Psychiatry Research 342 (2024) 116229

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Hallucinations across sensory domains in people with post-traumatic stress disorder and psychosis

Robert Dudley [a,b,*], Sarah White [a], Rebecca Miskin [a], Libby Oakes [a], Eleanor Longden [c], Craig Steel [d], Sarah Swann [e], Raphael Underwood [e], Emmanuelle Peters [e]

[a] Early Intervention in Psychosis services, Cumbria, Northumberland, Tyne and Wear NHS Foundation Trust, St. Nicholas Hospital, Jubilee Road, Gosforth, Newcastle Upon Tyne, NE3 3XT, UK
[b] Department of Psychology, University of York, York, YO10 5DD UK
[c] Psychosis Research Unit, Greater Manchester Mental Health NHS Foundation Trust, Manchester Academic Health Science Centre, UK
[d] Oxford Centre for Psychological Health, Oxford Health NHS Foundation Trust University of Oxford, UK
[e] King's College London, Institute of Psychiatry, Psychology & Neuroscience, Psychology Department, South London and Maudsley NHS Foundation Trust, UK

ARTICLE INFO

Keywords:
Voices
Visions
Auditory
Visual
Hallucinations
Trauma
Psychosis

ABSTRACT

Auditory hallucinations are common in people with histories of adversity, possibly indicating a causal relationship. However, hallucinations occur in multiple sensory modalities and the relationship between trauma and hallucinations in other sensory domains is less explored. We examined the occurrence of hallucinatory experiences in different sensory modalities in people with psychosis who also met criteria for Post-Traumatic Stress Disorder ($n = 67$). Particular attention was paid to the number of modalities reported and whether the experiences were linked to the person's adversity. This linkage was explored in two ways. First, it was predicted that those people reporting more trauma experiences and symptoms of PTSD would report a greater number of hallucination modalities. Second, we examined if there was content or thematic linkage between the trauma and the hallucinatory experiences. There were high levels of reported auditory (89.6 %), visual (58.2 %) and tactile (46.3 %) hallucinations. Hallucinations in two or more modalities were the norm (71.6 % of the participants). The number of hallucination modalities was moderately associated with a greater number of past traumas and PTSD symptoms. There was a high degree of content and thematic linkage between the trauma and the hallucinations. The linkage between trauma and auditory hallucinations extends to other sensory domains.

1. Introduction

Hallucinations are a common experience in people with psychosis. Some two-thirds or more report hearing things that others do not (McCarthy-Jones et al., 2017). For some, it can cause considerable distress (Hayward, 2018). Given this, there has been a focus on understanding and treating auditory hallucinations but this has led to a neglect of hallucinations occurring in other sensory domains (Badcock et al., 2021; Hayward et al., 2023; Toh et al., 2019; 2020).

Recent studies have systematically asked about hallucinations across sensory modalities in non-clinical groups (Aynsworth et al., 2022; Heriot-Maitland et al., 2023; Linszen et al., 2022; Toh et al., 2020), those at risk of transition to psychosis (Dudley, Denton, et al., 2023) and those in their first episode (Dudley, Watson, et al., 2023). Whilst findings vary, it seems that across this spectrum there is an increase in the frequency of reporting hallucinations in a range of domains, with fewer unimodal experiences and more co-occurring or multi-modal experiences (Montagnese et al., 2021) with some exceptions (Moseley et al., 2022) . However, for people with psychosis hallucinations in two or more modalities is the norm (Lim et al., 2016).

This change in the quantity and quality of hallucinations across the continuum is important both clinically and theoretically. In terms of clinical implications, where people report hallucinations in more sensory modalities it is associated with greater distress (Oorschot et al., 2012), delusional ideation (Dudley, Watson, et al., 2023) and poorer clinical outcomes (Kreis et al., 2024). Consequently, identifying hallucinations in multiple sensory domains could be a way to prioritise access to treatment. Unfortunately, we lack specific treatments for non-auditory experiences like visual (Thomson et al., 2017; Wilson et al., 2016) or tactile hallucinations (Pao et al., 2024). In turn, given

* Corresponding author at: Department of Psychology, University of York, York, YO10 5DD, UK.
E-mail address: rob.dudley@york.ac.uk (R. Dudley).

https://doi.org/10.1016/j.psychres.2024.116229
Received 1 July 2024; Received in revised form 8 October 2024; Accepted 10 October 2024
Available online 11 October 2024

their modest benefit, just adapting current psychological therapies for auditory hallucinations is unlikely to address this need. Rather, to develop treatments for these less explored modalities, or for combinations of hallucinatory experiences, it is necessary to explore their phenomenology and identify plausible tractable causal mechanisms that may be targeted in treatment.

In terms of theoretical understanding there are many causal factors that contribute to the development of hallucinations (Radua et al., 2018), although a particular role for trauma and adversity is evident (Hardy, 2017; Morrison et al., 2003). Exposure to maltreatment in childhood increases the risk of psychosis (Rosenfield et al., 2022), positive symptoms (Stevens et al., 2019) and auditory hallucinations (Bentall et al., 2014; Dudley, Turkington, et al., 2023; Longden et al., 2020). Less explored is the relationship between trauma and other sensory modalities, but Shevlin et al. (2011) reported that in a large community survey those who had experienced childhood sexual abuse were 3.3 times more likely to experience visual hallucinations compared to those who had not. Similarly, childhood trauma increased the likelihood of having visual hallucinations in people with a first episode of psychosis (Solesvik et al., 2016). In a study of 75 children and adolescents, greater reported trauma was associated with a larger number of sensory modalities (Medjkane et al., 2020). Trauma, therefore, may have an effect on the number of sensory domains that people experience hallucinations in (Badcock et al., 2021) but it raises the question as to how this may occur.

Recent meta-analyses (Williams et al., 2018; Sideli et al., 2020) have indicated that Post Traumatic Stress Disorder (PTSD) symptoms mediate the relationship between trauma and psychosis and hallucinations with roles for dissociation (Pilton et al., 2015), emotional dysregulation (Timmer-Murillo et al., 2023), core PTSD symptoms (avoidance, numbing and hyperarousal (Isvoranu et al., 2017) and trauma related beliefs (Hardy et al., 2021). The pathway through which trauma leads to hallucinations thus seems likely to be multifactorial. However, Bloomfield and colleagues (Bloomfield et al., 2021) noted a direct link between PTSD and hallucinations. A hallmark feature of PTSD is 're-experiencing' where the person experiences vivid, emotionally intense intrusions of past events, which may feel as if the event or an aspect of the event is happening again. Normally, perceptual, emotional and spatiotemporal information is encoded as an integrated contextual memory which is more easily identified as having occurred in the past when the memory is recalled. However, trauma memories are stored as unintegrated fragments, which can intrude unexpectedly into the present and are re-experienced in an emotionally salient manner in the here and now (Brewin et al., 2010).

As trauma memories lack spatiotemporal information it increases the risk of confusion between real and imagined or remembered events (Aynsworth et al., 2017; Morrison, 2001; Steel et al., 2005). Intrusive memories and flashbacks are often visual, somatic, olfactory and gustatory experiences. Hence, these features of PTSD are also multi-sensory, potentially increasing the risk of hallucinations in other sensory modalities (Lyndon and Corlett, 2020; Wilkinson et al., 2017).

Such a route between trauma and hallucinations would increase the chance that hallucinatory content is phenomenologically/thematically linked to experiences of trauma (Hardy, 2017). Consistent with this, a number of studies)Hamner, 1997; Corstens and Longden, 2013) have identified overlaps between trauma and hallucinations in terms of identity of the voice/abuser, content of what was said, and in thematic correspondence. In the more methodologically robust studies, the authors used coding frames to systematically investigate links between the phenomenology of trauma and hallucinations (usually auditory). Hardy et al. (2005) used three categorisations (no link, thematic link and direct or content links) in a group of 40 people with non-affective psychosis who had experienced childhood trauma. Researchers rated 12.5 % of hallucinations as having content directly related to an identified trauma with another 45 % of hallucinations as thematically related to the traumatic event. Higher rates of phenomenological links were identified by Peach et al. (2021), who recruited 36 people with first episode psychosis who reported trauma experience and hallucinations of whom 27 % also met criteria for PTSD. 12 participants (33 %) experienced hallucinations with content directly related to their traumas and 67 % reporting hallucinations with content thematically related to their traumas. The higher rates reported in Peach et al. (2021) may be owing to their asking about multiple traumatic events as well as the content of post traumatic intrusions.

