (95% CI = 1.71 to 7.77)	nc
<b>Dose-response</b>	Severity of CSA and severity of AH	$r = .16$ (95% CI = .09 to .24)	$r = -.02$ <sup>2</sup> (95% CI = -.19 to .15)	$r = .14$ (95% CI = .06 to .22)

*Note.* Abbreviations: nc = non-calculable

<sup>1</sup> Data based on single study (Hardy et al., 2016), data was not meta-analysed.

<sup>2</sup> Data based on single study (Goldstone et al., 2012), data was not meta-analysed.

## **4. Discussion**

This review found that CSA increases the likelihood of experiencing AH in both non-clinical and psychosis populations. A dose-response effect, whereby more severe CSA was associated with more severe AH, was also established. These findings support the broader notion that childhood adversity increases the risk of developing specific psychiatric symptoms in later life. The results are also in line with other meta-analytic evidence that has explored the impact of CSA and found that it confers a higher risk for the development of psychosis (Varese et al., 2012) and that childhood trauma is correlated with hallucination severity (Bailey et al., 2018). This review has narrowed this association further, showing a specific relationship between CSA and AH in two separate populations.

### **4.1. Continuum of Auditory Hallucinations**

Over recent years there has been a surge of research interest in the phenomenon of healthy individuals who experience AH (Bentall, 2006). This change in focus appears to reflect a broader reconceptualisation of psychosis and a shift from diagnostic to symptom-focused approaches (McCarthy-Jones, 2011). In support of a continuum-based understanding, a recent systematic review found that the risk factors for AH development were similar between clinical and non-clinical voice-hearers (Baumeister et al., 2017). The results of the present meta-analysis offer further evidence of an AH spectrum by demonstrating that CSA is a risk factor across both clinical and non-clinical populations.

While a relationship between CSA and AH was found in both groups, some differences are noteworthy. The meta-analyses showed higher prevalence rates of CSA in those with AH in the psychosis group (23%), comparative to the general

population group (15%). However, due a large range between studies and high heterogeneity these results should be interpreted with caution. There were also differences between groups in risk of AH development following CSA, with the psychosis population showing a higher likelihood of AH development (OR: 3.05) than the general population group which did not remain significant when studies using the construct 'CSA' were meta-analysed (OR: 1.85). In the four studies that explored childhood rape, the risk in the general population was shown to be higher (OR: 3.64). However, as no studies with a psychosis population sample explored childhood rape separately, it is not possible to make a direct comparison between the two groups. Overall, it is therefore difficult to distinguish with certainty how many of the observed discrepancies between groups were attributable to methodological differences between studies (e.g. how CSA was measured and classified, study design and sample size), particularly given that heterogeneity was shown to be high between studies.

Methodological issues aside, these differences between groups could be attributable to a stronger effect of CSA among those in the clinical sample. Some have argued that there are important differences between AH experiences in the general and psychosis populations, with “healthy voice hearers” shown to differ significantly in their control over AH, their beliefs about the voices, and the level of distress they experience as a result of them (Baumeister et al., 2017). It has been hypothesised that risk factors such as CSA may affect individuals differently depending upon the presence of other factors (van Os & Reininghaus, 2016). For instance, the three-hit model of stress vulnerability (Daskalakis, Bagot, Parker, Vinkers, & de Kloet, 2013), argues that those in the psychosis and general populations both experience a first hit (genetic/neurobiological predisposition), then

a shared second hit (CSA), but then differ in terms of the presence or absence of a final third hit (later life adversity). Supportive of this, non-clinical voice hearers have been shown to have fewer additional risk factors, (e.g. less likely to use drugs and be unemployed) (Peters et al., 2016). This discrepancy in adult life experiences in the aftermath of CSA may crucially shape the diagnostic trajectory and could explain the observed higher rates/severity of AH seen in the clinical group (Baumeister et al., 2017).

#### **4.2. Theoretical Underpinnings of Results**

The findings observed in this review are in line with any number of trauma focused explanatory models and could be explained at the neurobiological, psychological, or social levels.

A cognitive framework of psychosis argues that maltreatment leads to a disrupted ability to make accurate appraisals (Garety et al., 2001). This is then said to result in the individual mistakenly interpreting perceptual, psychological, and bodily experiences as being beyond their control. These inaccurate appraisals of internal events as anomalous and foreign sensations are thought to lead to the individual experiencing internal stimuli as an external AH experience (Chadwick & Birchwood, 1994; Read et al., 2005). Cognitive theorists have also explored the role of negative schemas in the development and maintenance of AH (Thomas, Farhall, & Shawyer, 2015; Smith et al., 2006; Paulik, 2012). Distressing life events, such as childhood abuse can result in the development of negative beliefs (e.g. “I am unlovable”, “people are dangerous”) (Beck, Himelstein, & Grant, 2017; Young, Klosko, & Weishaar, 2003). In some individuals, these maladaptive ways of thinking are thought to exceed the perceptual threshold, becoming exaggerated and causing

hallucinatory expressions of dysfunctional beliefs (Sundag, Ascone, de Matos Marques, Moritz, & Lincoln, 2016). This schematic theory has also been linked to the traumagenic neurodevelopmental model (Beck et al., 2017). Trauma is known to lead to over activation of the HPA-axis, causing excessive output of cortisol and increased dopamine into the limbic and other regions of the brain (Klaassens, Giltay, Cuijpers, van Veen, & Zitman, 2012). It has been proposed that these neurological changes are responsible for increasing an individual's vulnerability to maladaptive schemas becoming transformed into hallucinations (Beck et al., 2017).

The association between CSA and AH could also be explained by memory and dissociation models. The link between dissociation and childhood abuse is well established (Longden et al., 2012; Moskowitz, 2011; Moskowitz & Corstens, 2008), with research also showing associations between psychosis and dissociation (Pearce et al., 2017; Sar et al., 2010), and AH and dissociation (Kilcommons & Morrison, 2005; Varese et al., 2011). Due to the intense emotions typically triggered by traumatic childhood experiences, the memories of these events are believed to be stored in the brain in an unintegrated and incoherent manner (Deprince & Freyd, 2001; Hardy et al., 2005). Hallucinatory experiences may therefore reflect dissociated traumatic content (e.g. the frightening voice of an abuser), impinging on conscious awareness; however recent evidence has shown that this may not be a straightforward relationship (Hardy et al., 2016).

Whilst this review did not set out to test the explanatory power of any particular model, the results are consistent with each, as all would predict an association between CSA and AH.

### **4.3. Equifinality**

This review found a significant association between CSA and AH; however, the results have also confirmed that not all of those with AH have a history of CSA. The concept of equifinality, which states that various etiological mechanisms and developmental pathways can lead to a single end state (Cicchetti & Rogosch, 1996), could serve to explain this finding. An interpretation of the results in line with equifinality would be that CSA can be considered as just one of many causal routes to AH development.

The array of theoretical, trauma-based explanatory models, each with supporting evidence, are in keeping with the notion of equifinality. This framework would predict multiple and potentially non-overlapping pathways to AH development (i.e. via cognitive, schematic, neurobiological, and memory systems). Equifinality would also predict that regardless of casual pathways, CSA would exert an effect through its interaction with individual variables that are antecedent (e.g., genetics, personality traits) or consequent to the events (e.g., cannabis use, further abuse, co-morbid mental health problems) (Gibson, Alloy, & Ellman, 2016).

This review noted that the prevalence of AH in those with psychosis, with a history of CSA is high (60% in Hardy et al., 2016). This supports the idea that there may not only be different routes to the development of CSA, but also to the development of psychosis. It is possible, that in those who experience CSA, the route to psychosis involves the development of AH, whereas for others, who experience risk factors other than CSA, a different route is taken (e.g. via the development of jumping to conclusion biases and subsequent delusions).

#### **4.4. Multifinality**

Considerations of equifinality could explain the absence of CSA history in some who experience AH; conversely, multifinality would predict the finding that not all survivors of CSA develop AH. Multifinality predicts that one initial factor, in this case CSA, could lead to several potential outcomes, depending upon a number of personal and environmental factors (Cicchetti & Rogosch, 1996). This explanation could therefore account for the range of symptomology seen in survivors of CSA, including AH, psychosis, PTSD, depression, or indeed no mental health problems at all.

**4.4.1. Meditating factors.** The relationship between CSA and AH is likely to be complex and mediated by other factors that serve to determine which individuals go on to develop AH. Prior research has implicated depression and anxiety as mediators in the relationships between CSA and psychosis (Bebbington et al., 2011; Marwaha & Bebbington, 2014) and CSA and hallucinations (Sitko, Bentall, Shevlin, O'Sullivan, & Sellwood, 2014). However Hardy et al. (2016), found no evidence that depression mediated the relationship between CSA and AVH in those with psychosis. Others have argued that dissociation has a mediating role, (Anketell et al., 2010; Moskowitz, 2011), having been linked to the relationship between childhood trauma and psychosis (Holowka, King, Saheb, Pukall, & Brunet, 2003; Perona-Garcelan et al., 2010), and childhood trauma and hallucination proneness in both non-clinical (Perona-Garcelan et al., 2014) and clinical samples (Varese et al., 2012). At present, the specific mechanisms mediating the relationship between CSA and AH are unclear, despite previous research calling for further exploration in this area (Bentall et al., 2012; McCarthy-Jones et al., 2017).

**4.4.2. Resilience and protective factors.** Moderating factors, including personal resilience, may also account for the differential impact of CSA across individuals. Research into childhood adversity has tended to focus upon the deleterious impact upon the individual, often with the aim of furthering our understanding of how best to prevent such outcomes and how to intervene therapeutically when they do occur (Bethel, Newacheck, Hawes, & Halfon, 2014). However, survivors of abuse have idiosyncratic responses to these experiences, with maladaptation and psychiatric symptoms not the only possible outcomes (Bonnano, 2004). A substantial subset of individuals, usually referred to as “resilient” (Goldstein & Brooks, 20013), are exposed to childhood trauma and abuse but demonstrate positive outcomes or show few long-term negative outcomes as a result of these experiences (Collishaw et al., 2007; Luthar, 2003). In support of this, a systematic review (Domhardt, Münzer, Fegert, & Goldbeck, 2015), found that between 10% and 53% of CSA survivors exhibited “typical” levels of functioning. A further review reported that a number of protective factors were repeatedly associated with resilient outcomes in response to CSA (Marriot, Hamilton-Giachritsis, & Harrop, 2014). These included inner resources (e.g. coping skills, high self-esteem, more positive interpretation of experiences), strong family relationships and friendships, good community resources (e.g. church or school), as well as some abuse-related factors (e.g. older age at onset). Research has also indicated that a child disclosing the abuse and being believed (Corby, 2001), parental warmth (Lind et al., 2018), secure attachment style (Berry, Wearden, Barrowclough, Oakland, & Bradley, 2012), and the implementation of an effective intervention to render the child safe in the aftermath of the abuse (Read et al., 2001), are all associated with increased resilience to psychiatric difficulties in adulthood. Protective factors such as these

could theoretically prevent the development of AH in a number of ways, including moderating epigenetic processes, reducing stress and therefore lowering HPA axis over-activation, allowing for more thorough cognitive processing of the trauma memories, or preventing the development of negative and hostile perceptions of the external world.

**4.4.3 Severity of abuse.** In this analysis, more severe CSA was associated with more severe AH, with childhood rape conferring a higher risk of AH development than CSA generally. Three studies (Daalman, et al., 2012; Sheffield et al., 2013; Sommer et al., 2010) that could not be meta-analysed due to insufficient data, also suggested that CSA of greater severity conferred a higher risk of AH. These findings are indicative of a dose-response relationship and are in line with previous research which has shown that severe forms of child sexual abuse have particularly diffuse and serious consequences for mental health (Dube et al., 2005; Spataro et al., 2004).

This dose-response effect is in-keeping with a number of theoretical understandings. A stress-vulnerability interpretation of these results (Zubin & Spring, 1977), would be that abuse of greater severity is more likely to exert demands that outweigh an individual's personal resources to cope; this may therefore exceed a stress threshold and result in AH. The traumagenic neurodevelopmental model might posit that severe trauma would have more prolonged effects upon neurobiological, schematic, and memory pathways (Read et al., 2001). This would therefore be likely to cause greater disruption to the mechanisms implicated in the development and maintenance of psychotic symptoms (e.g. over activation of the HPA axis, dysregulated dopamine and cortisol levels). Cognitive theorists may argue that abuse

of greater frequency and severity is more likely to contribute to the problematic thinking styles linked to positive symptoms (e.g. negative schemas about the self and others; difficulties with source monitoring; jumping to conclusions biases) (Brébion et al., 2016; Dudley, Taylor, Wickham, & Hutton, 2016). In addition, some have noted that CSA of greater severity is more likely to co-occur with factors related to adverse outcomes, such as poverty (Drake & Pandey, 1996), maternal mental health and educational problems (Allen-Meares, Blazeovski, Bybee, & Oyserman, 2010), and other forms of childhood abuse (Matta Oshima, Jonson-Reid, & Seay, 2014). As such, more severe abuse could also be indicative of an underlying/co-occurring variable that is also exerting an effect upon an individual's risk of AH development

Overall, as any incidence of CSA was also shown to increase risk, it appears likely that in line with multifinality, severity of abuse is one of many factors determining outcome, and that other personal and environmental aspects are also likely to inform which developmental trajectory individuals follow.

#### **4.5. Limitations of Studies**

**4.5.1. Measurement of key concepts.** The most significant limitation of the included studies was the diversity of methods used to identify, measure, and classify experiences of CSA. A total of 11 studies used validated trauma-focused questionnaires, one study consulted child protection records, one used a clinician interview, and six studies used binary (yes/no) questions relating to separate forms of childhood sexual abuse. These varying methods of assessing CSA prevalence are likely to differ in terms of both their reliability and validity, with each open to biases. As the underreporting of sexual abuse is well established (Collin-Vézina, De La Sablonnière-Griffin, Palmer, & Milne, 2015), it is also highly probable that not all of

those who partook in each study would have disclosed CSA if it had indeed occurred. In terms of the recording of CSA levels, cut-off points were used by some studies in order to classify whether or not an individual had experienced CSA or not, such as a score above eight points on the CTQ (Daalman, et al., 2012) and a score high enough to reach PTSD criterion level (Freeman & Fowler, 2009). Another study included only “substantiated” claims of CSA (Abajobir et al., 2017) and one study only included only those who had experienced CSA perpetrated by parents (McCarthy-Jones et al., 2014). Across the studies included in this review, CSA was also conceptualised in different ways, with the some classing any act of sexual abuse under the overarching category of ‘CSA’ and others separating different acts of abuse (i.e. sexual talk, sexual touch, and rape). This heterogeneity in how CSA was identified, measured and categorised appears to reflect research in the area of childhood trauma more generally and may be indicative of the difficulty in accurately detecting and conceptualising experiences that are often stigmatised, distressing and complex.

The measurement of AH was also a limiting factor across studies. While all but one study (Honig et al., 1998) used a validated and appropriate measure of AH, there have been recent calls for researchers to take a more in-depth approach to understanding these phenomena (Jones, 2010). The differences between individual reports of AH experiences has led to proposals that subtypes exist (Dodgson & Gordon, 2009; Jones, Fernyhough, & Larøi, 2010; McCarthy-Jones et al., 2015) with some preliminary evidence supporting this claim (McCarthy-Jones et al., 2015). If it is indeed the case that there are separate phenomenologies, then it follows that each could be underpinned by distinctive mechanisms and neurocognitive processes. This understanding of AH would suggest that certain subcategories of AH would be more

likely to occur as a result of CSA than others. Jones (2010) observed that in order to infer causal pathways between abuse and specific AH sub-categories, studies with research designs that group individuals with AH according to phenomenological subcategorisations are needed. Currently, this remains the case, with the present included studies not distinguishing between different sub-types of AH and therefore not making an exploration of this possible.

**4.5.2. Study design.** Some of the included studies used a prospective design, however the majority used a cross-sectional, retrospective design, which makes it difficult to satisfactorily address issues of causation. Similarly, while numerous large-scale studies have explored the association between childhood trauma and psychosis whilst controlling for a wide range of potentially confounding variables, this does not always appear to be the case in studies exploring the more specific relationship between CSA and AH. Several studies did not control for the range of confounding factors that have been implicated in the relationship between CSA and AH in previous research, despite the importance of this being recognised in a previous review (McCarthy-Jones, 2011).

Sampling methods also posed a limitation for some studies, particularly in studies recruiting from the psychosis population. For instance, Offen et al. (2003) only recruited patients who were deemed by their caseworker to be able to discuss their experiences without distress and Freeman & Fowler (2009) recruited people who were willing to engage in a virtual reality experiment. Non-random recruitment of participants may have increased the risk of biased samples in such studies.

#### **4.6. Review Limitations**

In light of the growing questions regarding the reliability and validity of psychosis-spectrum diagnoses, transdiagnostic approaches to understanding symptoms, such as hallucinations, are being increasingly adopted (Bentall, 2006). In line with this, this review included studies that sampled from the psychosis-spectrum and general populations. However, a limitation of this review is that it did not take a fully transdiagnostic approach, as individuals from other groups (i.e. PTSD, bipolar disorder, mixed psychiatric, and prisoners) were not included. This decision was made in an attempt to reduce the heterogeneity of the data; however, this may have resulted in the loss of meaningful information about individuals from other parts of the AH spectrum.

This review also focused solely upon the relationship between CSA and AH. It did not explore whether other forms of childhood interpersonal abuse (e.g. neglect, physical, and emotional), or other forms of childhood trauma (e.g. death of a loved one) are also related to AH. Previous reviews have shown that multiple forms of childhood adversity are related to psychosis (Read, Agar, Argyle, & Aderhold, 2003; Varese et al., 2012), furthermore the proposed theoretical mechanisms linking trauma and AH do not appear to act in ways that would be uniquely associated with sexual abuse. It is therefore probable that other forms of trauma could also be risk factors for AH. The scope of this review did not allow for comparisons between CSA and other forms of abuse, nor did it explore whether other forms of abuse interact with CSA in a cumulative way, increasing the risk further with each given abuse experience. Similarly, this review did not explore the role of moderating factors and therefore it is unclear whether personal or situational factors (e.g. socioeconomic

status, attachment style, and personality traits) serve to determine the impact of CSA upon AH.

#### **4.7. Strengths of Review**

The current review has systematically evaluated the relationship between CSA and AH, building upon a previous review (McCarthy-Jones, 2011), by including studies which have since been published, focusing more broadly upon AH (as opposed to AVH), and examining the association in both the general and psychosis populations. The review has involved mainly studies that were rated as high quality and had a total sample size of 35,322, making it well powered to comment upon the nature of the relationship between CSA and AVH.

The review systematically explored the separate issues of prevalence, risk and dose-response. This separation of key questions maximised the use of the available data. The inclusion of studies from both the general population and psychosis populations is in keeping with the increased understanding of AH as sitting upon a spectrum of experiences and has allowed for a more comprehensive view of the relationship, it has also allowed for comparisons between the two groups to be made.

#### **4.8. Implications of Findings**

This meta-analysis contributes to the field's understanding of childhood risk factors for psychiatric symptoms. The results further stress the absolute necessity of safeguarding children and the potential repercussions if this is not done successfully. Efforts should continue to be focused upon training professionals to recognise signs of CSA and to respond appropriately. Clinicians should hold in mind the increased likelihood of CSA in those who are experiencing AH and be skilled in sensitively

facilitating conversations about this. Similarly, professionals working with young people with a known history of CSA should be aware of the increased likelihood of AH development and monitor this, so as to provide suitable and prompt intervention if necessary.

In both research and clinical practice, there has been a move away from viewing hallucinations as meaningless symptoms of mental illness, such experiences have instead begun to be reconceptualised as inherently meaningful, with grounding in an individual's life history (Callcott, Standart, & Turkington, 2004; Hornstein, 2009; McCarthy-Jones, 2011; Morrison, Frame, & Larkin, 2010; Romme et al., 2009). The findings of this systematic review further this discourse and suggest that it is important to consider an individual's lived experiences in order to best understand psychiatric symptoms. In both adults and young people who have experienced sexual abuse, the emphasis should be upon moving away from a solely biomedical understanding of AH and instead validating these experiences and giving them meaning. Efforts should be made to explore if, and how, experiences of abuse and psychiatric symptoms link with one another, and formulations should reflect these relationships. As AH continue to be stigmatised experiences, understanding these symptoms in the context of an individual's life history and against a backdrop of potential trauma may be helpful in promoting a more compassionate understanding. However, CSA also remains highly stigmatised and can be difficult for many to disclose and discuss, therefore a more compassionate narrative around both CSA and AH is essential in order for good quality mental health care to be provided.