Finally, van den Berg and colleagues (van den Berg et al., 2022) recruited a larger sample of voice hearers (n = 73). 96 % reported trauma histories. They employed a structured coding frame assessing four types of independent links (victimisation type, physiological-behavioural, emotional, and cognitive response themes including negative self-beliefs) and three types of dependent links: relational (similar interaction with/response to, voice and trauma); content (voice and trauma content are exactly the same); and identity (voice identity is the same as perpetrator). They had participants and researchers rate these links. Both noted many dependent links (80 %, 66 %, respectively), most frequently relational links (75 %, 64 %), followed by content (60 %, 25 %) and identity links (51 %, 22 %).

While existing evidence is compelling, it is less clear if the posited relationship between trauma and auditory experiences (McCarthy-Jones, 2011) extends to hallucinations in other sensory domains. Given the high rates of childhood sexual abuse in people with psychosis it would seem important to ask if there are phenomenological links between the sexual abuse and sexual hallucinations, however, reported sexual hallucinations are uncommon. One study screened 778 patients diagnosed with a Schizophrenia spectrum disorder and only 13 were found who reported sexual hallucinations. Where people experienced sexual hallucinations they had an increased rate of childhood trauma, most often sexual trauma (OR 8.7) (Blom and Mangoenkarso, 2018).

Past research has commonly relied on a limited number of measures of trauma, and/or only asked about one sensory domain, in people with varying levels of trauma histories. The present study addressed these limitations by asking about a wide range of sensory modalities, in people with high levels of trauma and PTSD who were assessed on comprehensive measures of trauma/adversity and current PTSD. This enabled us to examine occurrence and nature of hallucinations across the sensory domains in people with psychosis and trauma to establish i) the frequency of different hallucinations reported by people with PTSD and psychosis, ii) whether people report hallucinations in one single modality (unimodal hallucinations) or report more than one modality of hallucination. It also explored the potential causal mechanisms leading to the higher reporting of hallucinations in other modalities. It was predicted that where people report a greater level of trauma experiences and/or greater severity of PTSD symptoms they will also report a greater number of hallucination domains. This then attempts to replicate the work of Medjkane et al. (2020) but in an adult sample, and extends the work of Bloomfield et al. (2021) account of auditory hallucinations to a broader range of modalities. We also examined whether there were phenomenological links between traumatic events and hallucinations in terms of theme or direct content with the nature of their adversity experienced across a wide range of sensory experiences and trauma types.

2. Methods

2.1. Participants

Participants (n = 67) were recruited from one of the sites recruiting for the Study of Trauma and Recovery (STAR) therapy trial (Peters et al., 2022). Participants met criteria that included being aged 18 and above, being in a secondary care setting (Early Intervention in Psychosis (EIP) service or Community Mental Health Team (CMHT), meeting ICD-10 criteria for a schizophrenia spectrum disorder (F20 – F29),

experiencing distressing psychosis symptoms (rated by scoring a 2 or higher in distress on one of the PSYRATS subscales), and who have experienced stressful or traumatic event(s) at least 1 month ago, and meet criteria for DSM-5 PTSD. Both individuals on antipsychotic treatment, and those who declined to take medication, were included, as long as no medication changes had occurred in the previous three months. Individuals with a primary substance use disorder, organic factors related to psychosis and/or PTSD were ineligible. Additionally, anyone who had received trauma focused therapy within the last three months was not eligible, along with anyone in a current acute mental health crisis.

2.2. Procedure

Participants were assessed on a specifically designed interview measure of hallucinatory experiences across a range of sensory modalities as well as other measures of hallucinations, trauma and PTSD completed as part of the trial. All assessments were carried out by 3 assessors (SW, RM, LO) trained in the use of the measures.

2.3. Measures

2.3.1. Multi-modal hallucinations interview

The interview was developed with input from people with lived experience, clinicians and informed by previous research (Toh et al., 2022; Dudley, Watson, et al., 2023; Niles et al., 2019). Participants were told that hallucinations across a number of modalities were common and that the focus was on ones that occurred when awake, rather than when falling asleep or waking up, as well as not under the influence of alcohol or other substances. Questions covered hallucinations in a range of modalities: auditory verbal, auditory nonverbal, visual, somatic/tactile, sexual somatic, olfactory and gustatory that were experienced in the last month. Participants provided a description of their experiences which was recorded verbatim by the assessor. They were asked whether these were experienced at the same or different times (simultaneous or serial).

2.3.2. Psychotic symptom rating scales (PSYRATS; Haddock et al., 1999)

The PSYRATS is a clinician administered semi-structured interview assessing auditory hallucinations and delusions. The PSYRATS AH subscale consists of 11 items assessing distress, disruption, content, control, and other important features of auditory hallucinations experienced in the last month. Higher scores represent more distress and impact of hallucinations.

2.3.3. Trauma and life events checklist (TALE; Carr et al., 2018)

The TALE is a 20-item checklist of common traumatic events across the lifespan. The measure asks about exposure (i.e. 'yes' or 'no'), frequency (i.e. once or more) and the ages at which the events occurred.

2.3.4. Clinician-administered PTSD scale for DSM-5 (CAPS-5; (Weathers et al., 2018))

The CAPS-5 is a questionnaire investigating the onset and duration of PTSD symptoms, distress, impact on social and occupational functioning. Participants reported symptoms they experienced over the last month and were then scored on a range of 0 to 4 on severity based on intensity, frequency, and distress. For the present study the total symptom severity score was used (total of 20 item scores on Criteria B to E)

2.3.5. International trauma questionnaire (ITQ; Cloitre et al., 2018)

The ITQ is an 18 item self-report questionnaire focusing on the symptoms of PTSD and complex PTSD. The same event used in the CAPS was used in the administration of the ITQ. The questionnaire has two subscales with three symptom clusters in each: PTSD based on symptoms of re-experiencing, avoidance, and sense of threat (6 items). Disturbances in Self-Organization (DSO) based on symptoms of affective dysregulation, negative self-concept, and disturbances in relationships (6 items). For the analysis scores on the PTSD and DSO subscales were used. If a participant endorses scores of 2 or higher in each cluster on each subscale, they are considered to have symptoms of complex PTSD (cPTSD). Participants scoring a 2 or higher on the first subscale but not the second would be considered to have symptoms of PTSD.

2.4. Data analytic strategy

The data were checked for missing values. For questionnaire outcome measures, we applied prorating to address missing items, provided that no >20 % of the items were missing for any given participant. Specifically, we replaced the missing values with the mean of the completed items for each individual. Tests for normality (skew, kurtosis & Shapiro-Wilk tests) were used to establish if suitable for parametric or non-parametric analysis. The main hypotheses were that greater trauma history (more reported trauma experiences on the TALE) and/or PTSD symptomatology (severity score as assessed on the CAPS and ITQ) would be associated with more reported hallucinatory domains. Given this was an initial study, with a small sample size ($n = 67$), a range of modalities that could be reported and a number of measures used (CAPS, TALE, ITQ), r values, confidence intervals and p values were reported. No corrections for multiple testing were made.

2.4.1. Multisensory and multimodal analysis

All descriptions of reported hallucinatory experiences were checked to ensure they met the definition of a hallucination and were not unusual experiences such as illusions or misperceptions. Particular consideration was given to differentiating memories and flashbacks from hallucinations. For example, people were asked about the nowness of the experience, as if it was happening in the present or was linked to a specific memory. Classification as to whether a hallucination was multisensory or multimodal was made according to the definition of Toh et al. (2022) by considering if the experiences were described as serial or simultaneous in nature. For example, an auditory hallucination of a dog barking and later smelling burnt toast would be a serial/multisensory experience. A visual hallucination in which someone saw a man, and at the same time heard him speak would be a simultaneous/multimodal experience. Both examples would indicate the person was experiencing hallucinations in two sensory domains (auditory and olfactory; and visual and auditory, respectively).

2.4.2. Traumatic content in hallucination thematic analysis

Traumatic experiences were taken from the verbatim descriptions and information derived from the TALE, ITQ and CAPS. Hardy et al.'s (2005) methodology was followed for assessing for thematic and content overlap. Ratings were categorised into three types of associations: clear content overlap; thematic content; and no obvious content overlap. Where there was not enough information provided these were categorised as no obvious overlap.

A clear content rating was obtained when a participant's traumatic experiences were reflected directly in their hallucinations (e.g., a person who was abused by their parent, experiences the voice of their parent talking about the abuse). A thematic rating was applied where there were similar themes in the hallucinatory content as those from a past traumatic experience. These were rated on four themes of indirect associations, humiliation, intrusiveness, guilt, and threat (Hardy et al., 2005).

Descriptions of the traumatic experiences and hallucinations from each individual assessment were entered into a coding frame. The raters (SW, RM, LO) individually rated each participant's traumatic and hallucinatory experiences into one of the three categories. Given the importance of reliable assessment of the associations we took steps to ensure a this was done to a high standard. The assessors were research assistants on the trial and received intensive training in asking about psychosis symptoms and trauma experiences. They were trained to a

high level of competence and reliability on the CAPS and PSYRATS measures (with overall Intra-Class Correlations ratings from the main trial of 0.989 and 0.997, respectively; Peters et al., In Preparation). The research assistants received twice weekly supervision with the site lead (RD) and trial managers (RU, SS) where issues of assessment were discussed. With regards the linkage between trauma experience and hallucinations an interrater reliability check of the whole sample was performed and resulted in 91.04 % agreement between any two raters. Subsequently, the raters discussed discrepancies in scoring resulting in 100 % interrater agreement.

2.5. Ethical considerations

The data were collected as part of the STAR trial (Peters et al., 2022). The trial was funded from the National Institute for Health Research (20/LO/0853) and obtained ethical approval Health Research Authority (IRAS 275697). Participants gave full informed consent for the study.

3. Results

3.1. Participant characteristics

Of the 67 participants, half were female ($n = 34$, 51 %; male $n = 33$, 49 %) with an average age of 40.84 years ($sd = 11.76$). They were mainly White British (97 %) which is representative of the local population (Office for National Statistics, 2021). Most were unemployed ($n = 62$, 92.53 %) with the remainder employed either part or full-time ($n = 3$, 4.4 %; retired $n = 1$, 1.49 %) or studying ($n = 1$, 1.49 %).

39 (58.21 %) participants met criteria for F29 Unspecified Psychosis, which included those being treated in first episode psychosis services. 20 (29.85 %) were diagnosed with F20 Schizophrenia, 5 (7.46 %) with F25 Schizoaffective disorder, 3 (4.48 %) with F28 Other nonorganic psychotic disorders. 79 % ($n = 53$) had at least 1 other diagnosis (including anxiety; depression; personality disorders) in addition to meeting criteria for F20–29 and DSM-5 PTSD. 57 (85.07 %) were prescribed an antipsychotic medication. The other 10 were not currently taking an antipsychotic but were prescribed some form of psychiatric medication.

3.1.1. Trauma histories, PTSD, and cPTSD

Based on the TALE, the participants reported trauma experiences for an average of 11.83 of the 20 items (sd=2.97). The most commonly endorsed experience was "…someone close to you insulting you, putting you down or humiliating you" (88.06 %), followed by “physical abuse from someone close” (86.57 %),”feeling unsafe as a child” (79.10 %), “being bullied as a child” (64.18 %), “physical assault by a stranger” (53.73 %), and “experiencing unwanted sexual contact in any form under the age of 16″ (50.75 %). Females reported more trauma experiences than males, ($m = 12.50$ sd=2.93 vs $m = 11.15$ sd=2.99) to a near significant degree ($t(65)=-1.90$, $p = 0.06$).

All participants ($n = 67$, 100 %) met DSM-5 criteria for PTSD on the CAPS-5. Of 65 participants that completed the ITQ, 94 % ($n = 61$) met criteria for ICD-11 cPTSD, 3 % ($n = 2$) met criteria for ICD-11 PTSD and 3 % ($n = 2$) met criteria for neither.

3.1.2. Auditory hallucinations

The PSYRATS responses indicated 57 people (85.04 %) reported distressing auditory hallucinations. The mean score of 32.78 (sd=5.43) reflects a high degree of impact of voices, comparable to or higher than in other psychological treatment studies for Psychosis (Morrison et al., 2018) or auditory hallucinations (Craig et al., 2018).

3.1.3. Multimodal and multisensory experiences

On the multimodal hallucination interview measure, 61 participants reported hallucinations in the last month. Of the 67 participants, 6 reported delusional beliefs and no hallucinations. Our interview asked about a range of unusual sensory experiences (Lim et al., 2016) but it has been argued that multimodality needs to be considered in relation to the five primary senses (Toh et al., 2022). To this end we combined verbal and non-verbal hallucinations, as well as the sexual and tactile experiences. When asked about hallucinations in a range of modalities in the past month there were high rates of auditory (60/67; 89.55 %), visual (39/67; 58.21 %), somatic/tactile (31/67; 46.27 %), and olfactory (28/67; 41.79 %) experiences and to a less degree gustatory experiences (5/67; 7.46 %). Of those participants reporting somatic hallucinations, 6 described experiences that were sexual in nature (8.96 %).

We then considered whether people reported hallucinations in more than one domain (see Table 1). 71.64 % of the participants reported hallucinations across 2 or more sensory domains in the past month, with the most common being three domains. In comparison, Lim and colleagues found lifetime reporting of two or more modalities in 53 % of their sample of 750 patients (Lim et al., 2016). The mean number of domains reported was 2.45 (sd=1.34) and females reported a similar mean number of modalities as males ($m = 2.62$ sd=1.35, $m = 2.27$ $sd = 1.33$, $t(65)=-1.05$, $p = 0.30$).

The combinations of co-occurring hallucinations are shown in Fig. 1. In line with the approach of Toh and colleagues (Toh et al., 2022), we combined olfactory and gustatory hallucinations. Participants generally reported auditory hallucinations alongside other sensory experiences. 14 people reported hallucinations across all four domains (SH, AH, VH and OH+GH). One person reported solely visual experiences whereas Somatic, or Olfactory/Gustatory were always in combination with another hallucination.

Fig. 2a reports on the modalities described as serial experiences (multisensory hallucinations in different domains that are not temporally related to each other; Toh et al., 2022). Of the 61 participants with serial hallucinations, 59 reported auditory hallucinations (98.33 %), and 38 reported additional sensory experiences in addition to their auditory experiences (62 %). 1 participant had just visual hallucinations, and 1 had just somatic hallucinations.

Serial experiences were predominantly auditory in combination with other experiences. In comparison, simultaneous experiences (multimodal hallucinations or ones that occur at the same time as other experiences) represent a different constellation of experiences that were centred around visual hallucinations. Fig. 2b illustrates the combination of hallucinations that the participants reported as occurring together, with visual and auditory experiences being the most common. Only seven of the experiences reported as simultaneous in nature did not have a visual element to them.

3.2. Association between PTSD and number of hallucination modalities

Scores on the measures of exposure to trauma (TALE), and PTSD (CAPS ITQptsd and ITQdso subscales) were considered in relation to the number of modalities of hallucinations using non-parametric correlations. These indicated a small but significant relationship between the number of hallucinations and CAPS ($r = 0.25$, $p = 0.04$ CI 0.01 to 0.47), and a near significant association with the TALE ($r = 0.24$, $p = 0.053$ CI −0.11 to 0.46) but not with PTSD symptoms on the ITQ ($r = 0.15$, $p = 0.23$ CI −0.10 to 0.39) or with DSO symptoms on the ITQ ($r = 0.15$ $p = 0.24$ CI −0.11 to 0.39). The correlations are reported in Table 2.

Table 1
Number of domains.

Number of Domains	$n = 67$	%
0	6	8.96 %
1	13	19.40 %
2	11	16.42 %
3	22	32.84 %
4	13	19.40 %
5	2	2.99 %

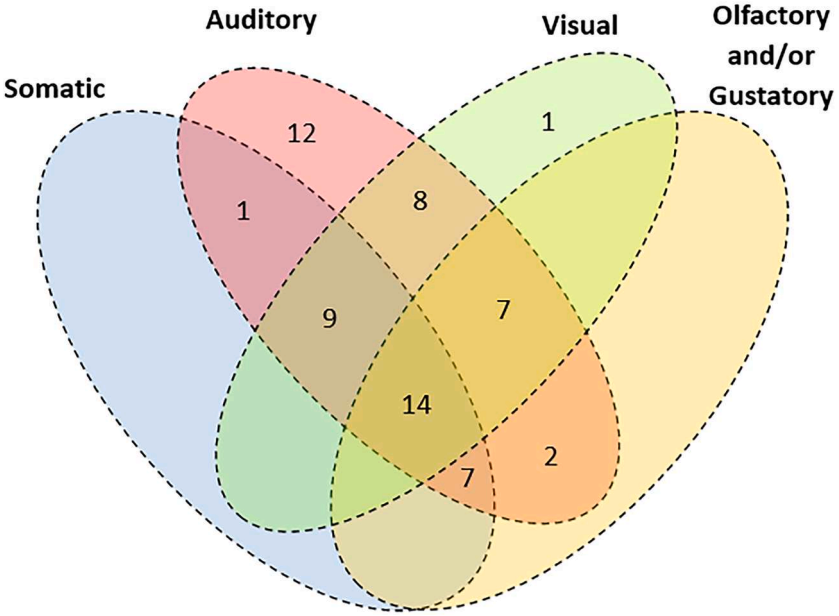

Fig. 1. Number of hallucinatory domains
nb When Olfactory and Gustatory categories are combined 23 people report 3 hallucination modalities, and 14 report 4 modalities.