Clinical interventions to treat trauma in psychotic disorders have tended to mainly focus on the treatment of PTSD (Swan, Keen, Reynolds, & Onwumere,

2017). However, the results of the current review suggest that CSA is associated with psychotic symptoms themselves, which provides support for the use of trauma-focused interventions in the treatment of psychosis (Steel et al., 2017; van den Berg et al., 2016).

#### **4.9. Further Research**

Sexual abuse is often underreported in research trials. Future research in this area would benefit greatly from improved measurement of CSA. The use of psychometrically validated measures, combined with sensitive clinical interviewing, whilst unlikely to eliminate this challenge altogether, may increase rates of disclosure and therefore provide more accurate indications of prevalence.

Future research should investigate the differences in those with AH, who have or have not experienced CSA, and between those who have experienced CSA and have or have not gone on to develop AH. Exploring factors such as attachment style, genetics, substance use, negative schemas, and personal resilience, could help to develop our understanding of why CSA may result in AH in some, but not others. In line with the concept of equifinality, prospective designs and individual case studies should be used as a complementary approach to large-scale, retrospective studies, which have the potential to miss associations that are only present for a subset of individuals. To best incorporate the proposed phenomenological spectrum of AH (McCarthy-Jones et al., 2015), efforts should also be made to explore the idiosyncrasies of each individual's particular AH, looking for both commonalities and differences between participants and investigating whether these potential subsets of AH can explain differential trajectories in response to abuse.

Given that experiences of trauma and abuse rarely occur in isolation (Kessler et al., 2010) and that the pathways linking childhood adversities and subsequent mental health symptoms are complex and inter-correlated; further research is needed to unify such experiences. A further systematic review, exploring the varying impact of different forms of childhood abuse and the effect these may have upon each other, would help to clarify whether CSA is uniquely associated with AH.

## **5. Conclusions**

This review found a significant association between the experiences of CSA and the development of AH. This effect was significant across the general and psychosis populations, although larger in the clinical population. The results have shown that experiencing any CSA increases the risk of experiencing AH later in life and that a higher severity and/or frequency of CSA increases the severity of AH. While CSA has been shown to be more prevalent in those with AH than it is in those without AH, it is important to stress, that the evidence confirms that not all those with CSA go on to develop AH, and similarly, not all those with AH have a history of CSA. CSA is therefore neither necessary nor sufficient to cause AH and it is likely that CSA interacts with a number of other genetic, psychological and environmental risk factors to result in this particular phenomenon. There is however, a robust association between CSA and AH, which lends support to the notion of specificity between particular adversities and symptoms. These findings contribute to the wider discussion around the impact of childhood trauma upon adult mental health outcomes; however further research is required to better understand this complex and multifaceted relationship.

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## **Part Two: Empirical Study**

### **Childhood Trauma, Negative Schemas, and Trust:**

#### **An Exploration using Virtual Reality**

## **Abstract**

**Aims:** Childhood trauma is associated with a multitude of adverse interpersonal outcomes. This study used an interactive virtual reality paradigm to explore the relationship between childhood interpersonal trauma, negative schemas, and trust.

**Method:** Seventy adult participants from the general population completed questionnaires pertaining to experiences of childhood trauma and negative schemas. They then took part in a virtual reality exercise which involved interacting with a friendly avatar. Two measures of trust were recorded; the participants' ratings of the avatar's trustworthiness and the interpersonal distance they maintained from him.

**Results:** Participants dichotomised into those with or without a history of trauma did not significantly differ on either trust measure. However, a dose-response effect was found. Those with more severe experiences of emotional abuse, emotional neglect, and physical neglect, rated the avatar as less trustworthy. Furthermore, those with more severe experiences of sexual abuse and emotional neglect maintained greater interpersonal distance. Negative beliefs about others were found to mediate the relationship between emotional abuse, emotional neglect, and physical neglect upon subjective trust ratings. Negative beliefs about self were found to mediate the effect of emotional neglect upon interpersonal distance.

**Conclusions:** Childhood trauma appears to be a risk factor for difficulties with subjective and moment-to-moment trust. The type of trauma, and its severity, alongside the way that these experiences were interpreted and internalised, were shown to be important in determining trust outcomes. The results are discussed in the context of methodological limitations. The clinical implications and future research directions are also considered.

## **1. Introduction**

### **1.1. Childhood Interpersonal Trauma**

Childhood trauma is a common worldwide phenomenon, referred to by some as a “silent epidemic” (Perepletchikova & Kaffman, 2010). Interpersonal childhood trauma refers to the harm that comes to a young person as a result of another human behaving in a way that violates social norms (Finkelhor, Ormrod, & Turner, 2009). Childhood maltreatment is commonly, but not necessarily, perpetrated by parents or carers (Thornberry, Knight, & Lovegrove, 2012) and can take many forms, including physical, sexual, and emotional abuse, as well as physical and emotional neglect (Larkin & Read, 2008).

Whilst different types of maltreatment frequently co-occur (Dong et al., 2004), there are important distinctions between each form (Trickett & McBride-Chang, 1995). Emotional abuse involves an array of psychologically harmful behaviours, such as verbal aggression, exploitation, manipulation, the deliberate evoking of shame, guilt or fear, and the involvement of a child in inappropriate situations (e.g. witnessing domestic violence) (Teicher & Samson, 2016; Wekerle et al., 2009). Physical abuse refers to the infliction of non-accidental injury through the use of physical violence or excessive punishment (Herbert & Bromfield, 2017). Sexual abuse describes any incident whereby an individual uses their power or authority to engage a young person in a sexual act or exposes them to inappropriate sexual behaviour or material (Putnam, 2003). Childhood maltreatment can also take the form of neglect; identified by the absence of secure and competent parental care (Nikulina, Widom, & Czaja, 2010). Physical neglect is defined as a failure to meet a child’s basic human needs (e.g. provision of food, clothing, and safety), whereas emotional neglect involves parents acting in unresponsive, cold, or inappropriate

ways to a child's distress (Duprey, Oshri, & Caughy, 2017; Teicher & Samson, 2013).

## **1.2. Childhood Trauma and Mental Health Outcomes**

Child maltreatment has a large public health impact; the effects can be immediate (i.e. injury or death), or, more commonly, long-term (i.e. affecting physical and psychological development) (Bartlett, Kotake, Fauth, & Easterbrooks, 2017). Children exposed to trauma experience higher levels of mood and behavioural problems, including bouts of intense fear, uncontrolled crying, prolonged temper tantrums, sleep disturbances, heightened aggression, regression in developmental achievements, and social withdrawal (Lieberman & Knorr, 2007). The impact of early life trauma can also persist, with survivors of childhood abuse shown to be more likely to experience mental health problems in adulthood, including post-traumatic stress disorder (PTSD) (Frans, Rimmo, Aberg, & Fredrikson, 2005), depression (Chapman et al., 2004), anxiety (Huh, Kim, Lee, & Chae, 2017; Poli-Neto et al., 2018), suicidality (Dube et al., 2001), eating disorders (Caslini et al., 2016), substance addiction (Banducci, Hoffman, Lejuez, & Koenen, 2014), and psychosis (Varese et al., 2012). Evidence is also building for specific links between trauma and psychiatric symptoms, such as hallucinations, delusions (Bailey et al., 2018), and paranoia (Fisher, Appiah-Kusi, & Grant, 2012). Furthermore, particular forms of childhood maltreatment have been linked to specific outcomes; for instance, neglect has been shown to increase the risk of internalising behaviours and substance misuse (Duprey et al., 2017; Nikulina et al., 2012), whereas sexual abuse has been repeatedly associated with auditory hallucinations (McCarthy-Jones et al., 2017).

**1.2.1. Trauma and interpersonal outcomes.** Alongside risks to mental health, many survivors of childhood trauma have also been shown to experience difficulties in interpersonal relating. For some, childhood maltreatment can lead to difficulties in the formation and maintenance of relationships; including problems getting close to others, sharing personal information, and forming secure attachments (Compton & Follette, 1998; Whisman, 2006). Childhood interpersonal trauma has been linked to a number of negative social outcomes, including greater emotional distance in relationships (Davis, Petretic-Jackson, & Ting, 2001), higher rates of domestic violence (Coid et al., 2001; Ponce, Williams, & Allen, 2004; Wolfe, Wekerle, Scott, Straatman, & Grasley, 2004), lower marital satisfaction (Broman, Riba, & Trahan, 1996), and increased likelihood of divorce (DiLillo, 2001; Rumstein-McKean & Hunsley, 2001). While the majority of research has focused upon the detrimental impact on romantic relationships, trauma has also been shown to impact wider social networks, including friends, colleagues and strangers (Drapeau & Perry, 2004). Individuals who were maltreated as children may therefore differ from others in their tendency to become involved in intimate relationships and in the quality of these relationships when they are formed (Colman & Widom, 2004).

These well-established interpersonal problems could be attributable to difficulties in trusting others. It has been proposed that children who undergo interpersonal trauma do not fully develop the ability to make accurate, healthy, and appropriate decisions about who to trust (Gobin & Freyd, 2014; Zurbriggen & Freyd, 2004). This has been shown to be a particular risk when a child is repeatedly harmed, or when the perpetrator of the abuse is a family member or well known to the child (Gobin & Freyd, 2014). It is thought that trauma perpetrated by another human exerts a very different effect upon the victim than non-purposeful traumatic events (e.g. a

road accident). Interpersonal trauma, by its very nature, involves an element of betrayal; either of a position of trust, or of social and societal norms, which teach children that they should be protected from harm (Zurbriggen & Freyd, 2004). This betrayal has the potential to create a lasting sense of personal violation and a suspicion of intimacy that can permeate adult relationships (van der Kolk, Roth, Pelcovitz, Sunday, & Spinazzola, 2005).

### **1.3. Negative Schemas**

Childhood trauma is strongly associated with a complex constellation of intrapersonal and interpersonal difficulties; however, the mechanism by which maltreatment contributes to adult psychopathology remains unclear (Carr, Martins, Stingel, Lemgruber, & Juruena, 2013). Cognitive pathways and structures have long been implicated as having a causal role (Beck & Freeman, 1990), with many arguing that empirical exploration of the underlying cognitive, cross-diagnostic, mental constructs is crucial to understanding this relationship (Ehlers & Clark, 2000; Foa, Steketee, & Rothbaum, 1989; Karatzias, Jowett, Begley, & Deas, 2016).

Schemas are one such cognitive mechanism and have gained significant theoretical and research attention. Schemas are automatically activated and relatively independent organised patterns of thinking, feeling, and behaving (Young, Klosko, & Weishaar, 2003). They provide an internal lens for how the world is viewed, driving information processing and the interpretation of experience in line with these belief systems (Harris & Curtin, 2002). Schema theory integrates the assumptions of psychodynamic, cognitive-behavioural, and attachment theories (Baldwin, 1995). It proposes that individuals develop working models of relationships and that these help them to navigate their social world (Karatzias, et al., 2016). These working

models are thought to be made up of internalised images of the self and others, along with social scripts, detailing the expected pattern of interaction based on prior experiences (Young & Lindemann, 1992).

Schemas can be both adaptive and maladaptive (Padesky, 1994). Early maladaptive schemas are profoundly ingrained, distorted beliefs about the self, others, and the world (Young & Lindemann, 1992). These are informed by dysfunctional early life experiences and shaped by memories, emotions, cognitions, and bodily sensations (Young et al., 2003). A child's relationship with, and attachment to, primary caregivers informs the development of maladaptive schemas (Kellogg & Young, 2006). A caregiver who does not respond in a sensitive, loving, and consistent manner that meets the child's fundamental needs, can instil damaging beliefs about the self and others (Bretherton, 1990). Such maladaptive schemas have been termed "unconditional" because they lie at the core of an individual's belief system, remaining pervasive and influential into adulthood, across different environmental contexts and relationships (Young et al., 2003).

A number of studies have reported significant relationships between childhood maltreatment and the development of early maladaptive schemas (Carr & Francis, 2010; Gong & Chan, 2018; McCarthy & Lumley, 2012; Muris, 2006; Thimm, 2010; Wright, Crawford, & Del Castillo, 2009). These in turn have been linked to a range of mental health problems, including depression and anxiety (Wright et al., 2009), eating disorders (Waller, Kennerley, & Ohanian, 2007), and personality disorders (Petrocelli, Glaser, Calhoun, & Campbell, 2001). Many have argued that negative schemas mediate the relationship between trauma and adverse mental health outcomes (Gibb et al., 2001). Research supports this, with negative beliefs shown to mediate the relationship between early trauma and adult depression

and anxiety (Cukor & McGinn, 2006; Gong & Chan, 2018; Harris & Curtin, 2002; Lumley & Harkness, 2007; McGinn, Cukor, & Sanderson, 2005). A growing evidence base has also highlighted a mediating role of schemas in the relationship between childhood trauma and paranoia (Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001; Reininghaus et al., 2016). Cognitive models of paranoia propose that childhood adversity creates enduring negative beliefs about the self as vulnerable and the world as hostile, which consequentially lead to paranoid ideation (Garety et al., 2001). This has been supported by evidence from the general population (Fisher et al., 2012; Gracie et al. 2007), psychosis population (Hardy et al., 2016), and ultra-high-risk of psychosis population (Appiah-Kusi et al., 2017).

Negative schemas are also thought to mediate the relationship between childhood trauma and the interpersonal difficulties documented in survivors of abuse (Cloitre, Cohen, & Scarvalone, 2002; Fonagy, Target, & Gergely, 2000; Freyd, DePrince, & Gleaves, 2007; van der Kolk et al., 2005). It has been hypothesised that childhood maltreatment may cause individuals to interpret ambiguous information in a way that is consistent with their world view and result in others being perceived as untrustworthy and rejecting (Freyd et al., 2007). Resultantly, these negative interpretations could cause difficulties with trusting others and lead to the observed poor quality in interpersonal interactions (Baldwin, 1995).

#### **1.4. The Study of Trust**

Trust is a positive construct, defined as “the firm belief in the reliability, truth, or ability of someone or something” (Simpson & Weiner, 1989). It is an essential component of mutually beneficial human interactions and is vital for successful functioning within social environments (Fett et al., 2012). While paranoia

and reduced trust often coincide and share common factors, these are considered to be separate entities (Bell & O'Driscoll, 2018); with paranoia defined as the unfounded belief that others have hostile intentions and want to cause personal harm (Garety & Freeman, 2013).

Paranoia has been extensively researched due to its potential to be highly debilitating (Reininghaus et al., 2016). Trust, however, appears to have received significantly less empirical attention. The study of trust has traditionally been limited to subjective self-report measures, however in recent years, the use of experimental trust-game paradigms has provided a more objective way to study trust behaviours (Johnson & Mislin, 2011). These paradigms involve social interactions where decisions about who, and how much, to trust determine each participant's economic pay-off (Camerer & Weigelt, 1988). Studies using this methodology have confirmed the presence of reduced trusting behaviours in those with borderline personality disorder (Unoka, Seres, Áspán, Bódi, & Kéri, 2009) and clinical paranoia (Ellett, Allen-Crooks, Stevens, Wildschut, & Chadwick, 2013; Fett et al., 2012, 2016; Gromann et al., 2013). However, these paradigms have been shown to have limitations, with some arguing that altruism (Cox, 2004) and betrayal aversion (Bohnet & Zeckhauser, 2004) are more likely to influence these economical exchanges and that the methodology overlooks important aspects of trust behaviour (Ben-Ner & Halldorsson, 2010).

**1.4.1. Virtual reality paradigms.** Virtual reality (VR) provides opportunities to study trust in a more objective and ecologically valid way than self-report and trust-game paradigms have allowed for respectively. VR facilitates the exploration of moment-to-moment social interactions and the control of interpersonal variables in a

way that is not fully possible when using experimental stooges or naturalistic interactions (Krijn, Emmelkamp, Olafson, & Biemond, 2004). Such paradigms have proven useful in the study of paranoia, where the misinterpretation of interpersonal signals, such as facial expressions or body gestures, are thought to lead to suspicious behaviour that elicits certain responses from others (Freeman et al., 2005; Freeman, Pugh, & Garety, 2008; Newman & Stopa, 2013). The creation of objectively neutral avatars within virtual settings allows for control over these processes, meaning that unfounded appraisals can be isolated and identified (Freeman et al., 2003; Fornells-Ambrojo et al., 2008; Valmaggia et al., 2007). VR has the additional benefit of providing proxemic data; a measure of the interpersonal space that an individual maintains between themselves and another (Argyle & Dean, 1965; Bailenson, Blascovich, Beall, & Loomis, 2003; Gillath, McCall, Shaver, & Blascovich, 2008; Hall et al., 1968). This again allows for objective, real-time, considerations of social behaviours and has been used in past research as a proxy for trust (Bailenson et al., 2003; Fornells-Ambrojo et al., 2016; Reidy, 2016; Wingham, 2016).

VR has been successfully used to elicit paranoia (Freeman et al., 2005; Freeman, 2008; Valmaggia et al., 2007) and has also helped with social skills development in patients with schizophrenia (Rus-Calafell, Gutiérrez-Maldonado, & Ribas-Sabaté, 2014). More recently, experimental manipulations of avatar behaviour have been used to investigate responses to mimicry (Rinck et al., 2010) and interpersonal contingency (Fornells-Ambrojo et al., 2016). In the latter study, higher paranoia predicted participants keeping larger interpersonal distances from an avatar and a preference to subjectively trust more responsive avatars. Using the same paradigm, Reidy (2016) found that social connectedness in the real world predicted interpersonal distance kept from the avatar, suggesting a potential impact of the

social environment on interpersonal trusting behaviour. These studies attest to the ecological validity of VR paradigms in the study of social phenomena. They also suggest that VR would be an appropriate tool in the investigation of trauma and trust.

### **1.5. Study Aims**

Research has shown that the impact of childhood trauma on adverse outcomes is mediated by negative beliefs about the self and others (Appiah-Kusi et al., 2017; Cukor & McGinn, 2006; Gracie et al. 2007). However, despite increased research interest in transdiagnostic symptoms (Newby, McKinnon, Kuyken, Gilbody, & Dalgleish, 2015), and the well documented interpersonal difficulties in survivors of trauma, a study has yet to experimentally explore whether such a relationship also exists between childhood trauma, negative schemas, and trust.

This study used VR as a novel tool to investigate the impact of childhood interpersonal trauma and negative schemas about the self and others on subjective ratings of avatar trustworthiness and objective, moment-to-moment trust behaviour.

## **1.6. Hypotheses**

1. Experiencing any episode of childhood interpersonal trauma will be predictive of lower rates of subjective trust and greater interpersonal distance when compared to not having experienced any trauma.
2. Higher severity of childhood interpersonal trauma will be associated with lower rates of subjective trust and greater interpersonal distance.
3. Negative schemas about the self and others will mediate the effect of childhood interpersonal trauma on subjective trust and interpersonal distance.

## 2. Method

This study was a joint research project completed with a fellow Clinical Psychology Doctoral Trainee, EB (see Appendix 4). The core measures of subjective trust and interpersonal distance, as well as data pertaining to participant experience of the VR paradigm, were utilised by both researchers. No other measures were shared.

### 2.1. Design

This research used a group-comparison (trauma/no trauma) design to test hypothesis one and a within-group design to evaluate hypotheses two and three. Participants were randomly allocated to either a high or low contingency avatar condition in the VR exercise as part of a larger project within which the current study was embedded. However, data was analysed together across the two conditions to test the study's hypotheses. The impact of the contingency manipulation is reported separately in the results section. The potential impact that the contingency manipulation could have had on the hypothesised relationships in the current study is also considered and fully reported in the appendices.

**2.1.1. Participants.** Individuals aged 18 years and over were recruited from the general population. Exclusion criteria for the study were: a history of epilepsy (in order to minimise the risk of negative side effects from the VR), and an inability to read or speak English. Having a current or historical mental health diagnosis was not an exclusion criterion, however anyone presenting with psychosis, or symptoms of thought disorder, were not eligible to take part as this would have made the self-report measures and VR scenario unfeasible.

**2.1.2. Sample size and power analysis.** No previous studies had specifically explored whether childhood trauma and negative schemas predicted trust behaviour during a virtual encounter with an avatar. As such the power calculation was based upon prior research that explored similar constructs using VR paradigms.

Fornells-Ambrojo et al. (2008) found an association between negative schemas about others (as assessed by the Brief Core Schema Questionnaire, Fowler et al., 2006) and the severity of paranoia experienced in a VR scenario (an Underground train journey) in healthy volunteers. This finding had an effect size of 0.8 (large). A power calculation was carried out using the “G\*Power 3” computer program (Faul, Erdfelder, Lang, & Buchner, 2007), specifying alpha = 5% and desired power = 80%. This calculation estimated the required sample size to be seven. A further study by Fornells-Ambrojo et al. (2016) found an association between negative beliefs about self and the amount of interpersonal distance whilst inside of a virtual environment, also in healthy volunteers. This finding had an effect size of 0.44 (small). A further power calculation was carried out using “G\*Power 3” specifying alpha = 5% and desired power = 80%. This estimated the required sample size as 35. Based upon these two estimates, a conservative sample size of 35 was deemed suitable for this research. The sample size achieved was 70, making the study well powered to detect any possible effects.