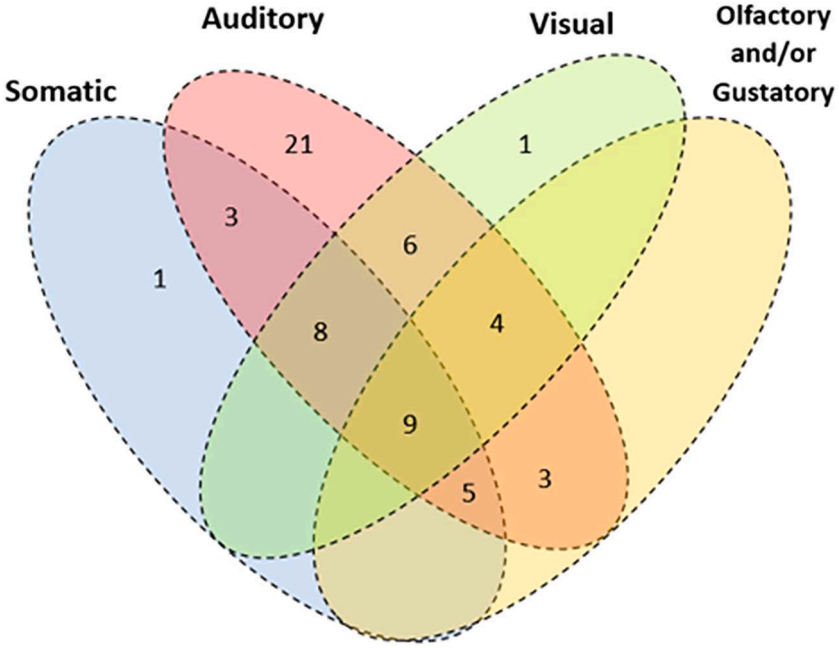

Fig. 2a. Serial hallucinatory experiences.

3.3. Trauma thematic content

80.33 % (49/61) of participants with hallucinations had either a clear content or thematic linkage with their traumatic experiences. For over half, there was a clear link in content, which for example could be someone who sees a visual hallucination of a person who abused them (32/61; 52.46 %). 17 participants (27.87 %) had some thematic linkage such as when a participant hears a voice that says something similar in theme (humiliation, intrusiveness, guilt, threat) to an experience of childhood bullying. 12 people (19.67 %) had no obvious linkage, or there was insufficient information to make an accurate assessment, including three participants who did not want to disclose what the voices said to them.

Fig. 3 represents the sensory domains that were linked with the traumatic experiences either in terms of direct content or thematic linkage. In most cases the linkage was in the auditory domain. However, other domains were also important to consider. For instance, 7 (10.75 %) participants reported an olfactory hallucination that was related to a traumatic experience.

4. Discussion

We explored the contribution of trauma and current PTSD symptoms to the number of sensory modalities of hallucinations reported by people with psychosis. We found reported rates of hallucinations across a range of sensory domains at levels higher than in surveys of people with

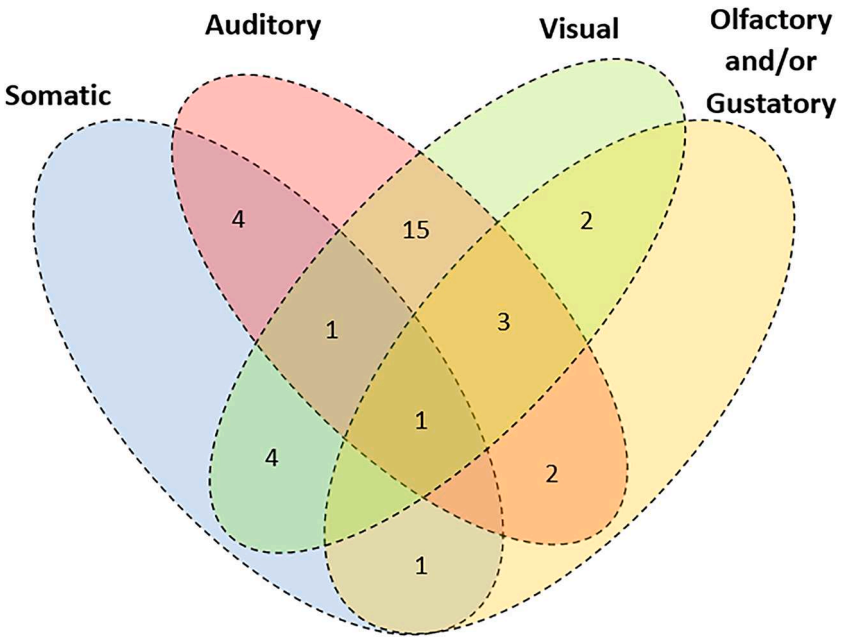

Fig. 2b. Simultaneous hallucinatory experiences.

Table 2
Relationships between number of modalities, trauma and PTSD ($n = 67$).

Measures	*M*	*SD*	1	2	3	4	5
1.Number of modalities	2.45	1.34	–				
2.TALE	11.84	2.97	.24	–			
3.CAPS	54.75	10.51	0.25*	0.36**	–		
4.ITQ ptsd	19.09	3.54	.15	.16	.49**	–	
5.ITQ dso	19.62	3.77	.15	.08	.36**	.59**	–

* $p < 0.05$,
** $p < 0.01$.
TALE Trauma And Life Events Checklist CAPS Clinician administered PTSD scale, ITQ ptsd international trauma questionnaire Ptsd symptoms ITQ dso international trauma questionnaire disorders of self organisation.

psychosis spectrum presentations who were not selected for having comorbid PTSD. For example, McCarthy-Jones et al. (2017) assessed the occurrence of hallucinations, for both lifetime and past month prevalence, across auditory, visual, olfactory, and tactile modalities, in people diagnosed with chronic schizophrenia-spectrum disorders in Ireland ($N = 693$) and Australia ($N = 218$). Past month prevalence was 23–27 % auditory, 5–8 % visual, 4–7 % tactile, and 2 % olfactory. Lifetime prevalence was 64–80 % auditory, 23–31 % visual, 9–19 % tactile, and 6–10 % olfactory. Similarly, in our sample reported somatic experiences that were sexual in nature (6/67; 8.96 %) were higher than has been reported in samples of people with psychosis (1-year prevalence rate of 0.017 in Blom and Mangoenkarso, 2018).

Second, there was a modest but significant association between the level of current PTSD symptomatology on the CAPS-5 (but not the separate subscales of core PTSD and DSO on the ITQ) and number of hallucinatory modalities. Third, the association with number of adverse experiences and number of modalities was similarly modest but did not quite reach the conventional threshold for significance. Fourth, there was a high rate of content and/or thematic linkage between trauma events and the hallucinations across a range of modalities, such as auditory and olfactory hallucinations. Whilst the associations were modest, collectively the findings would suggest that there are links between trauma and its consequences, and the number and content of hallucination modalities experienced.

These findings need to be considered in view of several limitations. The first is the representativeness of the sample, which was largely of white British ethnicity. Cultural differences in reporting of hallucinations in different domains is likely (Khaled et al., 2023; Laroi et al., 2014). Also, women with psychosis (Schäfer and Fisher, 2011; Sideli et al., 2020) report higher rates of adversity, potentially impacting on the number of, or expression of, hallucinations (Dudley, Turkington, et al., 2023), but owing to the small sample size this was not systematically explored in the current study. The second is that the relationship between trauma experiences and number of modalities of hallucinations was modest and was not consistently demonstrated on all measures of trauma and PTSD.

Third, the measure of multimodal experiences is not yet validated (Peters et al., 2022). However, it has been used in a number of previous studies (Dudley et al., 2023a, Dudley, Watson et al., 2023.) and was undertaken by researchers trained in its use. Nevertheless, the information gathered was quite limited. Consistent with past research (Toh et al., 2022) we considered only a limited number of sensory experiences. In our sample, for instance, the experience of sensed or felt presence was also common, with 43 people (64.18 %) reporting these in the past month suggesting these and other unusual experiences are also important to ask about (Lim et al., 2016). In our study there was not systematic and detailed information gathered about the frequency, duration, and distress associated with each sensory experience which could partly explain that the higher rate of linkage between auditory experiences and trauma content/themes. As we used the PSYRATS everyone was asked about auditory experiences in detail, meaning more examples of the content of the auditory experiences were gained than for olfactory, or visual experiences, for example. Future studies would benefit from asking about trauma, PTSD symptoms and about hallucinations across sensory modalities in the same systematic manner.

Fourth, in our assessments we tried to carefully distinguish between flashbacks, intrusive memories, rumination and recurrent negative thinking and features of psychosis (hallucinations, paranoia) but fully recognise that some of these are hard distinctions to make.

Despite these limitations, the work has some potential clinical implications. For instance, the prevalence of hallucinations in broader sensory domains suggests a clear value in routinely enquiring about both presence and content as part of clinical practice. In this respect, we found a high degree of linkage in content or themes between trauma and

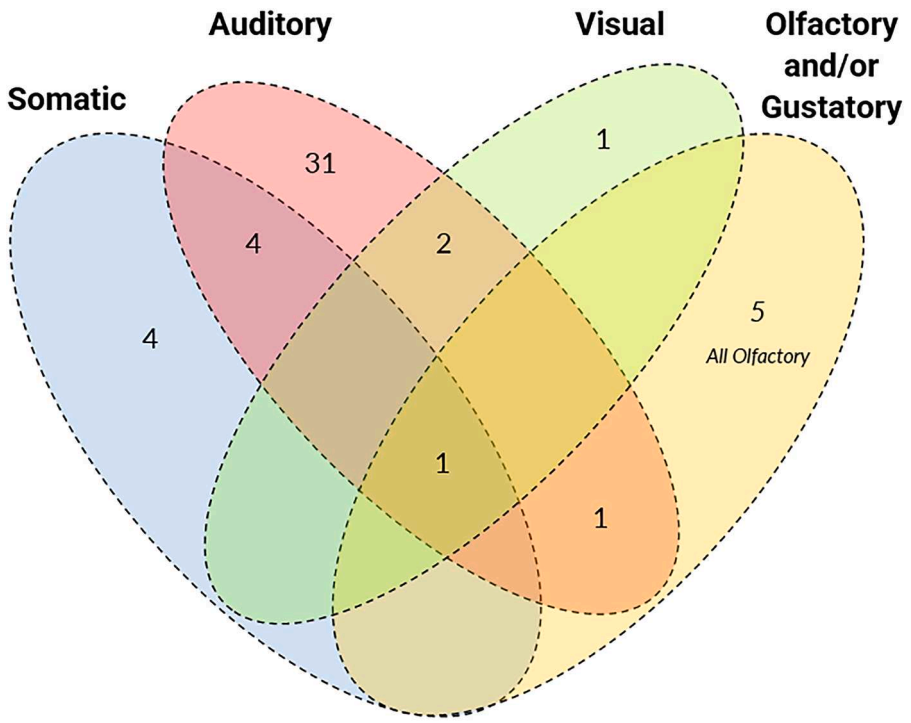

Fig. 3. Content and thematic overlap across domains.

current hallucination experiences, which further supports existing research indicating hallucination content is psychologically meaningful. Compared to previous findings (Peach et al., 2021; Hardy et al., 2005), which reported more thematic than direct linkage, in this study the pattern was reversed with more direct than thematic links detected (51 % vs 28 %). However, this may be owing to including a sample of people who all had PTSD, the use of multiple measures of trauma and PTSD, as well asrich data collection on the range of sensory experiences reported. When participants themselves rated the links they found higher direct linkage than the independent raters (. van den Berg et al., 2022), perhaps indicating that the relationships in previous studies had been under-estimated. Consequently, clinicians working in a trauma informed service setting need to consider that hallucination content, including but not limited to auditory, may be directly related to past adverse experiences.

Given the established association between adversity and hallucinations, therapeutic interventions that target both trauma symptoms and hallucinations (Hardy et al., 2024) would appear to be warranted. A number of specific treatments are developed focussed on trauma (Van Den Berg et al., 2015; Brand et al., 2021; Clarke et al., 2022; Peters et al., 2022) and hearing voices (Steel et al., 2017;McCartney et al., 2019; Varese et al., 2021; Longden et al., 2022) that are seemingly safe, well received and beneficial (Varese et al., 2023). These now need to be extended to addressing hallucinations across a number of sensory domains (Paulik and Taylor, 2024). People with psychosis hear voices, but also see, smell, and feel things that distress them and the content of these hallucinations can reflect their trauma experiences.

Theoretically, this study further supports the importance of trauma as a contributory factor to psychosis, as well as identifying a possible direct contribution of trauma and PTSD symptoms (Bloomfield et al., 2021) to a range of hallucinatory experiences (Medjkane et al., 2020). The findings also raise issues about whether existing models of hallucinations can fully account for multisensory/multimodal experiences. Whilst auditory experiences are common, and can be experienced as unimodal experience, people reporting visual hallucinations often report them as multimodal/simultaneous (Dudley et al., 2018, 2019; Dudley, Watson, et al., 2023). These differing constellations of hallucinatory experiences perhaps reveals different pathways to the expression of these experiences (Collerton et al., 2023).

As noted, future research would benefit from the use of validated measures but also with larger samples adequately powered to consider a number of hypotheses exploring associations with dissociation, delusions, functioning, and suicidal ideation. For example, dissociation may contribute to the development of hallucinations through decreasing an individual's ability to judge the origin of internal experiences, a form of source misidentification (Smailes et al., 2020). Within this context, non-integrated trauma memories may be externally attributed as "voices" rather than "memories". Elevated levels of dissociation are associated with greater auditory hallucinations (Pilton et al., 2015) but the role of dissociation in other hallucination experiences is less explored (Bortolon and Raffard, 2018). We focussed most on the correspondence between the trauma and its consequences and the hallucinatory experience. Consequently, future research could consider the relationship, or not, between the content of nightmares, flashbacks and the re-experiencing symptoms of PTSD and Psychosis in more depth than we were able to in this study.

Collaborators

Affiliated with South London and Maudsley NHS Foundation Trust: Lucy Ring, Christopher Shoulder, Morwennna Rickard, Firat Denizcaglar, Kavita Bains, Freya Meyer, Leilia Jameel, Majella Byrne, Nadine Keen, Sarah Swan, Rachel Frost, Ze Freeman, Gary Ngai, Jess Bird, Constance Harvey, Edward Bickers, Kaisha Santosa, Samantha Mansell

Siamara Goddard, Molly Bird, Harriet Mellotte, Rhea Kohli, Katja Shultz, Antonia Obele, Elizabeth Leahy, Max Dormitontov, Faiza Abbaz, Ho Chak (Milton) Suen

Affiliated with King's College London: Margaret Heslin, Emma Tassie, Sarah Byford, Elizabeth Kuipers, Laura Potts, Inez Verdaasdonk

Affiliated with Institute of Psychiatry: Hassan Jafarik, Richard Emsley

Affiliated with Greater Manchester Mental Health NHS Foundation Trust: Tony Morrison, Wendy Jones, Eleanor Longden, Aqsa Choudary, Marina Sandys, Kim Towey-Swift, Elizabeth Murphy, Vicky Brooks,

Samantha Bowe, Alice Newton-Braithwaite, Elliot Brewer, Leah Orme

Affiliated with University of Manchester: Tony Morrison

Affiliated with Cumbria, Northumberland, Tyne, and Wear NHS Foundation Trust: Laura McCartney, Marsha Cochrane, Antonia Newman, Nina Cioroboiu, Louise Prentice, Jane Mitchell, Doug Turkington, Kevin Meares.

Affiliated with Oxford Health NHS Foundation Trust: Amy Langman, Emily Smyth, Georgina Kirtland, Natalie Barnes, Kate Costello, Collins Larrys, Iulia Grabovschi, Charlotte Sagnay de la Bastida

Affiliated with Sussex Partnership NHS Foundation Trust: Kathryn Greenwood, Cat Sacadura, Sarah Mansfield, Ann Steele, Lauren Edwards, Dan Elton, Angie Culham, Nick Grey, Molly Heeger, Lucy Fishe, Krutika Sharma, Chris Scane, Lisa Wood, Joseph Sherborne, Lauren Mose, Guy Emery, Aparajita Pandey

Affiliated with University of Sussex: Kathryn Greenwood, David Fowler

Funding statement

This study/project is funded by the National Institute for Health and Care Research (NIHR) under its HTA programme (grant reference number NIHR 128623). RD was funded by the NIHR Applied Research Collaboration (ARC) North East and North Cumbria (NIHR200173). The views expressed are those of the authors and not necessarily those of the NIHR, or the Department of Health and Social Care. The study sponsor and funder have no role in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication.