**2.1.3. Ethical approval.** The study was given a favourable ethical opinion from the University College London (UCL) Research and Ethics Committee (see Appendix 5). Prior to taking part, participants were informed about the study’s procedure (See Appendix 6) and informed consent was obtained (see Appendix 7).

The VR paradigm was designed to be a pleasant experience that was non-intrusive and non-threatening; nevertheless, participants were informed that they could discontinue at any time. Due to the nature of the research questions, participants were asked to consider potentially traumatic personal histories, which therefore held potential to cause distress. It was made clear to participants that they were not obligated to complete any questionnaires and that they could leave questions that they did not feel comfortable answering. Throughout the experiment participants were monitored for signs of distress and all participants were debriefed following the completion of the study. During the debriefing participants were given a signposting sheet that provided information regarding ways of seeking help if they had been affected by the content of the study and required support (see Appendix 8).

## **2.2. Procedure**

**2.2.1. Participant recruitment.** An advertisement for the study, detailing the key information and eligibility criteria, was displayed on the UCL Psychology and Language Sciences Subject Pool. This was an online platform that facilitated student participation in psychological research. Prospective participants were able to view this advertisement and sign up to the available testing timeslots. An advertisement was also displayed on the researchers' individual social media accounts and on the 'King's College Mental Health Studies MSc' page. Those who indicated their interest in the study were invited to contact a study-dedicated email address to learn more about the research and to arrange a date and time to participate. Emails were sent to participants confirming their chosen slot and providing directions to the UCL VR department. Reminder emails were sent to participants the day before they were due to take part, this was designed to reduce the risk of drop-out and to re-allocate

timeslots if necessary. Attrition rates were low, in total only two participants did not attend their session.

**2.2.2. Overview of experimental procedure.** Each participant was met at the UCL VR lab by one of the researchers. Participants were informed that the study was investigating social interactions with a virtual character. An information sheet was provided, and participants had an opportunity to ask questions about the study. Written consent was then obtained.

Before beginning, participants were randomised to a high or low contingency condition; this was carried out using an online generator ([www.randomization.com](http://www.randomization.com)). The experiment involved completion of a series of questionnaires, a short VR exercise, and then the completion of a second set of follow-up questionnaires and a short, guided imagery task (see Table 1). The experiment took approximately 50 minutes in total. Once completed, participants were debriefed and paid £12.50 as remuneration for their time.

Table 1

*Overview of the Experimental Procedure*

Pre-virtual reality scenario	Virtual reality scenario	Post-virtual reality scenario
Randomisation to high or low contingency condition	Instructions given for VR exercise	PANAS questionnaire*
Study information provided	Rehearsal of four scripted questions	Subjective trustworthiness scale*
Written consent obtained	VR exercise began and participant interviewed	Detection of contingency check*
Demographic details collected (age, ethnicity, occupation, mental health, diagnoses, previous experience of flat sharing and VR)	virtual flatmate using four questions	Attention check*
CTQ**	Avatar moved towards the window and invited participant to follow him	SOP*
BCSS**	Distance between avatar and participant recorded*	Guided imagery task
RQ		Debriefing
PANAS questionnaire*		Payment of expenses

*Note.* Abbreviations: CTQ = Childhood Trauma Questionnaire (Bernstein et al., 2003); BCSS = Brief Core Schema Questionnaire (Fowler et al., 2006); RQ = Relationship Questionnaire (Bartholomew & Horowitz, 1991); PANAS = Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988); Sense of Presence Questionnaire (Slater, McCarthy, & Maringelli, 1998).

*Note.* \* = measures shared with fellow researcher EB, \*\* = measures used only by the author (other measures used only by co-researcher EB).

**2.2.3. The virtual reality apparatus and programming.** The VR scenario was designed specifically for Fornells-Ambrojo et al. (2016) and future follow-up studies. It was programmed by collaborators at the Department of Computer Science at UCL and the University of Barcelona.

The VR scenario was displayed within an immersive projection system, this involved high-resolution images being projected in real-time onto three back-

projected wall screens (3m x 2.2m) and a floor screen (3m x 3m). A stereo presentation of the VR environment was delivered using Lightweight CrystalEyes shutter-glasses worn by the participants. These glasses presented separate images to the left and right eyes, producing the illusion of 3D objects within and beyond the walls of the laboratory. An inertial/ultrasonic head-tracking device was mounted on the glasses, which enabled images to be presented in reference to the participant's physical orientation and viewpoint. This technology provided almost natural sensorimotor contingencies for visual perception (i.e. as participants moved around, the environment projected perspective-correct information). Spatialised audio was delivered through four corner speakers.

The virtual scenario was designed to be neutral, non-threatening, and naturalistic. It pictured a tidy modern flat; furnished with a living area to the left and a large window to the right, which looked out onto a terrace. The scenario featured an avatar named 'Mark' who was projected onto the back wall of the VR environment and appeared to be standing in the middle of the flat. Mark was designed to be a casually dressed, young Caucasian male and his voice had been pre-recorded by a male actor.

**2.2.4. Contingency manipulation.** The mapping between participant behaviour and avatar response is summarised in Table 2. In both high and low contingency conditions, when the participant moved their head from side to side the avatar tilted his head slightly in the same direction. Similarly, each time the participant spoke, the avatar would nod. In the high contingency condition these responses occurred after a 1.5 second delay, whereas in the low contingency condition, these responses occurred after a delay of 20 seconds.

Notably, due to a change in the VR software platform, the execution of one of the avatar responses (body swaying) in the high contingency condition was not applied in the present study. This resulted in a reduction of 16.3% of contingent responses in comparison to Fornells-Ambrojo et al.'s (2016) study. It therefore should be noted that the contingency mapping was not completely identical in the two studies (see Appendix 9 for a comparison of avatar behaviours across the two studies).

Table 2

*Contingency Mapping: Participant Behaviours and Avatar Responses*

Participant behaviour	Avatar response
Participant moved head side to the side	Avatar tilted head in the same direction and returned head to centre after participant had done so
Participant spoke	Avatar nodded
Participant moved head in any other direction (back/front, up/down)	Avatar moved his body (random choice of back to front or side to side (sway))

*Note.* Row highlighted in grey shows contingency mapping included in the repertoire of the avatar in Fornells-Ambrojo et al.'s study but omitted from the current study due to a technical error.

**2.2.5. Virtual reality exercise.** Participants were invited to enter the VR environment and try on the stereo glasses in order to acclimatise to the virtual environment, they were then asked to confirm that they could see the scenario in 3D. A standardised explanation about the context of the exercise was given. Each participant was told that they would be viewing a virtual flat which was available to rent and that they would be meeting a character named Mark, who would be their potential new flatmate. Participants were informed that they would have an opportunity to ask Mark four questions in order to find out more about living in the

flat. Participants had a chance to practice asking the questions and were also given a prompt sheet (see Appendix 10) to help them to remember the questions once the scenario had started. Participants were informed that Mark would start by introducing himself and asking their name. They were told that he would then respond by telling them that he was “ready”, which would be their cue to ask the first question. Participants were instructed that after each of Mark’s responses they should move on to asking the next question on the prompt sheet.

Before beginning the task, participants were asked to stand on a designated spot; this ensured that everyone taking part started the exercise in-line with the avatar and from the same distance (2m). Participants were informed that once the exercise began, they were free to move naturally and explore the environment as much or as little as they chose to. A curtain was then drawn and researchers explained that they would stand on the other side, monitoring the task. Once participants signalled that they were ready to begin, the VR program was run. Participants read the four scripted questions and upon asking the final one, “what is the best thing about living here?” Mark invited each participant to look at the terrace. Mark then received a phone call, turned away from the participant to take the call and apologised, stating that he had to leave. Mark finished by asking the participant whether they could continue the flat viewing at another time. The scenario then faded out to signify the end of the exercise (see Appendix 11 for full script and Figure 1 for images of the VR paradigm in use). The exercise lasted approximately two minutes in total. Upon finishing, researchers checked with participants to see how they were feeling and ensured that they were not experiencing any ill-effects of the VR.

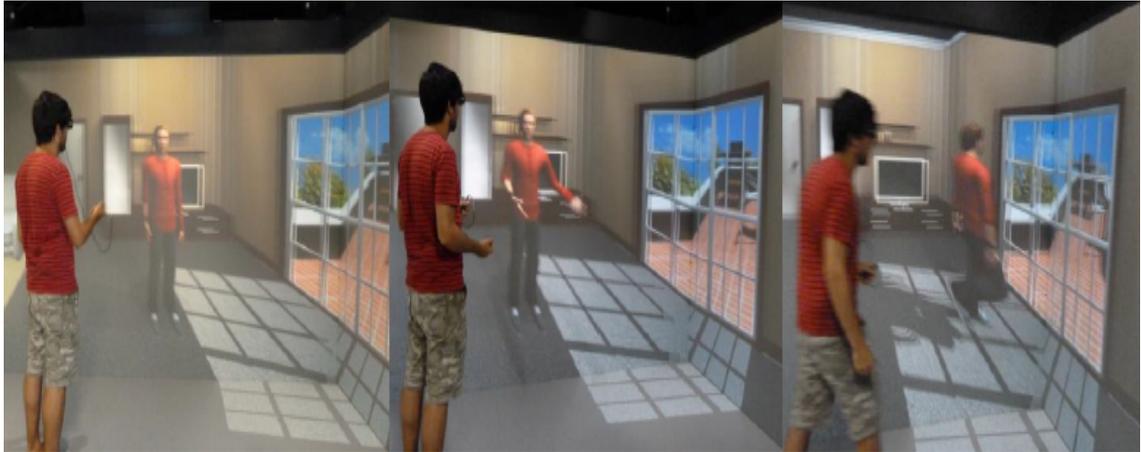


Figure 1. Images of the VR paradigm in use.

## 2.3. Measures

**2.3.1. Pre-virtual reality measures.** Before entering the VR environment, participants were asked to provide demographic details (age, gender, ethnicity, occupation, current/historical mental health diagnoses) and complete a series of baseline measures. These consisted of the following:

*Childhood Trauma Questionnaire* (CTQ; Bernstein et al., 2003) (see Appendix 12 for questionnaire and Appendix 13 for questions arranged by abuse type). The CTQ was used to measure participants' experiences of interpersonal childhood trauma. This questionnaire consisted of a 28-item scale that asked the respondent to rate how often they had experienced five different subtypes of childhood trauma: emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect. The questionnaire contained five questions pertaining to each form of abuse (e.g. emotional abuse: "People in my family said hurtful or insulting things to me"; physical abuse: "I got hit so hard by someone in my family that I had to see a doctor or go to hospital"; sexual abuse: "Someone tried to touch me in a sexual way, or tried to make me touch them"; emotional neglect: "I knew that there

was someone to take care of me and protect me” [Reverse scored]; physical neglect: “I didn’t have enough to eat”). There were also three questions that measured minimisation/denial (e.g. “I had the perfect childhood”), however these were not reported upon in the current study. Respondents were asked to rate each item using a 5-point scale ranging from “never true” to “very often true”. This measure is designed to provide five separate abuse subscales rather than a cumulative total. The CTQ has high internal consistency and good test-retest reliability; it has been shown to be reliable and valid for use with both clinical and non-clinical populations (Bernstein et al., 2003).

*The Brief Core Schema Scale* (BCSS; Fowler et al., 2006) (see Appendix 14). The BCSS was used to measure participants’ negative schemas about themselves and others. This was a 24-item measure with four sub-scales: negative beliefs about self, positive beliefs about self, negative beliefs about others, and positive beliefs about others. For the purposes of this study, in line with hypothesised mechanisms, only the negative-self and negative-other subscales were used.

These two subscales asked participants to rate how strongly they endorsed negative-self schemas such as: “I am a failure” and negative-other schemas such as: “Other people are hostile”. Each scale had 6 items that could be rated on a 5-point scale from: “0 - do not believe it at all”, “1 - believe it slightly”; “2 -believe it moderately”; “3 - believe it very much”; or “4 - believe it totally”. Scores could range on each scale from 0–24. This measure has been validated for use in both psychosis and non-clinical populations (Fowler et al., 2006).

*Positive and Negative Affect Schedule* (PANAS; Watson, Clark & Tellegen, 1988) (see Appendix 15). The PANAS was used to measure potential change in positive and negative affect during the VR exercise; it was completed prior to entering the VR environment and immediately afterwards. The PANAS had 20-items that assessed positive and negative affect on two independent subscales. Participants were asked to rate the extent to which each word applied to how they were feeling (e.g. “distressed” and “enthusiastic”) on a 5-point scale ranging from 1 = “very slightly or not at all” to 5 = “extremely”. The PANAS has good reliability and validity (Crawford & Henry, 2004).

### **2.3.2. Virtual reality measures.**

*Interpersonal distance.* The average distance maintained by the participant from the avatar during the last scene, when invited by Mark to view the terrace, was used as a more objective and behavioural measure of trust. This was automatically recorded using tracking systems throughout the task. For each animation frame the 3D positions of both the avatar’s head and the participant’s head were recorded. The distance was calculated using the horizontal Pythagorean distance so that difference in height between participant and avatar were ignored. Interpersonal distance is a traditional measure used by proxemics researchers (Hayduk, 1983) and is commonly used in VR research in this way (Bailenson et al., 2003).

### **2.3.3. Post virtual reality measures.**

*Subjective trust.* This was measured using a single item question (“How trustworthy did Mark seem?”) This was rated on a 7-point scale from 1 = “Not at all” to 7 = “Very much” (see Appendix 16). This measure of trust has been used

previously in VR studies using the same paradigm (Fornells-Ambrojo et al., 2016; Wingham, 2016; Reidy, 2016).

***Scenario feedback and checks.*** In order to ascertain whether participants had consciously perceived the contingency of the avatar's body movements (head tilts and nods), participants were asked whether they had noticed any relationship between their own actions and Mark's actions (see Appendix 17). To assess whether participants had been directing sufficient attention to Mark during the scenario, participants were also asked two true or false questions about what Mark had told them during their conversation about flat-sharing (e.g. "One reason that Mark the virtual flatmate gave for why he likes flat sharing is that he has made new friends"). These measures of contingency awareness and attention were used in previous VR studies using the same paradigm (Fornells-Ambrojo et al., 2016; Reidy, 2016; Wingham, 2016).

***The Sense of Presence Questionnaire*** (SoP; Slater et al., 1998) (see Appendix 18). The SoP questionnaire assessed the extent to which participants had felt present in the virtual world (e.g. "During the experience, which was strongest on the whole, your sense of being in the virtual flat, or being in the real world of the laboratory?") Participants rated each item on a 7-point scale with a higher score indicating a greater sense of presence in the virtual flat.

## **2.4. Planned Data Analysis**

All quantitative data analyses were conducted using SPSS (Version 24).

**2.4.1. Missing data.** One participant did not complete a singular item on the BCSS. A pro-rating method was therefore used, whereby the participant's scores across the other five completed items of this scale were averaged and this score used to complete the missing item.

**2.4.2. Normality of distributions.** Data was assessed for normality. If skewness and kurtosis scores were not between  $\pm 1.96$ , the Kolmogorov-Smirnov test was significant at  $p < .01$ , and the histogram appeared to deviate markedly from a normal distribution, data was judged to be non-normally distributed. These inspections indicated that the majority of data was non-normally distributed and also revealed the presence of multiple outliers (see Appendix 19 for normality figures across measures). To account for this, non-parametric tests were used where such an alternative was available, when it was not possible to use a non-parametric alternative, this is highlighted, and the implications discussed.

**2.4.3. Contingency manipulation.** ANCOVA tests were carried out to compare high and low contingency groups on subjective trust and interpersonal distance, while controlling for total avatar movement, this ensured the impact of contingency was not attributable to the greater exposure to movement in the high contingency condition. As ANCOVA is a parametric test, the results were interpreted with caution. Contingency manipulation is not the focus of the current study, and as such, following this initial analysis, the two contingency conditions were analysed together to test the main hypotheses.

**2.4.4. Comparison of trauma and non-trauma groups.** To investigate hypothesis one that those with any history of trauma would have lower subjective trust ratings and maintain greater interpersonal distance in comparison to those who have no history of trauma, participants were dichotomised into abuse/no abuse groups. This was carried out using standardised cut-off scores for each scale of the CTQ (Bernstein et al., 2003) (see Appendix 20 for scoring). Those who scored above the ‘none’ category on any of the subscales were classed as having experienced abuse. Non-parametric Mann-Whitney U tests were then conducted to compare the subjective trust ratings and average interpersonal distance of the two groups.

**2.4.5. Association between childhood trauma and trust.** To investigate hypothesis two, that childhood trauma would be associated with lower subjective trust and greater interpersonal distance, associations between scores on each subscale of the CTQ and trust measures were analysed using non-parametric correlational analyses (Spearman’s rho). To protect against inflated Type I error rates due to multiple comparisons, Bonferroni corrections were applied to all correlational analyses and it was noted when the corrected statistic remained significant.

**2.4.6. The mediating role of negative schemas.** In order to explore hypothesis three, which predicted that higher levels of negative self and other schemas would mediate the effect of trauma upon trust, mediation analyses were carried out.

In a simple mediation model, a dependant variable X is postulated to exert an effect on an outcome variable Y through an intervening variable, M (Baron & Kenny, 1986). There are multiple schools of thought regarding the most appropriate way to conduct a mediation analysis (Agler & De Boeck, 2017). Traditionally, Baron

and Kenny's (1986) four step causal approach to mediation stipulated that all variables (X, Y, M) should first be shown to be significantly associated with one another (via individual linear regressions). An effect of mediation could then be inferred by noting whether the significance of the association between X and Y is reduced once the mediator (M) was added into the model. Baron and Kenny's approach has come under criticism in recent years however (Hayes, 2009), with many now arguing that bootstrapping approaches are a more valid and powerful method for exploring mediation effects (Hayes, 2009; Williams & MacKinnon, 2008). Bootstrapping approaches have the benefit of not relying on the assumption of normality and are appropriate for use in studies of smaller sample sizes (Pardo & Roman, 2013). Bootstrapping is also considered to be a more robust method of significance testing than the more traditional Sobel's test and can determine mediation effects with greater statistical certainty (Zhao, Lynch, & Chen, 2010).

With these arguments in mind, bootstrapping was used in the analyses of this study. The mediation analyses were conducted using the Process Macro (Version 3.0) in SPSS (Hayes, 2012; Preacher & Hayes, 2004). This used a path-analytic framework based on logistic regression to estimate direct and indirect effects (Hayes, 2012). Bootstrap analyses with 5000 samples were implemented in order to allow for inference about indirect effects (Hayes, 2009). In line with the recommended guidance (Hayes, 2012), if zero did not fall within the upper and lower bootstrapped confidence intervals, then the indirect effect was considered statistically significant at the  $p < .05$  level and demonstrated a significant effect of mediation.

Only the forms of trauma, type of negative schemas, and measures of trust found to be significantly associated in the correlational analyses of hypothesis two were combined and entered into the mediational analyses.

### 3. Results

#### 3.1. Descriptives

**3.1.1. Demographics.** A total of 70 participants completed the study. Thirty-five participants were randomly allocated to the high contingency condition and 35 to the low contingency condition. As shown in Table 3, the sample consisted of 45 females and 25 males with a mean age of 26.09 ( $SD = 8.56$ ). Participants identified as a range of ethnicities, with the three predominant groups being Asian (38.57%), White British/White Other (28.57%), and Other (24.29%). The sample comprised largely of individuals who were in some form of education (30 undergraduate students and 10 postgraduate students), a further 24 were in employment, five were unemployed, and one was retired. Two participants reported a historical mental health diagnosis (non-psychotic in nature) and no current mental health problems were disclosed. The majority of participants (84.3%) had lived in a shared flat and had previous experience of VR (70%).

Table 3

*Summary Statistics of the Key Demographic Features*

Demographic variable	Summary statistic
<b>Gender, <i>n</i> (%)</b>	45 (64.29%)
Female	25 (35.71%)
Male	
<b>Age, mean (SD)</b>	26.09 (8.56)
<b>Ethnicity, <i>n</i> (%)</b>	
Asian	27 (38.57%)
White British/White Other	20 (28.57%)
Other	17 (24.29%)
African	3 (4.29%)
Indian	3 (4.29%)
<b>Occupational status, <i>n</i> (%)</b>	
Student	40 (57.14%)
Employed	24 (34.29%)
Unemployed or Retired	6 (8.57%)
<b>Historical mental health diagnosis, <i>n</i> (%)</b>	2 (2.86%)
<b>Previous experience of flat sharing, <i>n</i> (%)</b>	
Yes	59 (84.29%)
No	11 (15.71%)
<b>Previous experience of VR, <i>n</i> (%)</b>	
Yes	49 (70%)
No	21 (30%)

*Note.* Abbreviations: *n* = number; SD = standard deviation.