CRediT authorship contribution statement

Robert Dudley: Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Sarah White:** Writing – review & editing, Investigation, Formal analysis, Data curation, Conceptualization. **Rebecca Miskin:** Writing – review & editing, Investigation, Formal analysis, Data curation. **Libby Oakes:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation. **Eleanor Longden:** Writing – review & editing, Methodology, Funding acquisition. **Craig Steel:** Writing – review & editing, Methodology, Funding acquisition, Conceptualization. **Sarah Swann:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Raphael Underwood:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Emmanuelle Peters:** Writing – review & editing, Resources, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

EP, RD, CS, and RU provide psychological therapies for individuals with psychosis and/or PTSD in NHS settings, and EP is the Director of a psychological therapies specialist service for psychosis (PICuP). EL, CS & RD have written manuals for psychological therapies for psychosis and psychological formulation for which they receive book royalties (from APPI;

Guildford Press; Wiley; Routledge; New Harbinger). EP, and CS are employed to provide training and/or receive fees (or generate fees for their clinics) for workshops and presentations on psychological therapies for psychosis and/or PTSD; EL, EP, CS, and RD hold or have held grants to carry out trials of psychological therapy for individuals with psychosis. All other authors declare no competing interest.

Acknowledgements

We would like to thank the participants in the study and acknowledge the contribution of the other collaborators involved in the delivery of the STAR trial.

The authors would like to thank the NIHR for funding this study.

Data availability

Owing to this being one element of a larger multisite trial (ISRCTN registry, reference: ISRC TN93382525, registered on 03/08/20) the full data set from the trial will be made available at completion of the study. For the present study, summary and anonymised data would be available on the basis of written reasonable request. *Data not routinely available / The data that has been used is confidential.*

References

Aynsworth, C., Nemat, N., Collerton, D., Smailes, D., Dudley, R., 2017. Reality monitoring performance and the role of visual imagery in visual hallucinations. Behav. Res. Ther. 97. https://doi.org/10.1016/j.brat.2017.07.012.

Aynsworth, C., Rolinson, J., Pervez, M., Collerton, D., Dudley, R., 2022. What is the frequency and nature of visual hallucinations in non-clinical participants? Psychol. Psychother.: Theory Res. Pract. https://doi.org/10.1111/papt.12440.

Badcock, J.C., Brand, R., Thomas, N., Hayward, M., Paulik, G., 2021. Multimodal versus unimodal auditory hallucinations in clinical practice: clinical characteristics and treatment outcomes. Psychiatry Res. 297. https://doi.org/10.1016/j.psychres.2021.113754.

Bentall, R.P., De Sousa, P., Varese, F., Wickham, S., Sitko, K., Haarmans, M., Read, J., 2014. From adversity to psychosis: pathways and mechanisms from specific adversities to specific symptoms. Soc. Psychiatry Psychiatr. Epidemiol. 49 (Issue 7), 1011–1022. https://doi.org/10.1007/s00127-014-0914-0.

Blom, J.D., Mangoenkarso, E., 2018. Sexual hallucinations in schizophrenia spectrum disorders and their relation with childhood trauma. Front. Psychiatry 9 (MAY). https://doi.org/10.3389/fpsyt.2018.00193.

Bloomfield, M.A.P., Chang, T., Woodl, M.J., Lyons, L.M., Cheng, Z., Bauer-Staeb, C., Hobbs, C., Bracke, S., Kennerley, H., Isham, L., Brewin, C., Billings, J., Greene, T., Lewis, G., 2021. Psychological processes mediating the association between developmental trauma and specific psychotic symptoms in adults: a systematic review and meta-analysis. World Psychiatry 20 (1), 107–123. https://doi.org/10.1002/wps.20841.

Bortolon, C., Raffard, S., 2018. Dissociation mediates the relationship between childhood trauma and experiences of seeing visions in a French sample. J. Nerv. Ment. Dis. 206 (11), 850–858. https://doi.org/10.1097/NMD.0000000000000885.

Brand, R.M., Bendall, S., Hardy, A., Rossell, S.L., Thomas, N., 2021. Trauma-focused imaginal exposure for auditory hallucinations: a case series. Psychol. Psychother.: Theory Res. Pract. 94 (S2), 408–425. https://doi.org/10.1111/papt.12284.

Brewin, C.R., Gregory, J.D., Lipton, M., Burgess, N., 2010. Intrusive images in psychological disorders: characteristics, neural mechanisms, and treatment implications. Psychol. Rev. 117 (1), 210–232. https://doi.org/10.1037/a0018113.

Carr, S., Hardy, A., Fornells-Ambrojo, M., 2018. The Trauma and Life Events (TALE) checklist: development of a tool for improving routine screening in people with psychosis. Eur J Psychotraumatol 9 (1), 1512265. https://doi.org/10.1080/20008198.2018.1512265.

Clarke, R., Kelly, R., Hardy, A., 2022. A randomised multiple baseline cases series of a novel imagery rescripting protocol for intrusive trauma memories in people with psychosis. J. Behav. Ther. Exp. Psychiatry 75. https://doi.org/10.1016/j.jbtep.2021.101699.

Cloitre, M., Shevlin, M., Brewin, C.R., Bisson, J.I., Roberts, N.P., Maercker, A., Karatzias, T., Hyland, P., 2018. The International Trauma Questionnaire: development of a self-report measure of ICD-11 PTSD and complex PTSD. Acta Psychiatr Scand 138 (6), 536–546. https://doi.org/10.1111/acps.12956.

Collerton, D., Barnes, J., Diederich, N.J., Dudley, R., ffytche, D., Friston, K., Goetz, C.G., Goldman, J.G., Jardri, R., Kulisevsky, J., Lewis, S.J.G., Nara, S., O'Callaghan, C., Onofrj, M., Pagonabarraga, J., Parr, T., Shine, J.M., Stebbins, G., Taylor, J.P., …, Weil, R.S., 2023. Understanding visual hallucinations: a new synthesis. Neurosci. Biobehav. Rev. 150. https://doi.org/10.1016/j.neubiorev.2023.105208.

Corstens, D, Longden, E, 2013. The origins of voices: links between life history and voice hearing in a survey of 100 cases. Psychosis Psychol. Soc. Integr. Appr 5, 270–285.

Craig, T.K., Rus-Calafell, M., Ward, T., Leff, J.P., Huckvale, M., Howarth, E., Emsley, R., Garety, P.A., 2018. AVATAR therapy for auditory verbal hallucinations in people with psychosis: a single-blind, randomised controlled trial. Lancet Psychiatry 5 (1), 31–40. https://doi.org/10.1016/S2215-0366(17)30427-3.

Dudley, R., Aynsworth, C., Cheetham, R., McCarthy-Jones, S., Collerton, D., 2018. Prevalence and characteristics of multi-modal hallucinations in people with psychosis who experience visual hallucinations. Psychiatry Res. 269. https://doi.org/10.1016/j.psychres.2018.08.032.

Dudley, R., Aynsworth, C., Mosimann, U., Taylor, J.-P., Smailes, D., Collerton, D., McCarthy-Jones, S., Urwyler, P., 2019. A comparison of visual hallucinations across disorders. Psychiatry Res. 272. https://doi.org/10.1016/j.psychres.2018.12.052.

Dudley, R., Denton, S., Mathewson, J., Pervez, S., Aynsworth, C., Dodgson, G., Barclay, N., 2023a. Prevalence of multisensory hallucinations in people at risk of transition to psychosis. Psychiatry Res. 322, 115091. https://doi.org/10.1016/j.psychres.2023.115091.

Dudley, R., Turkington, D., Coulthard, N., Pyle, M., Gumley, A., Schwannauer, M., Kingdon, D., Morrison, A.P., 2023b. Childhood Trauma in Clozapine-Resistant Schizophrenia:prevalence, and relationship with symptoms. Schizophr. Bull. Open. https://doi.org/10.1093/schizbullopen/sgad030.

Dudley, R., Watson, F., O'Grady, L., Aynsworth, C., Dodgson, G., Common, S., Day, B.A., Fernyhough, C., 2023c. Prevalence and nature of multi-sensory and multi-modal hallucinations in people with first episode psychosis. Psychiatry Res. 319. https://doi.org/10.1016/j.psychres.2022.114988.

Haddock, G., McCarron, J., Tarrier, N., Faragher, E.B., 1999. Scales to measure dimensions of hallucinations and delusions: the psychotic symptom rating scales (PSYRATS). Psychol Med 29 (4), 879–889. https://doi.org/10.1017/s0033291799008661.

Hamner, M.B., 1997. Psychotic features and combat-associated PTSD. Depress Anxiety 5 (1), 34–38. https://doi.org/10.1002/(sici)1520-6394(1997)5:1<34::aid-da6>3.0.co;2-5.

Hardy, A., Keen, N., van den Berg, D., Varese, F., Longden, E., Ward, T., Brand, R.M., 2024. Trauma therapies for psychosis: A state-of-the-art review. Psychol Psychother 97 (1), 74–90. https://doi.org/10.1111/papt.12499.