**3.1.2. Trauma and schemas.** Summary statistics for rates of childhood trauma and negative schemas are detailed in Table 4. Mean scores for childhood trauma ranged from 5.33 ( $SD = 1.07$ ) for sexual abuse, to 9.27 ( $SD = 4.14$ ) for emotional neglect. On the BCSS the mean score for negative beliefs about the self was 3.14 ( $SD = 3.67$ ), the mean for negative beliefs about others was 4.93 ( $SD = 4.73$ ). These scores were similar to those reported by Gracie et al. (2007) who also sampled from a non-clinical population (negative beliefs about self:  $M = 4.3$ ,  $SD = 4.9$ ; negative beliefs about others:  $M = 3.8$ ,  $SD = 4.3$ ).

Table 4

*Summary Statistics for Measures of Childhood Trauma and Schemas*

Key measures	Mean ( $SD$ )	Range
<b>Childhood Trauma Questionnaire</b>		
Emotional abuse	8.36 (3.62)	5 - 20
Physical abuse	6.11 (2.44)	5 - 18
Sexual abuse	5.33 (1.07)	5 - 11
Emotional neglect	9.27 (4.14)	5 - 19
Physical neglect	6.87 (2.45)	5 - 18
<b>Brief Core Schema Scale</b>		
Negative beliefs about self	3.14 (3.67)	0 - 18
Negative beliefs about others	4.93 (4.73)	0 - 16

*Note.* Abbreviations: SD = standard deviation.

As shown in Table 5, several of the trauma variables were significantly correlated with one another, although only emotional abuse/emotional neglect and emotional neglect/physical neglect remained significant after Bonferroni corrections (adjusted  $\alpha$  level = .005 [0.05/10]). This is in line with previous research which has highlighted the common co-morbidity between different forms of childhood trauma (Dong et al., 2004; Edwards, Holden, Felitti, & Anda, 2003).

Table 5  
*Associations between Trauma Variables*

Trauma variables	1	2	3	4	5
1. Emotional abuse	-				
2. Physical abuse	.349**	-			
3. Sexual abuse	.135	.154	-		
4. Emotional neglect	.583***#	.154	.201	-	
5. Physical neglect	.222	.124	.275*	.469***#	-

*Note.* Correlation coefficients are Spearman's Rho ( $r_s$ ), two tailed.

*Note.* \* = significant at the  $p < .05$  level; \*\* = significant at the  $p < .01$  level; \*\*\* = significant at the  $p < .001$  level; # = significant after Bonferroni corrections ( $p < .005$ ).

**3.1.3. Virtual reality measures.** The degree to which participants felt immersed within the VR environment, as measured by the Sense of Presence questionnaire, ranged from 7 to 40 ( $M = 26.09$ ,  $SD = 6.73$ ) (see Table 6). This was slightly higher, but similar to two previous studies which utilised the same VR scenario with a non-clinical population ( $M = 25.47$ ,  $SD = 6.52$ ) (Fornells-Ambrojo et al., 2016) and a psychosis population ( $M = 24.9$ ,  $SD = 9.77$ ) (Reidy, 2016; Wingham, 2016). The data suggests that participants were sufficiently immersed within the scenario.

The majority (80%) of the present study sample answered the two attention check questions correctly. This rate is lower than in a previous study using this scenario, where 90.2% of respondents answered both questions correctly (Fornells-Ambrojo et al., 2016), but higher than the 66.7% of individuals from a psychosis population (Reidy, 2016; Wingham, 2016). Fourteen participants (20%) had answered one or both questions incorrectly, this is higher than in Fornells-Ambrojo et al. (2016), in which 9.8% of the sample of healthy participants answered one or both questions incorrectly and lower than the 33.3% reported in Reidy (2016) and Wingham (2016). These figures suggest that some consideration of attention levels is warranted, however overall the data suggests that participants were paying sufficient attention to the scenario and were engaged with the avatar.

Pre-VR, participants reported higher levels of positive affect ( $M = 32.84$ ,  $SD = 7.36$ ) comparative to negative affect ( $M = 12.97$ ,  $SD = 3.04$ ). Positive affect ( $M = 33.39$ ,  $SD = 9.14$ ) was also higher than negative affect ( $M = 11.57$ ,  $SD = 2.27$ ) post-VR (see Table 6). Non-parametric comparison of means (Wilcoxon test) found a significant reduction in the mean total of negative emotion scores ( $Z = -4.18$ ,  $p < .001$ ) following the VR exercise. No significant change was found in positive affect scores ( $Z = -.940$ ,  $p = .347$ ). This suggests that in line with previous studies utilising this paradigm (Fornells-Ambrojo et al., 2016; Reidy, 2016; Wingham, 2016) the VR task was not experienced as distressing.

Table 6

*Summary Statistics for Sense of Presence and PANAS Questionnaires*

Measure	Mean ( <i>SD</i> )	Range
<b>Sense of Presence</b>	26.09 (6.73)	7 - 40
<b>PANAS Pre-VR</b>		
Positive	32.84 (7.36)	14 - 50
Negative	12.97 (3.04)	10 - 23
<b>PANAS Post-VR</b>		
Positive	33.39 (9.14)	14 - 50
Negative	11.57 (2.27)	10 - 20

*Note.* Abbreviations: *SD* = standard deviation

**3.1.4. Trust measures.** Trust towards the avatar was measured using both participant ratings of trustworthiness and data pertaining to interpersonal distance. Subjective trust was measured using a single-item scale, ranging from 1 to 7. The mean rating across the sample was 4.61 (*SD* = 1.49). This is similar to, but slightly lower than, the mean trustworthiness score of 4.87 (*SD* = 1.07) reported in the original non-clinical sample (Fornells-Ambrojo et al., 2016).

Interpersonal distance was calculated from the average distance in metres that the participant kept from the avatar when invited to walk over to the window ( $M = 1.43$ ,  $SD = 0.39$ ), this is in line with the average distance found in Fornells-Ambrojo et al. (2016) ( $M = 1.43$ ,  $SD = 0.26$ ).

As expected, subjective trust ratings were shown to be negatively correlated with the average interpersonal distance ( $r_s = -.257$ ,  $p = .032$ ).

**3.1.5. Contingency check.** In the highly contingent condition, post-VR responses to the contingency perception check indicated that 21 participants (60%) thought that there was a relationship between their actions and the avatars actions. Comparatively 28 participants (80%) in the low contingency condition reported a relationship between their actions and those of the avatar.

As anticipated, a Mann-Whitney U test confirmed that participants allocated to the high contingency condition were subject to a higher number of avatar movements (high contingency condition: mean rank = 52.29, low contingency condition: mean rank = 18.71,  $U = 25.00$ ,  $p = .00$ ). Therefore, as in Fornells-Ambrojo et al.'s (2016) previous study, ANCOVAs were run in order to compare the subjective trust and interpersonal distance outcomes between conditions whilst covarying for total avatar movements. As ANCOVA is a parametric test, the findings should be interpreted with caution.

Neither contingency condition ( $F(1, 69) = 3.61$ ,  $p = .062$ ) nor total avatar movements ( $F(1, 69) = 2.82$ ,  $p = .098$ ) were significantly associated with subjective trust. Avatar movement was however significantly related to interpersonal distance from the avatar ( $F(1, 69) = 15.44$ ,  $p = .000$ ) and a significant effect of contingency condition remained after controlling for the covariate ( $F(1, 67) = 11.62$ ,  $p = .001$ ).

These results were not anticipated, as previous research using this paradigm had shown no effect of contingency on interpersonal distance (Fornells-Ambrojo et al., 2016, Reidy, 2016; Wingham, 2016). As the impact of contingencies is not the focus of the current study all further analyses treated the two contingency groups as one, as initially planned. However, see Appendix 21 for the main correlational analyses controlling for contingency condition and avatar movement, conducted in

order to check for the potential effect of contingency or avatar movement on the relationship between trauma and trust.

### **3.2. Differences between Abused and Non-Abused Groups**

In order to explore the hypothesis that experiencing any episode of childhood interpersonal trauma would be predictive of lower rates of subjective trust and greater interpersonal distance, participants were dichotomised into history of abuse and no history of abuse groups using standardised cut off scores (Bernstein et al., 2003). Of the 70 participants, 20 (28.6%) had no history of any form of abuse and 50 (71.4%) had a history of at least one form of abuse.

Non-parametric Mann-Whitney U tests showed that there was no significant difference between the abuse and no abuse groups in levels of subjective trust (no abuse group: mean rank = 42.2, abuse group: mean rank = 32.82,  $U = 366$ ,  $p = .073$ ) or interpersonal distance kept from the avatar (no abuse group: mean rank = 33.38, abuse group: mean rank = 36.35,  $U = 457.5$ ,  $p = .581$ ).

### **3.3. Associations between Trauma and Trust**

To explore the hypothesis that greater severity of childhood trauma would be associated with lower rates of subjective trust and greater interpersonal distance, non-parametric correlations (Spearman's Rho) were conducted (see Table 7). To protect against Type I error due to multiple analyses, Bonferroni corrections were applied, making the adjusted  $\alpha$  level = .0036 (0.05/14). In order to strike a balance between risk of Type I and Type II error, all originally significant results were retained, however those which remained significant after these corrections are highlighted.

Table 7

*Associations between Childhood Trauma, Negative Schemas, and Trust Variables*

Measure	Subjective trust		Interpersonal distance	
	$r_s$	$p$	$r_s$	$p$
<b>CTQ</b>				
Emotional abuse	-.418***#	<.001	.109	.368
Physical abuse	-.141	.244	-.024	.844
Sexual abuse	-.052	.672	.237*	.049
Emotional neglect	-.353***#	.003	.271*	.023
Physical neglect	-.304*	.011	.187	.120
<b>BCSS</b>				
Neglect beliefs about self	-.146	.228	.269*	.024
Neglect beliefs about others	-.539***#	<.001	.061	.617

Note.  $r_s$  = Spearman's Rho correlation, two tailed.

Note. \* = significant at the  $p < .05$  level, \*\* = significant at the  $p < .01$  level, \*\*\* = significant at the  $p < .001$  level; # = significant after Bonferroni corrections ( $p < .0036$ ).

**3.3.1. Trauma and trust.** Those who experienced some forms of childhood trauma reported reduced feelings of trust towards the avatar and kept larger distances from him. Specifically, higher levels of sexual abuse and emotional neglect resulted in a preference for standing further away from the avatar during the virtual interaction, whereas severity of physical neglect and emotional abuse/neglect were negatively associated with subjective trustworthiness. Only the latter two forms of neglect remained significant after Bonferroni corrections.

**3.3.2. Negative schemas and trust.** Negative beliefs about others predicted reduced trust towards the avatar while negative views of the self were associated

with standing further away from him. Only the former of these associations remained significant after the Bonferroni corrections.

### **3.4. Mediating Role of Negative Schemas**

The hypothesis that negative schemas would mediate the effect of trauma on trust behaviours was explored using mediated regression analyses. Only the forms of abuse, schema types (negative self or other), and trust measures (subjective or interpersonal distance) shown to be significantly associated with one another in the prior correlational analyses were entered into mediation analyses. While some advocate for the use of mediation to explore all potential pathways, regardless of non-significant associations between the IV and DV (Hayes, 2009), a more cautious approach was taken to minimise risk of type I error, whereby only those that had shown promise in the correlational analyses were explored further. It was felt that exploration of only the associations which had survived Bonferroni corrections would be too conservative, as such all five combinations were explored. These five combinations are detailed and each will be discussed in turn. Results are reported as unstandardised beta coefficients ( $B$ ) as provided by the Process Macro and are summarised in Table 8 and Figures 2-6.

#### *i. Emotional abuse and subjective trust, mediated by negative beliefs about others*

As Figure 2 illustrates, emotional abuse was a significant predictor of subjective trust ( $B = -.189, SE = .044, p < .001, 95\% CI = -.277 \text{ to } -.101$ ) (path c, total effect). Emotional abuse was a significant predictor of negative beliefs about others ( $B = .522, SE = .145, p = .001, 95\% CI = .233 \text{ to } .811$ ) (path a) and negative beliefs about others were a significant predictor of subjective trust ( $B = -.122,$

$SE = .034, p = .001, 95\% CI = -.189 \text{ to } -.054$ ) (path b). Emotional abuse was shown to still be a significant predictor of subjective trust after controlling for the mediator ( $B = -.126, SE = .045, p = .006, 95\% CI = -.214 \text{ to } -.037$ ) (path c', direct effect), however the significance of this association was reduced, suggestive of partial mediation (Baron & Kenny, 1986). The overall model was significant ( $F(2,67) = 17.11, p < .001$ ) and approximately 34% of the variance in subjective trust was accounted for by the predictors ( $R^2 = .34$ ).

The indirect effect was calculated using a bootstrapped estimation of 5000 samples. The results indicated that the indirect effect coefficient was  $B = -.064$ , bootstrapped  $SE = .028$ , bootstrapped 95%  $CI = -.142 \text{ to } -.023$ . As the 95% bootstrapped CI did not cross zero, this is consistent with significant mediation and suggests that negative beliefs about others partially mediate the relationship between emotional abuse and subjective trust.

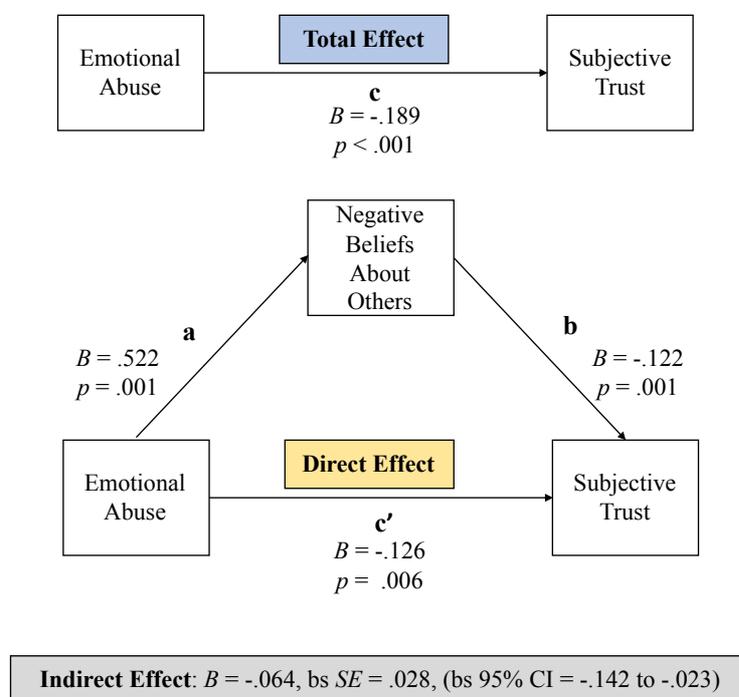


Figure 2. Diagrammatic representation of the mediating role of negative beliefs about others in the relationship between emotional abuse and subjective trust.

Note. Abbreviations:  $B$  = unstandardised beta coefficient;  $bs SE$  = bootstrapped standard error;  $bs 95\% CI$  = bootstrapped 95% confidence intervals.

ii. Emotional neglect and subjective trust, mediated by negative beliefs about others

As Figure 3 illustrates, emotional neglect was a significant predictor of subjective trust ( $B = -.136$ ,  $SE = .04$ ,  $p = .001$ , 95% CI =  $-.216$  to  $-.056$ ) (path c, total effect). Emotional neglect was a significant predictor of negative beliefs about others ( $B = .283$ ,  $SE = .134$ ,  $p = .039$ , 95% CI =  $.015$  to  $.551$ ) (path a) and negative beliefs about others were a significant predictor of subjective trust ( $B = -.139$ ,  $SE = .033$ ,  $p < .001$ , 95% CI =  $-.204$  to  $-.074$ ) (path b). Emotional neglect was shown to still be a significant predictor of subjective trust after controlling for the mediator ( $B = -.097$ ,  $SE = .037$ ,  $p = .012$ , 95% CI =  $-.171$  to  $-.022$ ) (path c', direct effect), however the significance of this association was reduced, suggestive of partial mediation (Baron & Kenny, 1986). The overall model was significant ( $F(2,67) = 16.29$ ,  $p < .001$ ) and approximately 33% of the variance in subjective trust was accounted for by the predictors ( $R^2 = .33$ ).

The indirect effect was calculated using a bootstrapped estimation of 5000 samples. The results indicated that the indirect effect coefficient was  $B = -.039$ , bootstrapped  $SE = .024$ , bootstrapped 95% CI =  $-.092$  to  $-.001$ . As the 95% bootstrapped CI did not cross zero, this is consistent with significant mediation and suggests that negative beliefs about others partially mediate the relationship between emotional neglect and subjective trust.

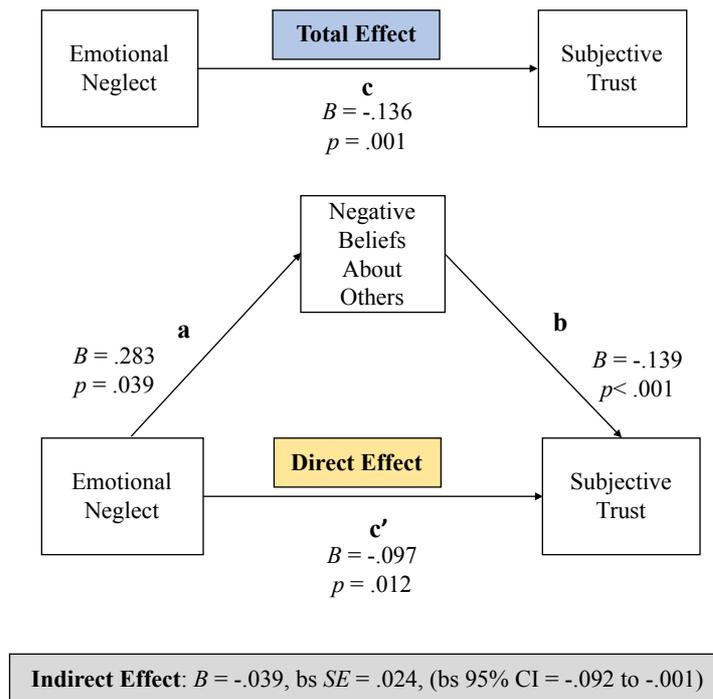


Figure 3. Diagrammatic representation of the mediating role of negative beliefs about others in the relationship between emotional neglect and subjective trust.

Note. Abbreviations:  $B$  = unstandardised beta coefficient;  $bs\ SE$  = bootstrapped standard error;  $bs\ 95\% \text{ CI}$  = bootstrapped 95% confidence intervals.

### iii. Physical neglect and subjective trust, mediated by negative beliefs about others

As Figure 4 illustrates, physical neglect was a significant predictor of subjective trust ( $B = -.209$ ,  $SE = .069$ ,  $p = .004$ ,  $95\% \text{ CI} = -.347 \text{ to } -.071$ ) (path c, total effect). Physical neglect was a significant predictor of negative beliefs about others ( $B = .598$ ,  $SE = .223$ ,  $p = .009$ ,  $95\% \text{ CI} = .154 \text{ to } 1.042$ ) (path a) and negative beliefs about others were a significant predictor of subjective trust ( $B = -.140$ ,  $SE = .034$ ,  $p < .001$ ,  $95\% \text{ CI} = -.208 \text{ to } -.073$ ) (path b). Physical neglect was no longer a significant predictor of subjective trust after controlling for the mediator ( $B = -.125$ ,  $SE = .065$ ,  $p = .060$ ,  $95\% \text{ CI} = -.256 \text{ to } .005$ ) (path c', direct effect), consistent with full mediation (Baron & Kenny, 1986). The overall model was significant ( $F(2,67) = 14.21$ ,  $p < .001$ ) and approximately 30% of the variance in subjective trust was accounted for by the predictors ( $R^2 = .30$ ).

The indirect effect was calculated using a bootstrapped estimation of 5000 samples. The results indicated that the indirect effect coefficient was  $B = -.084$ , bootstrapped  $SE = .038$ , bootstrapped 95% CI =  $-.173$  to  $-.019$ . As the 95% bootstrapped CI did not cross zero, this is consistent with significant mediation and suggests that negative beliefs about others fully mediate the relationship between physical neglect and trust.

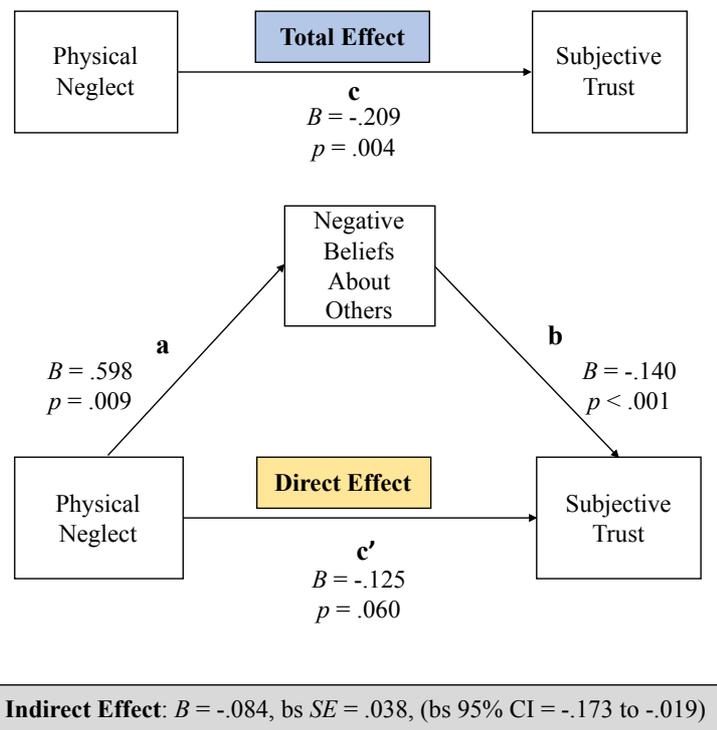


Figure 4. Diagrammatic representation of the mediating role of negative beliefs about others in the relationship between physical neglect and subjective trust.

Note. Abbreviations:  $B$  = unstandardised beta coefficient; bs  $SE$  = bootstrapped standard error; bs 95% CI = bootstrapped 95% confidence intervals.

iv. Sexual abuse and interpersonal distance, mediated by negative self-beliefs

As figure 5 illustrates, sexual abuse was a significant predictor of interpersonal distance ( $B = .127$ ,  $SE = .042$ ,  $p = .003$ , 95% CI =  $.044$  to  $.211$ ) (path c, total effect). Sexual abuse and negative beliefs about self were not significantly correlated ( $B = -.104$ ,  $SE = .414$ ,  $p = .802$ , 95% CI =  $-.931$  to  $.723$ ) (path a). Negative

beliefs about self were a significant predictor of interpersonal distance ( $B = .038$ ,  $SE = .011$ ,  $p = .001$ , 95% CI = .015 to .061) (path b). Sexual abuse remained a significant predictor of interpersonal distance after controlling for the mediator ( $B = .131$ ,  $SE = .039$ ,  $p = .001$ , 95% CI = .054 to .209) (path c', direct effect). The overall model was significant ( $F(2,67) = 10.95$ ,  $p < .001$ ) and approximately 25% of the variance in subjective trust was accounted for by the predictors ( $R^2 = .25$ ).

The indirect effect was calculated using a bootstrapped estimation of 5000 samples. The results indicated that the indirect effect coefficient was  $B = -.004$ , bootstrapped  $SE = .018$ , bootstrapped 95% CI = -.035 to .039. As the bootstrapped CI crossed zero, this suggests that there was no significant effect of mediation.

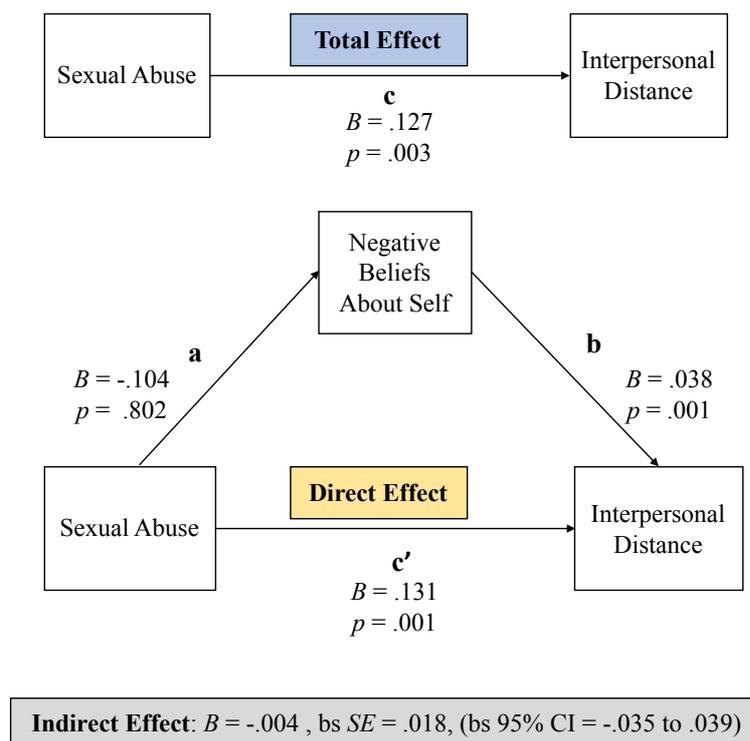


Figure 5. Diagrammatic representation of the non-significant mediating role of negative beliefs about self in the relationship between sexual abuse and interpersonal distance.

Note. Abbreviations:  $B$  = unstandardised beta coefficient;  $bs SE$  = bootstrapped standard error;  $bs 95\% CI$  = bootstrapped 95% confidence intervals.

v. Emotional neglect and interpersonal distance, mediated by negative self-beliefs

As figure 6 illustrates, emotional neglect was a significant predictor of interpersonal distance ( $B = .029$ ,  $SE = .011$ ,  $p = .010$ , 95% CI = .007 to .051) (path c, total effect). Emotional neglect was a significant predictor of negative beliefs about self ( $B = .307$ ,  $SE = .101$ ,  $p = .003$ , 95% CI = .106 to .509) (path a) and negative beliefs about self were a significant predictor of interpersonal distance ( $B = .029$ ,  $SE = .013$ ,  $p = .027$ , 95% CI = .003 to .055) (path b). Emotional neglect was no longer a significant predictor of interpersonal distance after controlling for the mediator ( $B = .020$ ,  $SE = .011$ ,  $p = .077$ , 95% CI = -.002 to .043) (path c', direct effect), suggestive of full mediation (Baron & Kenny, 1986). The overall model was significant ( $F(2,67) = 6.34$ ,  $p = .003$ ) and approximately 16% of the variance in subjective trust was accounted for by the predictors ( $R^2 = .16$ ).

The indirect effect was calculated using a bootstrapped estimation of 5000 samples. The results indicated that the indirect effect coefficient was  $B = .009$ , bootstrapped  $SE = .007$ , bootstrapped 95% CI = .00004963 to .029. As the 95% bootstrapped CI did not cross zero, this is consistent with significant mediation and suggests that negative beliefs about self fully mediate the relationship between emotional neglect and interpersonal distance.

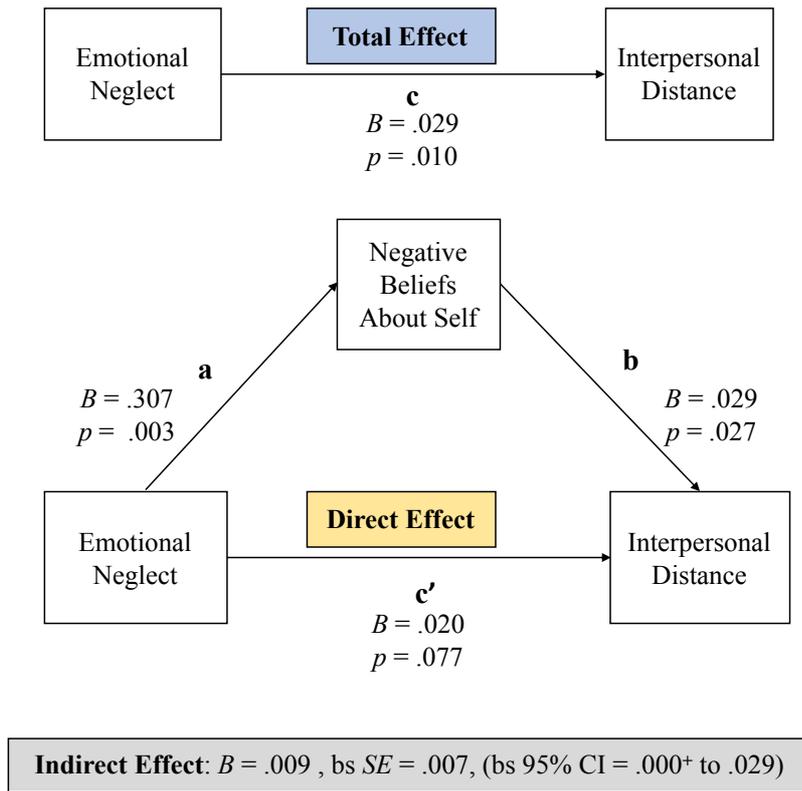


Figure 6. Diagrammatic representation of the mediating role of negative beliefs about self in the relationship between emotional neglect and interpersonal distance.

Note. Abbreviations:  $B$  = unstandardised beta coefficient;  $bs SE$  = bootstrapped standard error;  $bs 95\% CI$  = bootstrapped 95% confidence intervals.

Note. + = actual 95% CI value = .00004963

Table 8  
*Summary of Mediation Analyses*

Included variables	<i>B</i>	<i>SE</i>	<i>p</i> (95% CI)	Overall model
<b>Emotional abuse, NBO, and subjective trust</b>				
<i>Path C</i> : Emotional abuse predicts subjective trust	-.189***	.044	<.001 (-.227 to -.101)	
<i>Path A</i> : Emotional abuse predicts NBO	.522**	.145	.001 (.233 to .811)	
<i>Path B</i> : NBO predict subjective trust	-.122**	.034	.001 (-.189 to -.054)	
<i>Path C'</i> : Emotional abuse and subjective trust mediated by NBO	-.126**	.045	.006 (-.214 to -.037)	$F(2,67) = 17.11, p < .001, R^2 = .34$
<b>Indirect effect: <math>B = -.064</math>, bootstrapped <math>SE = .028</math>, bootstrapped 95% CI = <math>-.142</math> to <math>-.023</math>: Partial mediation</b>				
<b>Emotional neglect, NBO, and subjective trust</b>				
<i>Path C</i> : Emotional neglect predicts subjective trust	-.136**	.040	.001 (-.216 to -.056)	
<i>Path A</i> : Emotional neglect predicts NBO	.283*	.134	.039 (.015 to .511)	
<i>Path B</i> : NBO predict subjective trust	-.139***	.033	<.001 (-.204 to -.074)	
<i>Path C'</i> : Emotional neglect and subjective trust mediated by NBO	-.097*	.037	.012 (-.171 to -.022)	$F(2,67) = 16.29, p < .001, R^2 = .33$
<b>Indirect effect: <math>B = -.039</math>, bootstrapped <math>SE = .024</math>, bootstrapped 95% CI = <math>-.092</math> to <math>-.001</math>: Partial mediation</b>				
<b>Physical neglect, NBO, and subjective trust</b>				
<i>Path C</i> : Physical neglect predicts subjective trust	-.209**	.069	.004 (-.347 to -.071)	
<i>Path A</i> : Physical neglect predicts NBO	.598**	.223	.009 (.154 to 1.042)	
<i>Path B</i> : NBO predict subjective trust	-.140***	.034	<.001 (-.208 to -.073)	
<i>Path C'</i> : Physical neglect and subjective trust mediated by NBO	-.125	.065	.060 (-.256 to .005)	$F(2,67) = 14.21, p < .001, R^2 = .30$
<b>Indirect effect: <math>B = -.084</math>, bootstrapped <math>SE = .038</math>, bootstrapped 95% CI = <math>-.173</math> to <math>-.019</math>: Full mediation</b>				

Table 8 continued...

Included variables	<i>B</i>	<i>SE</i>	<i>p</i> (95% CI)	Overall model
<b>Sexual abuse, NBS, and interpersonal distance</b>				
<i>Path C</i> : Sexual abuse predicts interpersonal distance	.127**	.042	.003 (.044 to .211)	
<i>Path A</i> : Sexual abuse predicts NBS	-.104	.414	.802 (-.931 to .723)	
<i>Path B</i> : NBS predict interpersonal distance	.038**	.011	.001 (.015 to .061)	
<i>Path C'</i> : Sexual abuse and interpersonal distance mediated by NBS	.131**	.039	.001 (.054 to .209)	$F(2,67) = 10.95, p = <.001, R^2 = .25$
<b>Indirect effect: <i>B</i> = .004, bootstrapped <i>SE</i> = .018, bootstrapped 95% CI = -.035 to .039: No mediation</b>				
<b>Emotional neglect, NBS, and interpersonal distance</b>				
<i>Path C</i> : Emotional neglect predicts interpersonal distance	.029*	.011	.01 (.007 to .051)	
<i>Path A</i> : Emotional neglect predicts NBS	.307**	.101	.003 (.106 to .509)	
<i>Path B</i> : NBS predict interpersonal distance	.029*	.013	.027 (.003 to .055)	
<i>Path C'</i> : Emotional neglect and interpersonal distance mediated by NBS	.020	.011	.077 (-.002 to .043)	$F(2,67) = 6.34, p = .003, R^2 = .16$
<b>Indirect effect: <i>B</i> = .009, bootstrapped <i>SE</i> = .007, bootstrapped 95% CI = .000<sup>+</sup> to .029: Full mediation</b>				

*Note.* Abbreviations: *B* = unstandardised beta coefficient; *SE* = standard error; 95% CI = 95% confidence intervals; NBO = negative beliefs about others; NBS = negative beliefs about self.

*Note.* <sup>+</sup> = actual 95% CI value = .00004963; \* = significant at the  $p < .05$  level, \*\* = significant at the  $p < .01$  level, \*\*\* = significant at the  $p < .001$  level.

## **4. Discussion**

### **4.1. Summary of Findings**

This research used an experimental VR paradigm to explore the relationship between childhood trauma, negative schemas, and trust. Contrary to the first hypothesis, those who had experienced abuse were found to be no less trusting towards a virtual character than those without any history of abuse. In line with the second hypothesis however, a dose-response effect was found, whereby the severity of emotional abuse, emotional neglect, and physical neglect was shown to be associated with lower subjective trust ratings. Associations were also found between the severity of sexual abuse and emotional neglect and the amount of interpersonal distance maintained from the avatar. Consistent with the final hypothesis, schemas were implicated in these relationships. Whereas negative beliefs about others were shown to mediate the effects of emotional abuse, emotional neglect, and physical neglect on subjective trust ratings. Negative beliefs about the self were found to mediate the relationship between emotional neglect and interpersonal distance.

### **4.2. Trauma and Trust: A Complex Relationship**

It is perhaps unsurprising that the relationship between trauma and trust, which is inevitably dynamic and complex, was not best understood by the trauma/no-trauma dichotomy made in hypothesis one. While a wealth of research has shown strong associations between childhood trauma and a range of adverse outcomes, it is also known that this relationship is not straightforward, with many survivors of childhood trauma not developing psychological difficulties (Agaibi & Wilson, 2005; Bonanno, 2004). Correlational analyses showed that the relationship between trauma and trust is indeed more subtle and in-keeping with a dose-response understanding of

risk and adversity (Varese et al., 2012). The data showed that greater severity of some forms of abuse was associated with decreased ratings of subjective trust and increased interpersonal distance. Furthermore, negative beliefs about the self and others were shown to partially or fully mediate the majority of these trauma-trust associations.

Previous research using an experience sampling method (a structured self-assessment diary technique), has revealed the moment-to-moment effect of childhood trauma on stress sensitivity in those with psychosis (Lardinois, Lataster, Mengelers, Van Os, & Myin-Germeys, 2011). The current study builds upon these findings by using VR as an alternative method of exploring real-time interactions and finding an effect of trauma and negative schemas on trust behaviours. The dose-response relationship reported in the current study is also consistent with previous research which has described a cumulative effect of trauma (Briere, Kaltman, & Green, 2008; Edwards et al., 2003; Suliman et al., 2009). Individuals with a trauma history have been found to commonly undergo multiple traumatic events (Kessler, 2000) and these recurrent experiences have been shown to result in a greater risk of adverse outcomes and a more complex symptom presentation (Varese et al., 2012; Whisman, 2006). The mediating role of schemas within this relationship is in-keeping with cognitive models of psychopathology. Such frameworks argue that internalised representations of others, based on caregiver attachments, are created over time, being shaped and reshaped by early experiences (Bowlby, 1988). This process is on-going and dynamic, therefore events that are repeated or sustained are more likely to result in strongly held views of the self and others (D'andrea, Ford, Stolbach, Spinazzola, & van der Kolk, 2012; Young et al., 2003). As such, it follows that abuse of greater frequency and severity is more likely to result in the creation

and maintenance of global schemas, which in turn could serve to mediate the impact of such traumas upon trust behaviours.

### **4.3. Specificity of Effect**

The relationship between trust and trauma was found to vary by trauma type, with some forms of maltreatment shown to be uniquely associated with only one measure of trust. These differential associations could be considered as further support for the growing specificity literature, which highlights particular risks and the resulting symptom/s (Bentall, Wickham, Shevlin, & Varese, 2012; Gibson, Alloy, & Ellman; 2016). However, while these specific associations will be discussed, it is notable that some abuse categories showed significant associations with each other (see Table 5). This is in line with previous research which has highlighted the high probability of individuals experiencing multiple forms of abuse (Dong et al., 2004; Higgins & McCabe, 2000). Results relating to specificity should therefore be interpreted bearing in mind this potential overlap of abuse types.

**4.3.1. Emotional neglect.** Emotional neglect was associated with both subjective trust ratings and interpersonal distance; although the latter did not remain significant after corrections for multiple comparisons. Physical neglect was also found to be associated with subjective trust; however, this did not remain significant after Bonferroni corrections and unlike emotional neglect, was not associated with interpersonal distance.

Emotional neglect had the most pervasive impact on trust among the various trauma types; spanning across both measures. These associations are theoretically coherent, given that this form of maltreatment is characterised by parenting which is

cold, critical, and lacking in nurturance; factors known to influence a child's development of relational skills (Glaser, 2002). Furthermore, unlike sexual and physical abuse, which are more likely to be incident-specific, emotional neglect tends to be chronic, exerting its effects over sustained periods (Dube et al., 2003; Hibbard, Barlow, & Macmillan, 2012; van der Kolk et al., 2005). Alongside the risks stemming from a prolonged lack of parental warmth, emotional neglect has also been shown to co-occur with a number of other known risk factors for adult psychopathology; including poverty (Berger, 2005; Theodore, Runyan, & Chang, 2007), parental mental health problems, family break up, and poor prenatal and postnatal care (Repetti, Taylor, & Seeman, 2002). In the current study, emotional neglect was also found to be significantly associated with emotional abuse, suggesting that for some, these forms of maltreatment co-occur, which may present additional risk.

In line with these inherent and co-occurring risks, emotionally neglected children have been shown to be more likely to form insecure attachments (Murphy et al., 2014) and are prone to internalising behaviours, including a greater tendency to be isolated, avoidant, and withdrawn in their social interactions (Manly, Muhtadie, Zhou, Eisenberg, & Wang, 2001). Similarly, research has reported that emotionally neglected children find it more difficult to discriminate between the emotions of their peers and as adults they have an increased risk of alexithymia (Aust, Hartwig, Heuser, & Bajbouj, 2013). These individuals have also been shown to perceive others as more powerful than themselves (Bolger & Patterson, 2001) and have an increased risk of paranoia (Bentall et al., 2014). The findings of the current study are aligned with these established patterns of interpersonal difficulties. Whilst sexual and physical abuse have come under intense scrutiny as psychiatric risk factors (Wekerle

et al., 2009), emotional neglect may be a more elusive and insidious problem, impacting upon interpersonal outcomes, including trust behaviours, in ways that have previously been difficult to demonstrate.

**4.3.2. Emotional abuse.** Emotional abuse was associated with lower ratings of avatar trustworthiness, remaining significant after corrections for multiple comparisons. No relationship was observed between emotional abuse and interpersonal distance.

Those who experience emotional abuse are commonly made to feel unvalued and their thoughts, feelings, and behaviours actively condemned (Barnett, Miller-Perrin, & Perrin, 2005; Harper & Arias, 2004; Krause, Mendelson, & Lynch, 2003; Webb, Heisler, Call, Chickering, & Colburn, 2007). This may teach children that not all relationships are positively reinforcing; resulting in the young person learning to associate imitate relationships with expectations of fear and distress (Wekerle et al., 2009). Accordingly, children who have experienced emotional abuse have been shown to be more likely to describe interpersonal relationships as threatening and painful (Ornduff, 2000). These early experiences can therefore be informative; exerting subtle, but powerful effects upon the way young people see the world and other people. This in turn is likely to influence their ability and desire to form close and trusting relationships.

While emotional abuse was found to negatively impact the way that a neutral character was perceived, no effect upon interpersonal distance was found. This suggests that emotional abuse specifically effects the interpretation of another's trustworthiness, but not how they overtly act towards them.