Hardy, A., 2017. Pathways from trauma to psychotic experiences: a theoretically informed model of posttraumatic stress in psychosis. Front. Psychol. 8 (MAY). https://doi.org/10.3389/fpsyg.2017.00697.

Hardy, A., Fowler, D., Freeman, D., Smith, B., Steel, C., Evans, J., Garety, P., Kuipers, E., Bebbington, P., Dunn, G., 2005. Trauma and hallucinatory experience in psychosis. J. Nerv. Ment. Dis. 193 (8), 501–507. https://doi.org/10.1097/01.nmd.0000172480.56308.21.

Hardy, A., O'Driscoll, C., Steel, C., Van Der Gaag, M., Van Den Berg, D, 2021. A network analysis of post-traumatic stress and psychosis symptoms. Psychol. Med. 51 (14), 2485–2492. https://doi.org/10.1017/S0033291720001300.

Hayward, M., 2018. Evidence-based psychological approaches for auditory hallucinations. BJPsych. Adv. 24 (3), 174–177. https://doi.org/10.1192/bja.2017.11.

Hayward, M., Bibby-Jones, A.M., Thomas, N., Paulik, G., Mutanda, D., Berry, C., 2023. Multi-modal hallucinations across diagnoses: what relationships do they have with voice-related distress? Schizophr. Res. https://doi.org/10.1016/j.schres.2023.04.005.

Heriot-Maitland, C., Vitoratou, S., Peters, E., Hermans, K., Wykes, T., Brett, C., 2023. Detecting anomalous experiences in the community: the Transpersonal Experiences Questionnaire (TEQ). Psychol. Psychother.: Theory Res. Pract. 96 (2), 383–398. https://doi.org/10.1111/papt.12445.

Isvoranu, A.M., van Borkulo, C.D., Boyette, L.L., Wigman, J.T., Vinkers, C.H., Borsboom, D., Group Investigators, 2017. A Network Approach to Psychosis: Pathways Between Childhood Trauma and Psychotic Symptoms. Schizophr Bull 43 (1), 187–196. https://doi.org/10.1093/schbul/sbw055.

Khaled, S.M., Brederoo, S.G., Yehya, A., Alabdulla, M., Woodruff, P.W., Sommer, I.E.C., 2023. Cross-cultural differences in hallucinations: a comparison between Middle Eastern and European community-based samples. Schizophr. Bull. 49 (1), S13–S24. https://doi.org/10.1093/schbul/sbac086.

Kreis, I., Wold, K.F., Åsbø, G., Simonsen, C., Flaaten, C.B., Engen, M.J., Lyngstad, S.H., Widing, L.H., Ueland, T., Melle, I., 2024. The relationship between visual hallucinations, functioning, and suicidality over the course of illness: a 10-year follow-up study in first-episode psychosis. Schizophrenia 10 (1), 30. https://doi.org/10.1038/s41537-024-00450-8.

Laroi, F., Luhrmann, T.M., Bell, V., Christian, W.A., Deshpande, S., Fernyhough, C., Jenkins, J., Woods, A., 2014. Culture and hallucinations: overview and future directions. Schizophr. Bull. 40 (SUPPL. 4). https://doi.org/10.1093/schbul/sbu012.

Lim, A., Hoek, H.W., Deen, M.L., Blom, J.D., Bruggeman, R., Cahn, W., de Haan, L., Kahn, R.S., Meijer, C.J., Myin-Germeys, I., van Os, J., Wiersma, D., 2016. Prevalence and classification of hallucinations in multiple sensory modalities in schizophrenia spectrum disorders. Schizophr. Res. 176 (2–3), 493–499. https://doi.org/10.1016/j.schres.2016.06.010.

Linszen, M.M.J., de Boer, J.N., Schutte, M.J.L., Begemann, M.J.H., de Vries, J., Koops, S., Blom, R.E., Bohlken, M.M., Heringa, S.M., Blom, J.D., Sommer, I.E.C., 2022. Occurrence and phenomenology of hallucinations in the general population: a large online survey. Schizophrenia 8 (1). https://doi.org/10.1038/s41537-022-00229-9.

Longden, E., Branitsky, A., Moskowitz, A., Berry, K., Bucci, S., Varese, F., 2020. The relationship between dissociation and symptoms of psychosis: a meta-analysis. Schizophr. Bull. 46 (5), 1104–1113. https://doi.org/10.1093/schbul/sbaa037.

Longden, E., Corstens, D., Bowe, S., Pyle, M., Emsley, R., Peters, S., Branitsky, A., Chauhan, N., Dehmahdi, N., Jones, W., Holden, N., Larkin, A., Miners, A., Murphy, E., Steele, A., Morrison, A.P., 2022. A psychological intervention for engaging dialogically with auditory hallucinations (Talking With Voices): a single-site, randomised controlled feasibility trial. Schizophr. Res. 250, 172–179. https://doi.org/10.1016/j.schres.2022.11.007.

Lyndon, S., Corlett, P.R., 2020. Hallucinations in posttraumatic stress disorder: insights from predictive coding. J. Abnorm. Psychol. 129 (6), 534–543. https://doi.org/10.1037/abn0000531.

McCarthy-Jones, S., 2011. Voices from the storm: a critical review of quantitative studies of auditory verbal hallucinations and childhood sexual abuse. Clin. Psychol. Rev. 31 (Issue 6), 983–992. https://doi.org/10.1016/j.cpr.2011.05.004.

McCarthy-Jones, S., Smailes, D., Corvin, A., Gill, M., Morris, D.W., Dinan, T.G., Murphy, K.C., Anthony O'Neill, F., Waddington, J.L., , Australian Schizophrenia Research Bank, Donohoe, G., Dudley, R, 2017. Occurrence and co-occurrence of hallucinations by modality in schizophrenia-spectrum disorders. Psychiatry Res. 252. https://doi.org/10.1016/j.psychres.2017.01.102.

McCartney, L., Douglas, M., Varese, F., Turkington, D., Morrison, A.P., Dudley, R., 2019. Cognitive behavioural therapy for psychosis targeting trauma, voices and dissociation: a case report. Cognit. Behav. Therapist. https://doi.org/10.1017/S1754470x19000035.

Medjkane, F., Notredame, C.E., Sharkey, L., D'Hondt, F., Vaiva, G., Jardri, R, 2020. Association between childhood trauma and multimodal early-onset hallucinations. Brit. J. Psychiatry 216 (3), 156–158. https://doi.org/10.1192/bjp.2019.266.

Montagnese, M., Leptourgos, P., Fernyhough, C., Waters, F., Larøi, F., Jardri, R., McCarthy-Jones, S., Thomas, N., Dudley, R., Taylor, J.-P., Collerton, D., Urwyler, P., 2021. A review of multimodal hallucinations: categorization, assessment, theoretical perspectives, and clinical recommendations. Schizophr. Bull. 47 (1). https://doi.org/10.1093/schbul/sbaa101.

Morrison, A.P., 2001. The interpretation of intrusions in psychosis: an integrative cognitive approach to hallucinations and delusions. Behav. Cogn. Psychother. 29 (3), 257–276. https://doi.org/10.1017/S1352465801003010.

Morrison, A.P., Frame, L., Larkin, W., 2003. Relationships between trauma and psychosis: a review and integration. Brit. J. Clin. Psychol. 42. www.bps.org.uk.

Morrison, A.P., Pyle, M., Gumley, A., Schwannauer, M., Turkington, D., MacLennan, G., Norrie, J., Hudson, J., Bowe, S.E., French, P., Byrne, R., Syrett, S., Dudley, R., McLeod, H.J., Griffiths, H., Barnes, T.R.E., Davies, L., Kingdon, D., Aydinlar, S., …., Tully, S., 2018. Cognitive behavioural therapy in clozapine-resistant schizophrenia (FOCUS): an assessor-blinded, randomised controlled trial. Lancet Psychiatry 5 (8), 633–643. https://doi.org/10.1016/S2215-0366(18)30184-6.

Moseley, P., Powell, A., Woods, A., Fernyhough, C., Alderson-Day, B., 2022. Voice-hearing across the continuum: a phenomenology of spiritual voices. Schizophr. Bull. 48 (5), 1066–1074. https://doi.org/10.1093/schbul/sbac054.

Niles, H.F., Walsh, B.C., Woods, S.W., Powers, A.R., 2019. Does hallucination perceptual modality impact psychosis risk? Acta Psychiatr. Scand. 140 (4), 360–370. https://doi.org/10.1111/acps.13078.

Oorschot, M., Lataster, T., Thewissen, V., Bentall, R., Delespaul, P., Myin-Germeys, I., 2012. Temporal dynamics of visual and auditory hallucinations in psychosis. Schizophr. Res. 140 (1–3), 77–82. https://doi.org/10.1016/j.schres.2012.06.010.