**4.3.3. Sexual abuse.** More severe experiences of sexual abuse were associated with increased interpersonal distance. Sexual abuse has been previously linked to a fear of intimacy, paranoia, and heightened anxiety in romantic relationships and friendships (Davis & Petretic-Jackson, 2000). However, other research has reported a paradoxical relationship; with childhood sexual abuse found to be associated with both overly-trusting and untrusting behaviours (Nelson, Baldwin, & Taylor, 2011).

It has been hypothesised that inconsistencies in the expression of trust, represent an impaired ability to reliably judge the trustworthiness of others (Finkelhor & Browne, 1985; Freyd, 1994). Childhood sexual abuse is commonly perpetrated by someone within the family (Feerick & Snow, 2005). Betrayal trauma theory proposes that when this is the case, it is adaptive for the young person to remain emotionally connected to the perpetrator as they are still relied upon for survival (Freyd, 1994, 1996). The child may therefore show “betrayal blindness”, failing to identify the experiences as abusive. This defence mechanism is advantageous in the short term as it maintains the attachment; however, it is detrimental for development, as the individual does not learn to accurately make judgements about the trustworthiness of others (Finkelhor & Browne, 1985). The results of this study may therefore reflect this difficulty with trust, with survivors of sexual abuse unconsciously exhibiting behaviours aimed at trying to protect the self against future betrayals and threats (i.e. maintaining greater interpersonal distance).

**4.3.4. Physical abuse.** Physical abuse was the only form of abuse not found to be associated with either trust measure. This suggests that despite being

extensively linked to adverse outcomes (Norman et al., 2012), it does not appear to pose a specific risk for difficulties with trust as assessed in the current study.

A possible explanation for this is that children subjected to physical abuse may experience periods during which they are responded to in appropriate ways and where their physical and emotional needs are met (e.g. violence is used excessively, but sporadically, as a form of punishment) (Claussen & Crittenden, 1991). This could result in the young person still having exposure to relationships which are predominantly trusting in nature and therefore less likely to result in a global reluctance to trust others. Additionally, some research suggests that victims of physical abuse are more likely to develop externalising problems (as opposed to the aforementioned internalising behaviours common among victims of emotional neglect) (Afifi, Brownridge, Cox, & Sareen, 2006). This could result in survivors of physical abuse tending to exert more aggressive responses, rather than withdrawal-based behaviours (i.e. increased interpersonal distance).

#### **4.4. Negative Schemas: A Central Role**

Negative schemas appear to have a role in determining the impact of trauma upon trust. This suggests that the way that an individual incorporates adverse childhood experiences into their world view is important in shaping their ability and willingness to trust in later life. Once again, specificity was observed in these relationships.

**4.4.1. Negative beliefs about others and subjective trust.** Negative beliefs about others were found to either partially or fully mediate the relationships between emotional abuse, emotional neglect, physical neglect, and subjective trust. These

results are in line with recent evidence which found that negative schemas mediated the association between childhood trauma and psychological distress, and that, as in the current study, emotional abuse and emotional neglect had the strongest associations (Gong & Chan, 2018).

The negative-other schemas evaluated in the BCSS were that others are: “hostile”, “harsh”, “unforgiving”, “bad”, “devious”, and “nasty”. Children who experience neglect and emotional abuse have their needs chronically unmet; it is therefore entirely feasible that a child who does not receive adequate physical and emotional resources could develop these negative beliefs in light of how they have been treated. It also follows that greater endorsement of these schemas could serve to lower subjective trust ratings by biasing the way individuals interpreted the avatar’s behaviour. This would be consistent with research which has established that negative schemas impact the way neutral stimuli are perceived (Baldwin, 1995; van Harmelen et al., 2010).

Theoretical understandings of paranoia may help to further elucidate the current findings. Some have argued that a proportion of paranoid individuals (those with “poor me” paranoia) transform historical feelings of neglect and rejection into persecutory beliefs about others (Bentall, Corcoran, Howard, Blackwood, & Kinderman 2001; Trower & Chadwick, 1995). It is hypothesised that this results in a pattern of seeing others as bad and frightening, and themselves as a victim, which serves to protect self-esteem and avoid negative self-appraisals (Trower & Chadwick, 1995). It is possible that experiences of neglect and rejection, which are at the core of childhood maltreatment, impact trust via similar cognitive mechanisms. The fear of repeating distressing interpersonal experiences from the past may have resulted in the misattribution of negative intentions to the avatar, which in turn could

have negatively influenced perceived trustworthiness. This potential overlap in the mechanisms underlying both trust and paranoia is supported by the similarity of the current findings to those reported by Gracie et al. (2007), who found that negative beliefs mediated the relationship between trauma and paranoia in a student population.

**4.4.2. Negative beliefs about self and distance.** The influence of emotional neglect on increased interpersonal distance was fully mediated by negative beliefs about the self. The negative-self schemas evaluated in the BCSS were, I am: “unloved”, “worthless”, “weak”, “vulnerable”, “bad” and “a failure”. It is again understandable that a child who has suffered emotional neglect could endorse these negative views of themselves more strongly.

As discussed, negative-other beliefs may have acted upon participants’ interpretations of the avatar’s intentions. In the case of interpersonal distance however, it is possible that negative-self beliefs exerted an influence via an individual’s lack of confidence in their ability to keep themselves safe. This interpretation would be in keeping with emotional processing theory (Foa & Rothbaum, 1998), which posits that the effects of trauma on psychological wellbeing are mediated by a victim’s beliefs about themselves; particularly when the beliefs relate to being incompetent. More strongly held negative views of the self could therefore result in the protective mechanism of increased hypervigilance for threat, which may manifest as the observed preference for greater interpersonal distance.

The non-significant association between sexual abuse and negative beliefs about the self was unexpected as previous research has highlighted links between sexual abuse and negative schemas (Feiring, Taska, & Chen, 2002). Furthermore,

contrary to the hypothesised mechanisms, negative-self beliefs did not mediate the impact of sexual trauma upon trust. As previously discussed, this result is potentially indicative of a more unconscious method of regulating arousal and maintaining a sense of safety in interpersonal situations. Proxemic behaviours are thought to be controlled mostly out of conscious awareness (Hall et al., 1968), as such it is possible that sexual abuse exerts a less explicit influence over trust by shaping unconscious behaviours, rather than working via cognitive appraisals. This notion would be in-keeping with previous research which reported that sexual abuse is linked to unconscious submissive behaviours in a student population (Çelik & Odacı, 2012). It is also possible that while negative schemas mediate the impact of non-sexual maltreatment upon trust, different factors are implicated in the case of sexual abuse. Factors such as dissociation, shame, self-blame, avoidant coping strategies, and insecure attachment style could be potential candidates, with each shown to be influential in the relationship between sexual abuse and other adverse outcomes (Dutra, Bureau, Holmes, Lybchik & Lyons-Ruth, 2009; Freyd, Klest, & Allard, 2005; Whiffen & MacIntosh, 2005).

#### **4.5. Other Contributing Factors**

Not all of those who experienced more severe trauma exhibited reduced levels of trust. Furthermore, although negative schemas were shown to have a central role, they did not account for 100% of the variance in trust behaviours and a mediating role was not found for all relationships. This is unsurprising given the complex nature of trauma and serves to confirm that the relationship is not straightforward.

Individual contributing factors were not explored in the current study, however past research suggests that these are likely to play a role in this relationship (Hardy et al., 2016). Some have argued that an individual's genetic disposition and biological susceptibility to stress may determine the extent to which an early harmful environment influences psychopathology (Van Winkel et al., 2010). It has also been proposed that personal characteristics such as intelligence (Alvord & Grados, 2005), self-control (Masten & Coatsworth, 1998), self-esteem, and attractiveness (Osofsky, 1999), alongside demographic factors (e.g. an older age at the time of the trauma) (Sternberg, Baradaran, Abbott, Lamb, & Guterman, 2006) could moderate the effect of maltreatment on later outcomes.

The presence of protective factors, such as supportive others, may also moderate the effect of trauma (Howell, 2011). Previous research has shown that supportive romantic relationships (Schilling, Aseltine, & Gore, 2008) and parental warmth in the aftermath of trauma (Khaleque, 2012) positively influence the life-course trajectories of at-risk young adults. This is in-keeping with schema theory, which would predict that the presence of a positive relationship could help to prevent the internalisation and generalisation of negative beliefs by providing an alternative, and more helpful, view of relationships.

While this study has focused upon negative schemas, it is possible that the presence of positive schemas could also serve to moderate the impact of trauma on trust and be a marker of personal resilience (Messman-Moore & Coates, 2007). Previous research consistent with a protective function explanation has shown that positive schemas significantly moderated the relationship between childhood trauma and depressive symptoms in young adulthood (Lumley & McArthur, 2016).

Prior research has also highlighted the role of emotions. A study using an experience sampling method reported that strong affect and low self-esteem triggered symptoms of paranoia (Thewissen et al., 2011). Others have demonstrated that anxiety manipulation leads to an increase in paranoia in those at high-risk of psychosis (Lincoln, Lange, Burau, Exner, & Moritz, 2009) and amongst healthy individuals (Lincoln, Peter, Schäfer, & Moritz, 2009). Additionally, previous VR studies have shown that increased anxiety predicts persecutory ideation (Freeman et al., 2005; Freeman et al., 2008). This research therefore suggests that emotions could also have a contributory role in trust behaviours.

#### **4.6. Study Strengths and Limitations**

This study used VR as a novel tool in the investigation of trauma and trust. Although VR has been used effectively in the treatment of PTSD (e.g. Beidel et al., 2017; Rothbaum, Hodges, Ready, Graap, & Alarcon, 2001) it had not previously been applied to the experimental study of childhood trauma. Similarly, the study of trust has traditionally relied upon self-report measures and, more recently, trust-game paradigms. The use of VR proxemic moment-to-moment data, alongside a subjective rating, provided this study with a more objective measure of trust and adds to the robustness of the findings.

The results of this study must be interpreted in the context of several limitations. Firstly, as discussed, VR offers the benefits of increased objectivity, however it is notable that VR is less ecologically valid than an experience sampling method, which has been used in previous trauma-focused studies (Lardinois et al., 2010; Thewissen et al., 2011). Additionally, in line with past research (Bailenson et al., 2003), interpersonal distance was used in this study as a proxy for trust

behaviour. However, this measure could be understood as reflecting other underlying constructs. It is possible for example, that the participant's willingness to approach Mark when he directs them to the terrace was more reflective of compliance, rather than trust. Additionally, interpersonal distance may have been influenced by other factors, such as culture, which has previously been linked to differential distance keeping (Remland, Jones, & Brinkman, 2010).

Secondly, the sample, recruited via online platforms, was self-selecting. This may have meant that the individuals who took part were inherently more trusting (i.e. willing to come to a new location and meet a stranger from an online advertisement), which could have resulted in a biased sample of individuals. Additionally, the sample was drawn from a non-clinical population, participants reported no current mental health problems and the majority were either students (57.14%) or in employment (34.29%). Participants can therefore generally be considered a healthy, well-adjusted, and high-functioning sample; this may therefore limit the generalisability of these findings.

A significant limitation of this research is the lack of control for possible confounding factors. As previously discussed, child maltreatment is commonly associated with a range of other risk factors, such as family disruption and poverty (Howell, 2011). However, these were not measured, nor controlled for, in the current study. Similarly, whilst data pertaining to demographic factors was collected, these characteristics were not controlled for within the analyses. This study had a higher number of females (64.29%), a substantial proportion of individuals of Asian ethnicity (38.57%), and a large number of students (57.14%). Research has suggested that gender and ethnicity can influence the impact of trauma (DeSantis et al., 2011; Roberts, Gilman, Breslau, Breslau, & Koenen, 2011) and that student

status predicts fewer trusting behaviours in trust-game paradigms (Johnson & Mislin, 2011). It is therefore unclear whether these attributes may have influenced the findings of this study. A further factor that was not controlled for is paranoia. Alongside unfounded concerns about coming to harm, paranoia commonly involves feelings of mistrust (Freeman et al., 2008). Previous research has reported that higher ratings of paranoia predicted larger interpersonal distance kept from an avatar and a preference to subjectively trust more responsive avatars (Fornells-Ambrojo et al., 2016). Furthermore, others have described links between trauma, negative schemas, and paranoia (Appiah-Kusi et al., 2017; Gracie et al., 2007). It is therefore possible that paranoia may also have an explanatory role in the relationship between trauma and trust.

Another limiting factor surrounds the use of a young, Caucasian, and male avatar; it is possible that any of Mark's personal characteristics could have influenced participants' perception of his trustworthiness. The information extracted from a stranger's face is critical in forming initial impressions and shaping interpersonal interactions (Qi, Li, & Du, 2018). Perceptions of trustworthiness have been shown to be influenced by factors such as attractiveness (Dion, Berscheid, & Walster, 1972), facial masculinity (Little, Roberts, Jones, & DeBruine, 2012; Oosterhof & Todorov, 2009), tone of voice (Montano, Tigue, Isenstein, Barclay, & Feinberg, 2017), and ethnicity (Ito & Senholzi, 2013). Participants were not asked questions about their perception of Mark's appearance, relatability, and attractiveness. As such these variables were not controlled for.

A further limitation surrounds the measurement of trauma. It is well established that childhood maltreatment is underreported (Collin-Vézina, De La Sablonnière-Griffin, Palmer, & Milne, 2015), as such it cannot be assumed that all

experiences of trauma were accurately captured by the figures of this study. This research used the CTQ (Bernstein et al., 2003), which is one of the most commonly used, reliable, and valid scales to assess and quantify traumatic experiences. It is possible however, that the addition of a clinical interview about childhood history could have resulted in more accurate detection of trauma. However, this may not have eliminated this issue, as interviewing is prone to its own biases (e.g. social desirability) and is still subject to under-disclosure (Gilbert et al., 2009). It is also of note that the mean scores for the five trauma variables fell predominantly within the 'none' range, with only emotional abuse ( $M = 8.36, SD = 3.62$ ) and emotional neglect ( $M = 9.27; SD = 4.14$ ) scoring slightly higher and reaching the 'low' category. This is indicative of low prevalence, or mild severity, of trauma in the sample as a whole. In line with a dose-response effect, it is possible that if the observed abuse had been more severe, the impact upon trust would have been greater; this sample may therefore have been underpowered to fully detect potential effects. Additionally, although this study explored five different types of interpersonal trauma, this was not an exhaustive list and other forms, such as bullying, were not investigated. This study also only explored the effects of individual forms of interpersonal trauma on trust. While this allowed for greater understanding of specific relationships, it also meant that any possible cumulative or interactional effect of multiple traumas was not investigated. Furthermore, this study did not gather information as to the perpetrator/s of maltreatment. As this is an established predictor of adverse interpersonal outcomes (Cromer & Smyth, 2010; Lawyer, Ruggiero, Resnick, Kilpatrick, & Saunders, 2006) this additional data may have allowed for a more thorough exploration.

In regard to study design, the correlational nature of analyses means that a causal relationship between trauma and trust cannot be assigned. The CTQ was also retrospective and dependent upon participant recall. While recall of trauma has been found to be generally accurate, reliable over time, and corroborated by siblings (Fisher et al., 2011; Nelson, Lynskey, Heath, Madden, & Martin, 2010), a prospective study would have clear advantages in investigating these phenomena and would allow for greater certainty in inferring causality.

Finally, in terms of analysis, this study used multiple statistical tests to explore possible relationships between outcome measures, this increased the likelihood of making a Type I error (Cohen, 1992). Bonferroni corrections were applied; however, these can increase the likelihood of type II errors, thus reducing the power of a study (Nakagawa, 2004). There is no formal consensus for when, and how conservatively, Bonferroni corrections should be used (Perneger, 1998). In order to strike a balance, the Bonferroni corrections were conducted and highlighted, however results which did not remain significant after such corrections were still treated as significant and the results should therefore be interpreted with this caveat in mind.

#### **4.7. Clinical Implications and Future Research**

The findings of this study contribute to our growing understanding of the interpersonal implications of childhood trauma. Despite the modest sample size and need for replication, these results have potentially important clinical implications.

This study provides further evidence of the necessity of trauma-informed practices amongst agencies and professionals involved in the care of children. Systematic trauma screening and assessment procedures are required alongside

effective interventions that help to create a sense of safety and promote positive and stable relationships in the child's life (Ko et al., 2008). Clinicians working therapeutically with survivors of childhood maltreatment should hold in mind that there is an increased likelihood of the individual having difficulty in trusting someone new. Professionals should also be aware that this has the potential to impact upon the process of establishing and maintaining therapeutic relationships, and that it may also influence a clients' general engagement with mental health services.

Negative schemas were shown to be implicated in the relationship between trauma and trust. This suggests the way in which traumatic experiences are evaluated and internalised may be as important as the events themselves in determining the extent to which these impact upon interpersonal functioning. This finding offers further support for the important role of early intervention. If maltreatment is identified during childhood, the young person should be supported in making sense of these experiences and helped to find ways to contextualise and reframe these events, in order to limit their generalisability. Therapeutic modalities which focus upon the modification of internal working models of the self and others (e.g. Schema Therapy; Young et al., 2003) and on the links between trauma and unhelpful cognitive distortions/behaviours (e.g. Trauma-Focused Cognitive Behavioural Therapy; Cohen & Mannarino, 2008) may be particularly helpful with this group of individuals. Other approaches in which the therapeutic relationship can serve to provide an effective context for exploring core relationship themes and to develop more positive models of self and others may also be effective.

Given the multifaceted nature of the relationship between trauma and trust, as well as the complexity of the proxemic processes (Hall et al., 1968), replication of the study controlling for demographic factors (e.g. gender, occupation, and

ethnicity/culture) and family background variables (e.g. socioeconomic status) could allow for a more in-depth exploration and would allow for more certain conclusions about the impact of maltreatment on adult trust. Future research should also replicate the current study while controlling for other possible mediating and moderating factors. Particularly salient avenues would be to explore the impact of abuse perpetrator, paranoia, and the role of positive self and other schemas. Finally, as research in the field of trauma remains pathology-orientated, future research should aim to explore the personal and environmental protective factors that counteract the impact of abuse and contribute to interpersonal success. This could inform mental health and social care interventions by helping professionals to foster such factors in survivors of abuse.

## **5. Conclusions**

This study has established that childhood interpersonal trauma and negative beliefs about the self and others pose a significant threat to the creation of trusting relationships. In the context of these results, the well documented interpersonal problems among survivors of childhood trauma can be understood as an individual's attempts to cope with the world through the lens of negative schemas. The results confirm the complex nature of trauma; finding that the frequency and severity of abuse are important, as is the form it takes, how the experiences are interpreted and the degree to which they are internalised and generalised to others. Every effort should be made to protect children from trauma and to intervene promptly and appropriately when such maltreatment is identified.

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## **Part Three: Critical Appraisal**

## **1. Introduction**

This critical appraisal aims to provide thoughts and personal reflections on the process of completing this thesis. It will begin by discussing the difficulties in recruiting from a clinical population and how these challenges shaped the final research design. It will then consider the complexities of studying trauma, before finally reflecting upon the bi-directional relationship between research and clinical practice.

## **2. Recruitment**

In the original protocol for the empirical study, my co-researcher (EB) and I, set out to recruit 35 participants with a diagnosis of psychosis. However, due to prolonged difficulties in obtaining a sample from NHS settings, the decision was later made to recruit from the general population. The initial phases of establishing this research, their associated setbacks, and the resulting learning points will be highlighted.

### **2.1. Ethical Approval and Recruitment of a Clinical Sample**

The NHS Research Ethics Committee have an essential gate-keeping role in minimising the potential harm to research participants (Clark, 2010). For this study we sought an ethical amendment to an original research protocol by Fornells-Ambrojo et al. (2016). As our intended sample was considered a vulnerable group and due to the trauma-based nature of the research questions, the task of seeking ethical approval was understandably time-intensive. The process took six months in total from collation of the necessary information (January 2017), to submission (April 2017), and eventual approval (June 2017).

We had planned to recruit our sample by liaising with nine Early Intervention in Psychosis Teams (EIPs). We approached these services and joined team meetings in order to promote the study, provide information sheets, and answer any questions team members had. We then asked care-coordinators to approach potentially suitable clients, inform them about the research, and request consent for us to contact them. This involvement of care-coordinators was an essential component of the recruitment process, as approaching an individual experiencing psychosis has the potential to result in undue anxiety and stress. Unfortunately, recruitment within these settings was slow and despite us making contact with teams on a weekly basis over the course of several months, we received only one referral to the study.

Team members, including care-coordinators, typically showed enthusiasm in regard to the research; with many commenting that the virtual reality aspect and the monetary incentive would be highly appealing to the predominantly young, male, service users. This suggests that the lack of referrals was not due to disapproval or a disinterest in the study. The difficulty instead appeared to be largely attributable to the tension between the demands of everyday working within the NHS and the time required to facilitate research. EIPs commonly manage large, high-risk caseloads (Belling et al., 2011), and in this busy and pressurised context, research is, understandably, not always a priority. It became increasingly clear over the course of this period that the problem at hand was not in engaging service users, but in engaging team members who appeared to be over-stretched. Attempts were made to minimise the burden of staff involvement as much as possible (e.g. by providing flyers for potential participants so that team members did not have to keep relaying study information), however we continued to receive no referrals for suitable clients.

Ideally, it would have been helpful at this point to have fully immersed ourselves within these busy teams, basing ourselves within each office on a weekly basis and therefore helping staff members to hold the study in mind. However, the high number of different teams, combined with the demands of our own NHS clinical work, and other study commitments, made doing this on a regular basis unfeasible. This served to highlight some of the challenges of part-time research and the benefits of extra time and resources to invest within teams.

After three months of continued recruitment efforts we decided, in conjunction with our supervisors, to change our study design and recruit a non-clinical sample. We had approached the recruitment process knowing that previous D.Clin.Psy doctoral trainees (Dr Hannah Reidy and Dr Gail Wingham) had used the same virtual reality paradigm with a psychosis population and had also struggled with recruitment ( $N=18$ ), resulting in the study being underpowered to investigate their main hypotheses. This insight into potential pitfalls had fuelled our recruitment efforts; however, it also fuelled our own anxiety by empathising the importance of achieving a sufficient sample. The decision to switch to a non-clinical sample was considered at great length and predominantly pragmatic (due to time constraints), however, it is likely that this anxiety was also influential in shaping our decision not to persevere with the recruitment of a clinical sample.

Unfortunately, our experience does not seem to be uncommon, with the literature evidencing that difficulties in recruiting from psychiatric populations are widespread, sometimes leading to the abandonment of studies, particularly in small scale research (Patel, Doku, & Tennakoon, 2003). It is of note that this time-consuming recruitment process, coupled with the demands of balancing research, NHS work, and studying, may also result in more doctoral students deciding to carry

out research in easier-to-reach groups. While there is much to be gained from research utilising general population samples, this could ultimately result in fewer clinical research studies which would be detrimental to the evidence base.

Having made the decision to change our study design, the next step was to apply for ethical approval from the University College London (UCL) Research Ethics Committee. This process again spanned several months, resulting in the final study approval being granted in December 2017. Testing was then able to begin in January 2018, a full year after beginning the process. This period of multiple ethical applications and unsuccessful recruitment emphasised the energy-intensive nature of research planning. It also highlighted the importance of being flexible and adaptive in order to make changes in line with unforeseen setbacks.

## **2.2. Recruitment of a Non-Clinical Sample**

Trauma is known to be particularly prevalent amongst individuals with psychosis (Varese et al., 2012) and this understanding shaped my initial research questions. Changing to a non-clinical sample therefore had implications for the hypotheses I hoped to explore. My power calculations had been based upon two prior virtual reality studies, both with general population samples (Fornells-Ambrojo et al., 2008, Fornells-Ambrojo et al., 2016). However, I was concerned about whether a sample of 35 individuals from the general population would contain a sufficient number of individuals with a history of trauma in order to test my hypotheses.

Fortunately, recruitment within the general population was incredibly efficient, with testing timeslots filled on the same day that they were advertised and our only constraint the amount of time we were able to book in the VR lab. This high uptake was coupled with a low attrition rate ( $n = 2$ ), which may be at least partially

attributable to our efforts to send confirmation and reminder emails to participants. We therefore reached our initial target of 35 participants quickly and this made it feasible to consider recruiting a larger sample so as to improve the power of the study and generalisability of the results. We approached UCL to appeal for further funding and they were kindly able to support this request. This allowed for the recruitment of a further 35 participants ( $N = 70$ ) and resulted in the study containing a higher number of individuals with a trauma history.

Whilst recruitment was vastly more efficient in the general population, the use of convenience sampling has drawbacks. The sample we recruited was self-selecting and comprised predominantly of students, which may have biased the sample and limited the generalisability of the results. Furthermore, it is unclear how applicable the findings would be to a clinical sample. This trade-off between efficiency of recruitment and generalisability highlighted the pros and cons of recruiting from easier-to-reach groups.

### **3. The Study of Trauma**

The theme of trauma runs throughout this thesis. Research into childhood trauma and abuse has grown rapidly over the past two decades (Varese et al., 2012). The resulting wealth of literature is reflective not only of increased scientific interest, but also of the growing public awareness of the detrimental effects of such experiences (Nemeroff, 2016). Childhood trauma is now well established as a significant risk factor for a multitude of psychological problems; as such research into this phenomenon is vital to developing our theoretical understandings and improving outcomes. However, in the process of conducting a systematic review focused upon childhood sexual abuse and while conducting my own research into

childhood interpersonal trauma, I was repeatedly struck by the ethical and practical challenges of carrying out research in this area.

### **3.1. Ethical Considerations**

Firstly, I needed to consider how best to investigate childhood trauma in a way that balanced safety, sensitivity, and accuracy. As is the case in all research, the benefits gained from conducting trauma-focused studies must be weighed against the potential costs/risks (Schlenker & Forsyth, 1977). Research in this field almost always involves asking participants whether, and to what degree, they have experienced particular traumatic events. These kinds of questions can raise important ethical issues.

As a clinical researcher, my aim was to gather data pertaining to childhood abuse in a way that best captured its actual prevalence within the sample while also minimising any potential distress to participants. I felt apprehensive about obtaining information in a way that managed both of these demands. A recent meta-analysis showed that I was not alone in my concerns, with ethical review committees found to be more hesitant in granting approval to trauma-related research (Jaffe, DiLillo, Hoffman, Haikalis, & Dykstra, 2015). However, this review also addressed these concerns, reporting that individuals in well-designed trauma-focused studies generally tolerated participation well, did not feel retraumatised, and even benefited from involvement.

I felt strongly about the importance of research in this area and as such, I considered how to carry out the study in a psychologically-informed, ethical, and sensitive way. In line with this, efforts were made from the outset to hold participant experience in mind and to ensure that a safe and supportive research space was

created. A significant part of this design process was the involvement of a service user. While in the planning phase, the study was trialled by a member of the King's College Mental Health Service User Panel, who had lived experience of psychosis. My co-researcher and I were keen to ensure that this service-user involvement was not in any way tokenistic; therefore time was spent thoroughly going through each component of the study and asking for comments or suggestions on each part. This feedback was predominantly very positive and did not raise any significant concerns. Where constructive suggestions were made (e.g. changing the ordering of questionnaires), this was invaluable in reshaping the protocol. Although we did not end up carrying out the study with individuals with psychosis, the feedback we received was not diagnosis-specific and was therefore incredibly useful.

Prior research has shown that while answering questions about trauma exposes participants to trauma-related content, the inclusion of safeguards that impart a sense of control serves to counteract any sense of helplessness associated with traumatic events (Collogan, Tuma, & Fleischman, 2004). In line with this, steps were taken to ensure that participants retained autonomy and control throughout the entirety of the study. Participants were provided with information sheets detailing the content of the study, allowing them to make an informed decision as to whether or not to take part. It was made clear that participants had the right to leave any questions that they did not feel comfortable completing and to withdraw from the study at any point without explanation. It was also stressed, that all information provided would be anonymised and kept securely.

To further ensure participant wellbeing, participants were monitored for signs of distress throughout the study, particularly during the completion of the more emotionally salient measures (i.e. the Childhood Trauma Questionnaire, Bernstein et

al., 2003 and the Brief Core Schema Scale, Fowler et al., 2006). The debrief upon completion of the study further served to ensure that all participants left the study feeling contained and non-distressed. During this debrief, some participants ( $n = 6$ ) commented on the personal nature of the trauma questionnaire, with comments such as “those questions were quite intense” and “the trauma questionnaire made me feel lucky to have the family I do”. However, these participants did not describe feeling upset by these questions and had fully completed all items. It was also of note, that those with higher scores on the Childhood Trauma Questionnaire (Bernstein et al., 2003), were not among those who commented upon the use of this measure. As a final safeguard, we had been prepared to use our skills as clinicians to help participants manage any strong emotional reactions (e.g. through use of empathetic listening and guided relaxation techniques). However, this had ultimately not been necessary, as no participants showed or verbalised any distress.

### **3.2. Methodological Considerations**

The majority of studies included in the systematic review, as well my own empirical study, used correlational, retrospective designs. While this is common in psychological research, it makes claims of causality inappropriate and can result in the cause and effect of difficulties becoming blurred. For instance, although studies (including my own) tended to hypothesise that the reported traumatic experiences were the cause of any deficits in current psychological functioning, the reverse is also possible, and current symptomatology could impact upon retrospective recall and reporting of abuse. Similarly, the cross-sectional nature of designs is potentially problematic, as the effects of trauma are thought to wax and wane over the lifespan,

becoming more influential at critical periods, which may or may not coincide with study participation (Lupien, McEwen, Gunnar, & Heim, 2009).

As discussed throughout the systematic review, the way that childhood sexual abuse was identified, measured, and classified varied greatly between studies and almost certainly contributed to the high heterogeneity estimates across analyses. A number of different trauma measures were utilised, alongside differential implementation of age limits, cut off points, and classification types. This made collating this data in a meaningful and valid way challenging and allowed only for tentative suggestions as to the existence of relationships between variables.

On a personal level, I also noticed my own discomfort with the common practice of rating experiences of childhood rape as more severe than other forms. While research has established that this particular type of sexual abuse is often associated with higher levels of distress and more adverse outcomes (Spataro, Mullen, Burgess, Wells, & Moss, 2004), I was concerned about potentially invalidating the experiences of victims of “lesser” sexual abuses. This again stressed the difficulty in trying to measure and rank experiences that are difficult to quantify. It also further convinced me of the importance of supplementing large-scale quantitative research with smaller and more in-depth qualitative explorations of experience.

#### **4. The Bi-Directional Relationship**

During the course of conducting this research I have been struck by the interaction between my clinical and research work, with each informing and shaping my understanding of the other.

#### **4.1. The Impact of Clinical Work on Research**

Throughout the planning and implementation of this research, I have been working therapeutically, as part of my placements, with individuals who have experienced childhood trauma. I have found that whilst clinical work has helped to inform my hypotheses and writing, it has simultaneously made me more aware of the challenges of research within this field.

During clinical sessions, as part of a Narrative Exposure Therapy (NET) approach, I have worked alongside clients to create visual timelines of traumatic events. In doing so, I have often been taken aback by the result, which is filled with rich and personal life history. In the process of compiling these timelines, service users voiced how difficult it was to provide a coherent, chronological account of experiences that occurred in the distant past and now existed as fragmented childhood memories. Some clients also talked about their reluctance, and at times refusal, to disclose these experiences to professionals in the past.

This work has made me increasingly aware of the difficulty in accurately identifying and recording trauma as part of research and the near impossible task of creating categories that accurately define and capture the complexity of these lived experiences. At times, this made me question the validity of my own study and query its utility. However, research has shown that generally the recall of traumatic experiences in research trials is accurate (Meyer, Muenzenmaier, Cancienne, & Struening, 1996; Nelson, Lynskey, Heath, Madden, & Martin, 2010). Furthermore, I am reminded that psychological practice and research are not disciplines of black and whites and therefore this complexity should not lead us to abandon the study of trauma. Instead, as psychological researchers, it seems that we can only endeavour to explore complicated constructs using the best designs, skills, and tools available to

us, and transparently reflect upon the magnitude of potential confounders, biases, and methodological problems within the resulting findings.

#### **4.2. The Impact of Research on Clinical Work**

A key component of clinical psychology is evidence-based practice and in order to facilitate this, research with useful and relevant applications must be designed and applied (Spring, 2007). In line with this notion, I have also noticed the relevance of my own research in informing my clinical work. In particular, I have felt more attuned to issues concerning trauma and have considered more deeply the influence of these experiences upon clients' clinical symptomology and personal interactional styles.

My final placement has been on a perinatal Mother and Baby Unit. While working here with mothers who are experiencing psychosis-spectrum disorders, I have endeavoured to spend more time assessing for links between their symptoms and life histories. I have found that this has allowed for a richer understanding of these symptoms and that the discussions have been a helpful addition to the predominantly bio-medical interventions available to mothers on the unit. I have also been more mindful in sessions of the way a client's history has informed their beliefs about themselves and the world, and how this may influence their interpersonal interactions on the ward and within the therapy room. This has allowed me to better formulate a client's presenting problems and be better placed to reflect upon difficulties with engagement at a therapeutic and service level.

This research has further illustrated to me the potentially long-standing impact of adverse childhood experiences. I thoroughly enjoy working with young people and intend to work within a child setting post-qualification. Compiling this

thesis has heightened my desire to support early and effective recognition of trauma, and to provide effective interventions to those who have endured such experiences. I am pleased to note, that in line with my own clinical recommendations regarding the need for more training in recognising the signs of childhood trauma, I have since presented the findings of this research to my team, and resultantly been invited to provide child safeguarding training to new starters. This application of research to practice brings with it a sense of usefulness and practicality, which encourages me to conduct further research in the future.

## **5. Conclusions**

Having previously worked as a research assistant on a large and well-established psychosis trial, I had been somewhat sheltered to the processes of ethical approval, recruitment, and study design; usually undertaken by other members of the research team. As such, I perhaps embarked upon this research with an over-zealous sense of optimism. The tasks during the first year of this research were at best time-consuming and at worst frustrating and anxiety provoking; however, the necessity to keep moving and to find solutions to problems as they arose has been absolutely key in shaping my personal development as a researcher. Although we did not manage to overcome them, I have an increased awareness of the organisational barriers that can impede recruitment of clinical populations and would enter future research ventures feeling better equipped to tackle these. I am also more attuned to the difficulties in studying a construct that can be highly emotive and hard to accurately capture and would feel more confident in doing so again.

Despite the modest sample size and numerous methodological issues within the empirical study, I believe that virtual reality is a tool that lends itself well to the

study of traumatic experiences. It has the potential to contribute a great deal to the understanding of trauma and will no doubt be the focus of many trauma-focused interventions in coming years. It is imperative that researchers within this field continue trying to embody the complexity of trauma and work towards finding more unified and reliable methods of measurement.

Overall, the necessity of balancing clinical and research demands, whilst tolerating moments of great uncertainty, has been invaluable in shaping my learning over the last three years. The experience of compiling this thesis has greatly enhanced my professional working as a scientist-practitioner and I will endeavour to keep putting the skills I have learnt to good practice in my future role as a Clinical Psychologist.

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## Appendices

## **Appendix 1: Search Strategies**

### **Search strategy used in Pubmed database**

((child\*[Title/Abstract])

AND

(((((((((abuse\*[Title/Abstract]) OR trauma\*[Title/Abstract]) OR maltreat\*[Title/Abstract]) OR exploit\*[Title/Abstract]) OR adversit\*[Title/Abstract]) OR assault\*[Title/Abstract]) OR victimisation[Title/Abstract]) OR victimization[Title/Abstract]) OR CSA[Title/Abstract]))

AND

(((((((((hallucin\*[Title/Abstract]) OR "positive symptoms"[Title/Abstract]) OR "psychotic symptoms"[Title/Abstract]) OR "symptoms of psychosis"[Title/Abstract]) OR "psychotic experiences"[Title/Abstract]) OR "voice hearing"[Title/Abstract]) OR "hearing voices"[Title/Abstract]) OR AVH[Title/Abstract]))

### **Search strategy used in Psycinfo and Embase databases**

child\*.ti. or child\*.ab.

AND

abuse\*.ti. or abuse\*.ab. or trauma\*.ti. or trauma\*.ab. or maltreat\*.ti. or maltreat\*.ab. or exploit\*.ti. or exploit\*.ab. or adversit\*.ti. or adversit\*.ab. or assault\*.ti. or assault\*.ab. or victimi?ation.ti. or victimi?ation.ab. or CSA.ti. or CSA.ab.

AND

hallucin\*.ti. or hallucin\*.ab. or "positive symptoms".ti. or "positive symptoms".ab. or "psychotic symptoms".ti. or "psychotic symptoms".ab. or "symptoms of psychosis".ti. or "symptoms of psychosis".ab. or "psychotic experiences".ti. or "psychotic experiences".ab. or "voice hearing".ti. or "voice hearing".ab. or "hearing voices".ti. or "hearing voices".ab. or AVH.ti. or AVH.ab.

**Appendix 2: Original Version of the Standard Quality Assessment Criteria for  
Evaluating Primary Research Papers  
(Kmet, Lee, & Cook, 2004)**

Criteria		YES (2)	PARTIAL (1)	NO (0)	N/A
1	Question / objective sufficiently described?				
2	Study design evident and appropriate?				
3	Method of subject/comparison group selection or source of information/input variables described and appropriate?				
4	Subject (and comparison group, if applicable) characteristics sufficiently described?				
5	If interventional and random allocation was possible, was it described?				
6	If interventional and blinding of investigators was possible, was it reported?				
7	If interventional and blinding of subjects was possible, was it reported?				
8	Outcome and (if applicable) exposure measure(s) well defined and robust to measurement / misclassification bias? Means of assessment reported?				
9	Sample size appropriate?				
10	Analytic methods described/justified and appropriate?				
11	Some estimate of variance is reported for the main results?				
12	Controlled for confounding?				
13	Results reported in sufficient detail?				
14	Conclusions supported by the results?				

**Appendix 3: Table of Quality Rating Scores**

<b>Included studies</b>	Question/objective sufficiently described?	Study design evident and appropriate?	Method of subject group/comparison group selection described and appropriate?	Subject (and comparison group if applicable) characteristics sufficiently described?	Measure of childhood sexual abuse validated and appropriate?	Measure of auditory verbal hallucinations validated and appropriate?	Sample size appropriate?	Analytic methods described/justified and appropriate?	Method of analysis makes direct comparison between two variables?	Some estimate of variance is reported for the main results?	Controlled for confounding?	Results reported in sufficient detail?	Conclusions supported by the results?	<b>Total</b>
Bentall et al. (2012)	2	2	2	2	1	2	2	2	2	2	2	2	2	<b>25</b>
Daalman et al. (2012)	2	2	2	2	2	2	2	2	2	2	2	1	2	<b>25</b>
Sommer et al. (2010)	2	2	2	2	2	2	2	2	2	2	2	1	2	<b>25</b>
Hardy et al. (2016)	2	2	1	1	2	2	2	2	2	2	2	2	2	<b>24</b>
Misiak et al. (2016)	2	2	2	2	1	2	2	2	2	1	2	2	2	<b>24</b>
Pilton et al. (2016)	2	2	2	2	2	2	2	2	2	2	2	1	1	<b>24</b>
Berg et al. (2015)	2	2	2	2	2	2	2	2	2	1	1	1	2	<b>23</b>
Freeman & Fowler (2009)	2	2	2	1	1	2	2	2	2	2	1	2	2	<b>23</b>
Goldstone et al. (2012)	2	2	2	2	1	2	2	2	2	1	2	1	2	<b>23</b>
Sheffield et al. (2013)	2	2	2	2	2	2	2	2	2	1	1	1	2	<b>23</b>
Shevlin et al. (2007)	2	2	2	1	1	2	2	2	2	2	1	2	2	<b>23</b>
Abajobir et al. (2017)	2	1	2	2	0	2	2	2	2	2	1	1	2	<b>21</b>
McCarthy-Jones (2014)	2	2	1	2	2	2	2	2	1	1	1	2	2	<b>22</b>
Shevlin et al. (2011)	1	2	2	1	1	2	2	2	2	2	1	2	2	<b>22</b>
Üçok & Bikmaz (2007)	2	2	2	1	2	2	1	2	2	1	1	2	2	<b>22</b>
van Nierop et al. (2014)	2	2	1	1	1	2	2	2	2	2	1	2	2	<b>22</b>
Offen et al. (2003)	2	2	1	1	1	2	0	2	0	1	0	2	2	<b>16</b>
Andrew et al. (2008)	2	1	1	1	1	2	1	2	0	0	0	2	2	<b>15</b>
Honig et al. (1998)	2	2	1	1	0	1	1	1	1	1	1	1	2	<b>15</b>

## **Appendix 4: Summary of Each Researcher's Contribution to Joint Project**

This project used a virtual reality paradigm to investigate the effect of childhood trauma on trust.

The virtual reality scenario was originally used in a University College London (UCL) Clinical Psychology Doctoral Thesis by Dr Maikke Elenbaas (submitted in 2013 and published in 2016 by Fornells-Ambrojo et al., 2016). It has also been used in a joint UCL Clinical Psychology Doctoral Thesis project by Dr Gail Wingham and Dr Hannah Reidy (submitted in 2016).

The current study was completed by Hayley Dolan (the author) and Emilie Bourke (EB) (joint project researcher). Both were supervised by Dr Miriam Fornells-Ambrojo and Professor Chris Barker.

The current author's thesis uses the virtual reality paradigm to explore the association between childhood trauma, negative schemas, and trust. EB's project focuses on the role of attachment on trust and trials the use of a new attachment-based guided imagery task.

Within the current thesis, the research measurement choices were made jointly with EB under the supervision of Dr Miriam Fornells-Ambrojo and Professor Chris Barker. Decisions were made in collaboration with fellow researcher EB to ensure feasibility of the proposed data collection. The researchers shared measures of subjective trust (single-item rating scale), objective trust (average distance maintained from the avatar), Sense of Presence (Slater, McCarthy, & Maringelli, 1998), Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988), and questions designed to measure attention and contingency awareness (Elenbaas, 2014; Fornells-Ambrojo et al., 2016). All other measures were used independently in the two empirical papers.

Ethical approval was sought jointly for the two research projects by both researchers and research governance processes completed together. Both researchers were involved in the recruitment of participants.

Data collection was conducted jointly and data entry was shared between the two researchers. Data analysis and write up of this thesis was carried out entirely by Hayley Dolan.

**References:**

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- Reidy, H. (2016). No man is an island: Exploring the links between social connectedness and trust in clinical paranoia using a virtual reality paradigm. (Unpublished doctoral dissertation). University College London, UK.
- Wingham, G. (2016). The role of interpersonal contingency and self-focused attention in the development of trust in clinical paranoia: A virtual reality study (Unpublished doctoral dissertation). University College London, UK.

**Appendix 5: Notification of Ethical Approval from the UCL Research Ethics Committee**



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30 November 2017

Dr Miriam Fornells-Ambrojo  
Research Department of Clinical, Educational and Health Psychology  
UCL

Dear Dr Fornells-Ambrojo

**Notification of Ethics Approval with Provisos**

**Project ID/Title: 12179/001: Using virtual reality to investigate psychological factors in paranoia**

I am pleased to confirm in my capacity as Co-Chair of the UCL Research Ethics Committee (REC) that the data collection element of your study has been ethically approved by the UCL REC until **1<sup>st</sup> December 2018** subject to the following proviso:

1. Please confirm whether you have been granted 'conditional' data protection registration approval. Given that you are collecting personal data and data collection extends beyond the data when the new General Data Protection Regulation (GDPR) comes into force i.e. May 2018 your participant documentation is not GDPR compliant and it is highly likely that the documents will need to be updated. See attached an annotated template GDPR compliant participant information sheet (containing a mandatory privacy notice) and consent form, which you should use as a guide to make your documentation GDPR compliant

Ethical approval is also subject to the following conditions.

**Notification of Amendments to the Research**

You must seek Chair's approval for proposed amendments (to include extensions to the duration of the project) to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing an 'Amendment Approval Request Form'

<http://ethics.grad.ucl.ac.uk/responsibilities.php>

**Adverse Event Reporting – Serious and Non-Serious**

It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator ([ethics@ucl.ac.uk](mailto:ethics@ucl.ac.uk)) immediately the incident occurs. Where the adverse incident is unexpected and serious, the Joint Chairs will decide whether the study should be terminated pending the opinion of an independent expert. For non-serious adverse events the Joint Chairs of the Ethics Committee should again be notified via the Ethics Committee Administrator within ten days of the incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Joint Chairs will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

**Final Report**

At the end of the data collection element of your research we ask that you submit a very brief report (1-2 paragraphs will suffice) which includes in particular issues relating to the ethical implications of the research i.e. issues obtaining consent, participants withdrawing from the research, confidentiality, protection of participants from physical and mental harm etc.

In addition, please:

- ensure that you follow all relevant guidance as laid out in UCL's Code of Conduct for Research: <http://www.ucl.ac.uk/srs/governance-and-committees/resgov/code-of-conduct-research>
- note that you are required to adhere to all research data/records management and storage procedures agreed as part of your application. This will be expected even after completion of the study.

With best wishes for the research.

Yours sincerely



\_\_\_\_\_  
**Dr Lynn Ang**  
**Joint Chair, UCL Research Ethics Committee**

Encs.

Cc: Hayley Dolan & Emilie Bourke

## **Appendix 6: Participant Information Sheet**

**PARTICIPANT INFORMATION SHEET**

**PROJECT TITLE: UNDERSTANDING SOCIAL INTERACTIONS:  
AN EVALUATION OF A VIRTUAL FLATMATE**

We would like to invite you to take part in a study looking at people's reactions to virtual environments. This project is part of a student research project. Please take time to read the following information carefully and ask us if there is anything that is not clear to you or if you would like more information.

**Why have I been invited to take part in the study?**

You have been invited to take part in the study because we are looking for healthy volunteers who are 18 years old or above. In total, we hope that 30 healthy volunteers will take part.

**Do I have to take part?**

It is up to you to decide whether or not to take part. Choosing not to take part will not disadvantage you in any way. If you do decide to take part you will be given this information sheet to keep, and be asked to sign a consent form. You are still free to withdraw at any time, without giving a reason.

**What will happen if I decide to take part?**

If you decide to take part in this study, we will invite you to visit our virtual reality suite at University College London for a one-off appointment. We expect that this appointment will take a maximum of 2 hours and you will be reimbursed for your time.

The main thing you will be asked to do will be to explore a virtual environment. Brief questionnaires will be used to assess how realistic the environment is. You will be asked to complete the following steps:

**Part 1 - Questionnaires:** Prior to entering the virtual environment you will be asked to complete a number of brief questionnaires about your feelings at the time and some background information.

**Part 2 - Virtual Reality:** After completion of the questionnaire, we will invite you to enter the virtual reality room representing a student flat. You will be given instructions in the use of virtual reality before you start. You will be asked to wear glasses that produce three-dimensional images and you will be invited to remain in the student flat for a brief time and interact with a virtual flatmate character. The whole scenario will last 3 minutes. During your time in the virtual environment your movement will be tracked by motion sensors. There will be another researcher directly outside the virtual suite at all times to ensure that you feel comfortable during the exercise.

**Part 3 - Questionnaires:** Following the virtual reality exercise, we will ask you to complete some final questionnaires about your feelings at that time and to provide feedback on the quality of the virtual interaction with a flat mate avatar.

**Part 4 – Interview:** A research will complete a brief interview with you that asks about your experience of the virtual environment.

**Will I be paid for my participation?**

All participants will be paid £12.50 to thank them for their time. Any travel expenses will be reimbursed.

**Are there any disadvantages to taking part?**

When people use virtual reality systems they occasionally experience a degree of nausea. If at any time you wish to stop taking part in the study due to this or any other reason, please just say so and we will stop.

There has been some research that suggests that people using virtual reality might experience some disturbance in vision afterwards. No long-term studies are known to us, but the studies which have conducted testing after about 30 minutes, and have found that the effect is still sometimes there. It is advised that you do not drive a car, motorcycle, or operate complicated machinery in the four hours following virtual reality. There have been various reported side effects of using virtual reality equipment, such as ‘flashbacks’. With any type of video equipment there is a possibility that an epileptic episode may be generated. This, for example, has been reported for computer video games. **If you have epilepsy, please tell us. We would not want you to take part in study in this case.**

**What are the possible benefits of taking part?**

We cannot promise the study will help you but the information we get from the study will help improve understanding of social interactions for people under the care of mental health services and could help inform better practices and treatments for the future.

**What if there is a problem?**

If you wish to complain, or have any concerns about any aspect of the way you have been approached or treated by members of staff you may have experienced due to your participation in the research, National Health Service or UCL complaints mechanisms are available to you. Please ask your research doctor if you would like more information on this. In the unlikely event that you are harmed by taking part in this study, compensation may be available.

If you suspect that the harm is the result of the Sponsor’s (University College London) or the hospital’s negligence then you may be able to claim compensation. After discussing with your research doctor, please make the claim in writing to Dr. Miriam Fornells-Ambrojo who is the Chief Investigator for the research and is based at the Department of Clinical, Educational and Health Psychology, University College London. The Chief Investigator will then pass the claim to the Sponsor’s Insurers, via the Sponsor’s office. You may have to bear the costs of the legal action initially, and you should consult a lawyer about this.

**Will my taking part in the study be kept confidential?**

All the information obtained will be kept strictly confidential and you will not be identified. This is done by allocating you an anonymous participant number under which to collect data in the experiment. All data will be collected and stored in accordance with the Data Protection Act 1998.

**What will happen if I don't want to carry on with the study?**

If you withdraw from the study, we will destroy all your identifiable information e.g. name, contact number etc. However, we may use non-identifiable data that we have collected up until your withdrawal e.g. data from questionnaires that are assigned an anonymous participant number.

**What will happen to the results of the research study?**

The results of the research will be analysed in order to complete a doctorate in clinical psychology and the findings will be published in a scientific journal and may be presented at conferences. You will not be identified in any report or publication. Please inform Hayley Dolan or Emilie Bourke if you would like a copy of the study's findings.

**Who is organising this study?**

The research is being organised and funded by UCL.

**Who has reviewed the study?**

All research is looked at by an independent group of people, called a Research Ethics Committee, to protect your interests. The study has been reviewed and given favourable opinion by UCL Research Ethics Committee.

**Thank you for considering taking part and taking the time to read this information sheet.**

**Research Team Members:**

Hayley Dolan, Trainee Clinical Psychologist, Department of Clinical, Educational and Health Psychology, University College London. Telephone: Email: hayley.dolan.13@ucl.ac.uk

Emilie Bourke, Trainee Clinical Psychologist, Department of Clinical, Educational and Health Psychology, University College London. Telephone: Email: emilie.bourke.15@ucl.ac.uk

Dr. Miriam Fornells-Ambrojo, Lecturer in Clinical Psychology, Department of Clinical, Educational and Health Psychology, University College London. Email: Miriam.fornells-ambrojo@ucl.ac.uk

## **Appendix 7: Participant Consent Form**

Consent Form  
Version 1: 09.10.17  
THIS STUDY HAS BEEN APPROVED BY  
UCL RESEARCH ETHICS COMMITTEE

Patient Identification Number:  
Date:



**CONSENT FORM**

**PROJECT TITLE: UNDERSTANDING SOCIAL INTERACTIONS IN CLINICAL POPULATIONS: AN EVALUATION OF A VIRTUAL FLATMATE**

**Name of Researchers: Emilie Bourke & Hayley Dolan**

Thank you for your interest in taking part in this research. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to take part. You will be given a copy of this Consent Form to keep and refer to at any time.

1. I confirm that I have read and understand the information sheet dated 09.10.17 (Version 1) for the above study. I have had the opportunity to ask questions and have had these answered satisfactorily.
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.
3. I understand that if I decide to withdraw from the study, any identifiable data collected up to this point will be destroyed but non-identifiable data may be used for the research.
4. I understand that I must not take part in the study if I have epilepsy.
5. I understand that the information I have submitted will be published as a report and I will be sent a copy if I request this. Confidentiality and anonymity will be maintained and it will not be possible to identify me from any publications.
6. I consent to the processing of my personal information for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.
7. I understand that data collected during the study may be looked at by individuals from University College London or from regulatory authorities such as external auditors checking how the research is being run.
8. I agree that the research project named above has been explained to me to my satisfaction and I agree to take part in this study.

Name of Participant:.....

Signature:.....

Date:.....

Name of researcher taking consent: .....

Signature:.....

Date:.....

If you would like to receive a copy of the research findings once the study is complete please tick here:

*When completed: 1 for participant, 1 for researcher*

## **Appendix 8: Participant Signposting Sheet**

We realise that the questionnaires you have just completed relate to personal and, at times, sensitive topics. Below is some information about sources of support you can access should you feel that you this would be helpful:

### **Samaritans**

<https://www.samaritans.org>

*Whatever you're going through, call us free any time, from any phone on **116 123**. We're here round the clock, 24 hours a day, 365 days a year. If you need a response immediately, it's best to call us on the phone. This number is FREE to call. You don't have to be suicidal to call us.*



### **Mind**

<https://www.mind.org.uk/information-support/helplines/>

**Mind Infoline: 0300 123 3393 or Text: 86463**

*Our team provides information on a range of topics including:*

- *types of mental health problems*
- *where to get help*
- *medication and alternative treatments*
- *advocacy*



*We will look for details of help and support in your own area.*

### **Your GP**

If you would like to talk to someone in-person in a confidential environment, we would encourage you to arrange an appointment with your GP. They will also be able to signpost you to any local sources of support that may be relevant to you.

**Appendix 9: Contingency Mapping: Participant Behaviour and Avatar Responses,  
Current study vs. Fornells-Ambrojo et al. (2016)**

Triggered avatar responses	Overall frequency	
	Current study ( <i>N</i> = 70)	Fornells-Ambrojo et al. ( <i>N</i> = 63)
Head tilts	1034	836
Head nods	172	104
Front-to-back body movements	<i>Responses missing</i>	99
Left-to-right body movements	<i>Responses missing</i>	84
<b>Total</b>	1206	1123

## **Appendix 10: Virtual Reality Question Prompt Sheet**

1. What do you like about flat sharing?
2. How do you choose flatmates?
3. What makes a good flatmate?
4. What's the best thing about this flat?

## **Appendix 11: Full Script of VR Exercise**

**A**=Avatar

**P**=Participant

**A:** Hi my name is Mark thanks for coming. What's your name?"

**P:** (Tells avatar their name)

**A:** Thanks, OK I'm ready!

**P:** What do you like about flat sharing?

**A:** I enjoy meeting new people... I have made new friends this way...it's great getting to know them, have a laugh... mhm... and it helps to keep the cost of living low so you can live in a better area!

**P:** What do you ask potential flatmates before going ahead?

**A:** Well, I always meet them in person and get a sense of what they are like... I ask them what they are looking for in a shared flat, what is a typical day like for them, what music they like, if they smoke, if they are lazy about house chores... mhm.. If they like having friends around ... Oh, yeah it is also good to ask them what has been their best and worse experience of flat sharing!

**P:** In your experience... who makes a great flatmate?

**A:** Mhm... Good question... don't know... I'm trying to think ....someone how is easy going, friendly and fun but who also can give you space... It is also good to have something in common with them, like love for sport, or music...It's hard to answer because I think it really depends on the person... I've got on with people who were completely different from me, sometimes it just works.

**P:** What is the best thing about your flat?

**A:** The terrace and the view! Come and have a look! (Moves to the window)

**A:** It's amazing to have all this outside space, in the summer we practically live outside! We have great BBQs....

*(Phone rings – avatar answers and speaks discreetly on the phone)*

**A:** Hello? Okay... yeah I can be there! Okay bye.

**A:** Oh, sorry but I need to go now... anyway thank you for coming and maybe we can continue the interview some other time?

**P:** (Answers)

SCENARIO ENDS

**Appendix 12: Childhood Trauma Questionnaire  
(Bernstein et al., 2008)**

Appendix Removed to Protect Copyright

Appendix Removed to Protect Copyright

**Appendix 13: Items of Childhood Trauma Questionnaire (Bernstein et al., 2008)**  
**Sorted by Abuse Type**

Appendix Removed to Protect Copyright

**Appendix 14: The Brief Core Schema Scale  
(Fowler et al., 2006)**

Appendix Removed to Protect Copyright

**Appendix 15: Positive and Negative Affect Schedule  
(Watson, Clark & Tellegen, 1988)**

**PANAS (Post-VR)**

Participant no:

This scale consists of a number of words that describe different feelings and emotions. Read each item and then tick the appropriate answer next to that word. **Indicate to what extent you feel this way right now, that is, at the present moment.**

	1 Very slightly or not at all	2 A little	3 Moderately	4 Quite a bit	5 Extremely
Interested					
Distressed					
Excited					
Upset					
Strong					
Guilty					
Scared					
Hostile					
Enthusiastic					
Proud					
Irritable					
Alert					
Ashamed					
Inspired					
Nervous					
Determined					
Attentive					
Jittery					
Active					
Afraid					

**Reference:** Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of personality and social psychology*, 54(6), 1063.

## **Appendix 16: Single-Item Trust Scale**

How TRUSTWORTHY did Mark seem?

Not at  
all

1

2

3

4

5

6

Very  
much

7

## **Appendix 17: Detection of Contingency and Attention Checks**

Version 2  
01.07.15

Participant no:

## Scenario Feedback and Checks

1. In your experience of your interaction with the virtual flatmate, was there any relationship between what you did and the virtual flatmate's actions? Please Circle  
Yes                      No
2. If you experience any relationship between what you did and the virtual flatmates actions, what did you notice? Please write your comments in the space below.

### **Please circle whether the following statements are true or false**

1. One reason that Mark the virtual flatmate gave for why he likes flat sharing is that he has made new friends  
True                      False
2. When asked who makes a good flatmate, Mark mentioned that the most important thing is that they are tidy.  
True                      False

**Appendix 18: The Sense of Presence Questionnaire  
(Slater, Steed, McCarthy & Maringelli, 1998)**

Version 2  
01.07.15

**Participant no:**

**The following questions relate to your recent virtual reality experience. Please read each question and answer as you are instructed in each one.**

1. Please rate the sense of actually being in the flat

Abnormal Experience	1	2	3	4	5	6	7	Normal experience of being in a flat
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2. To what extent were there times during the experience when the virtual flat became “reality” for you, and you almost forgot about the “real world” of the laboratory in which the whole experience was actually taking place?

At no time	1	2	3	4	5	6	7	Almost all the time
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3. When you think back about your experience, do you think of the virtual flat more as “images that you saw”, or more as “somewhere you visited”?

Images that I saw	1	2	3	4	5	6	7	Somewhere that I visited
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4. During the experience, which was strongest on the whole, your sense of being in the virtual flat, or being in the real world of the laboratory

Laboratory	1	2	3	4	5	6	7	Virtual flat
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5. Consider your memory of being in the flat. How similar is the memory of the virtual reality experience to other memories of “real places” in terms of: visual quality, size, colour and how realistic and vivid it seems in your imagination?

Not at all Similar	1	2	3	4	5	6	7	Very similar
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6. During the experience, did you think to yourself that you were actually “just standing in a room wearing equipment” or did the virtual flat “overwhelm” you? The virtual flat overwhelmed me...

Not at all	1	2	3	4	5	6	7	All of the time
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## **Appendix 19: Normality Figures Across Measures**

Measure	Skewness	Kurtosis	Kolmogorov-Smirnov	Number of Outliers
Emotional abuse	1.347	1.181	.232, (p <.001)	2
Physical abuse	3.323	12.014	.324, (p <.001)	9
Sexual abuse	3.722	14.435	.506, (p <.001)	8
Emotional neglect	.675	-.616	.185, (p <.001)	0
Physical neglect	1.853	5.094	.235, (p <.001)	1
Negative self-schemas	2.158	6.114	.196, (p <.001)	4
Negative other-schemas	.721	-.473	.169, (p <.001)	0
Subjective trust	-.365	-.933	.231, (p <.001)	0
Interpersonal distance	1.176	1.111	.158, (p <.001)	9
Pre VR: PANAS positive	.037	-.083	.058, (p =.200)	1
Pre VR: PANAS negative	1.192	1.131	.197, (p <.001)	1
Post VR: PANAS positive	.066	-.865	.130, (p =.005)	0
Post VR: PANAS negative	1.809	2.910	.244, (p <.001)	7
Sense of Presence	-.350	-.082	.083, (p =.200)	1

**Appendix 20: Childhood Trauma Questionnaire (Bernstein et al., 2008)  
Cut-Off Scores**

**Emotional abuse**

None = 5 - 8

Low = 9 - 12

Moderate = 13 - 15

Severe = 16 +

**Physical abuse**

None = 5 - 7

Low = 8 - 9

Moderate = 10 - 12

Severe = 13 +

**Sexual abuse**

None = 5

Low = 6 - 7

Moderate = 8 - 12

Severe = 13+

**Emotional neglect**

None = 5 - 9

Low = 10 - 14

Moderate = 15 - 17

Severe = 18+

**Physical neglect**

None = 5 - 7

Low = 8 - 9

Moderate = 10 - 12

Severe = 13+

**Appendix 21: Non-Parametric Partial Correlation (Spearman's Rho)  
Co-Varied for Avatar Movements and Contingency Condition**

Measure	Subjective trust		Interpersonal distance	
	$r_s$	p	$r_s$	p
<b>CTQ</b>				
Emotional abuse	-.408***	.001	.121	.326
Physical abuse	-.146	.235	.003	.982
Sexual abuse	-.032	.798	.161	.190
Emotional neglect	-.343**	.004	.270*	.026
Physical neglect	-.304*	.012	.176	.151
<b>BCSS</b>				
Neglect beliefs about self	-.143	.244	.328**	.006
Neglect beliefs about others	-.547***	.000	.133	.279

Note.  $r_s$  = Spearman's Rho correlation, two tailed.

Note. \* = significant at the  $p < .05$  level, \*\* = significant at the  $p < .01$  level, \*\*\* = significant at the  $p < .001$  level.