Pao, M., Lohman, C., Gracey, D., Greenberg, L., 2024. Visual, tactile, and phobic hallucinations: recognition and management in the emergency department. Pediatr Emerg Care 20 (1), 30–34. https://doi.org/10.1097/01.pec.0000106240.72265.2d.

Paulik, G., Taylor, C.D.J., 2024. Imagery-focused therapy for visual hallucinations: a case series. Clin. Psychol. Psychother. 31 (3). https://doi.org/10.1002/cpp.2993.

Peach, N., Alvarez-Jimenez, M., Cropper, S.J., Sun, P., Halpin, E., O'Connell, J., Bendall, S., 2021. Trauma and the content of hallucinations and post-traumatic intrusions in first-episode psychosis. Psychol Psychother 94 (Suppl. 2), 223–241. https://doi.org/10.1111/papt.12273.

Peters, E., Hardy, A., Dudley, R., Varese, F., Greenwood, K., Steel, C., Emsley, R., Keen, N., Bowe, S., Swan, S., Underwood, R., Longden, E., Byford, S., Potts, L., Heslin, M., Grey, N., Turkington, D., Fowler, D., Kuipers, E., Morrison, A., 2022. Multisite randomised controlled trial of trauma-focused cognitive behaviour therapy for psychosis to reduce post-traumatic stress symptoms in people with co-morbid post-traumatic stress disorder and psychosis, compared to treatment as usual: study protoco. Trials 23 (1). https://doi.org/10.1186/s13063-022-06215-x.

Pilton, M., Varese, F., Berry, K., Bucci, S., 2015. The relationship between dissociation and voices: a systematic literature review and meta-analysis. Clin. Psychol. Rev. 40, 138–155. https://doi.org/10.1016/j.cpr.2015.06.004.

Radua, J., Ramella-Cravaro, V., Ioannidis, J.P.A., Reichenberg, A., Phiphopthatsanee, N., Amir, T., Yenn Thoo, H., Oliver, D., Davies, C., Morgan, C., Mcguire, P., Murray, R. M., Fusar-Poli, P., 2018. What causes psychosis? An umbrella review of risk and protective factors. World Psychiatry 17 (1), 49–66. https://doi.org/10.1002/wps.20490.

Rosenfield, P.J., Jiang, D., Pauselli, L., 2022. Childhood adversity and psychotic disorders: epidemiological evidence, theoretical models and clinical considerations. Schizophr. Res. 247, 55–66. https://doi.org/10.1016/j.schres.2021.06.005.

Schäfer, I., Fisher, H.L., 2011. Childhood trauma and posttraumatic stress disorder in patients with psychosis: clinical challenges and emerging treatments. Curr. Opin. Psychiatry 24 (Issue 6), 514–518. https://doi.org/10.1097/YCO.0b013e32834b56c8.

Shevlin, M., Murphy, J., Read, J., Mallett, J., Adamson, G., Houston, J.E., 2011. Childhood adversity and hallucinations: a community-based study using the National Comorbidity Survey Replication. Soc. Psychiatry Psychiatr Epidemiol. 46 (12), 1203–1210. https://doi.org/10.1007/s00127-010-0296-x.

Sideli, L., Murray, R.M., Schimmenti, A., Corso, M., La Barbera, D., Trotta, A., Fisher, H. L., 2020. Childhood adversity and psychosis: a systematic review of bio-psycho-social mediators and moderators. In: Psychological Medicine, 50. Cambridge University Press, pp. 1761–1782. https://doi.org/10.1017/S0033291720002172.

Smailes, D., Burdis, E., Gregoriou, C., Fenton, B., Dudley, R., 2020. Pareidolia-proneness, reality discrimination errors, and visual hallucination-like experiences in a non-clinical sample. Cogn. Neuropsychiatry 25 (2). https://doi.org/10.1080/13546805.2019.1700789.

Solesvik, M., Joa, I., Larsen, T.K., Langeveld, J., Johannessen, J.O., Bjørnestad, J., Anda, L.G., Gisselgård, J., Velden Hegelstad, W.ten, Brønnick, K., 2016. Visual hallucinations in first-episode psychosis: association with childhood trauma. PLoS ONE 11 (5). https://doi.org/10.1371/journal.pone.0153458.

Steel, C., Fowler, D., Holmes, E.A., 2005. Trauma-related intrusions and psychosis: an information processing account. Behav. Cogn. Psychother. 33 (Issue 2), 139–152. https://doi.org/10.1017/S1352465804001924.

Steel, C., Hardy, A., Smith, B., Wykes, T., Rose, S., Enright, S., Hardcastle, M., Landau, S., Baksh, M.F., Gottlieb, J.D., Rose, D., Mueser, K.T., 2017. Cognitive-behaviour

therapy for post-traumatic stress in schizophrenia. A randomized controlled trial. Psychol. Med. 47 (1), 43–51. https://doi.org/10.1017/S0033291716002117.
Stevens, L.H., Turkington, D., Drage, L., Morrison, T., Muncer, S., Spencer, H.M., Dudley, R., 2019. Investigation of a traumatic psychosis subgroup: a cluster analysis of an antipsychotic free cohort. Psychosis 11 (4). https://doi.org/10.1080/17522439.2019.1628290.
Thomson, C., Wilson, R., Collerton, D., Freeston, M., Dudley, R., 2017. Cognitive behavioural therapy for visual hallucinations: an investigation using a single-case experimental design. Cognit. Behav. Therapist 10. https://doi.org/10.1017/S1754470x17000174.
Timmer-Murillo, S., Schramm, A.T., Geier, T.J., Mcleod, E., Larson, C.L., deRoon-Cassini, T.A., 2023. Facets of emotion dysregulation differentially predict depression and PTSD symptom severity following traumatic injury. Eur J Psychotraumatol 14 (2), 2193524. https://doi.org/10.1080/20008066.2023.2193524.
Toh, W.L., Bere, M., Rossell, S.L., 2022. Distinguishing multimodal versus multisensory hallucinations in psychosis: key definitions and a way forward. Austr. N. Zeal. J. Psychiatry 56 (5), 445–450. https://doi.org/10.1177/00048674211031455.
Toh, W.L., McCarthy-Jones, S., Copolov, D., Rossell, S.L., 2019. Have we overlooked the significance of multinodal hallucinations in schizophrenia? Psychiatry Res. 279, 358–360. https://doi.org/10.1016/j.psychres.2019.06.018.
Toh, W.L., Thomas, N., Robertson, M., Rossell, S.L., 2020. Characteristics of non-clinical hallucinations: a mixed-methods analysis of auditory, visual, tactile and olfactory hallucinations in a primary voice-hearing cohort. Psychiatry Res. 289. https://doi.org/10.1016/j.psychres.2020.112987.
Van Den Berg, D.P.G., De Bont, P.A.J.M., Van Der Vleugel, B.M., De Roos, C., De Jongh, A., Van Minnen, A., Van Der Gaag, M, 2015. Prolonged exposure vs eyemovement desensitization and reprocessing vs waiting list for posttraumatic stress disorder in patients with a psychotic disorder: a randomized clinical trial. JAMA Psychiatry 72 (3), 259–267. https://doi.org/10.1001/jamapsychiatry.2014.2637.
van den Berg, D., Tolmeijer, E., Jongeneel, A., Staring, A.B.P., Palstra, E., van der Gaag, M., Hardy, A., 2022. Voice phenomenology as a mirror of the past. Psychol. Med. https://doi.org/10.1017/S0033291721004955.
Varese, F., Douglas, M., Dudley, R., Bowe, S., Christodoulides, T., Common, S., Grace, T., Lumley, V., McCartney, L., Pace, S., Reeves, T., Morrison, A.P., Turkington, D., 2021. Targeting dissociation using cognitive behavioural therapy in voice hearers with psychosis and a history of interpersonal trauma: a case series. Psychol. Psychother.: Theory Res. Pract. 94 (2). https://doi.org/10.1111/papt.12304.
Varese, F., Sellwood, W., Pulford, D., Awenat, Y., Bird, L., Bhutani, G., Carter, L.A., Davies, L., Aseem, S., Davis, C., Hefferman-Clarke, R., Hilton, C., Horne, G., Keane, D., Logie, R., Malkin, D., Potter, F., Van Den Berg, D., Zia, S., Bentall, R.P, 2023. Trauma-focused therapy in early psychosis: results of a feasibility randomized controlled trial of EMDR for psychosis (EMDRp) in early intervention settings. Psychol. Med. https://doi.org/10.1017/S0033291723002532.
Weathers, F.W., Bovin, M.J., Lee, D.J., Sloan, D.M., Schnurr, P.P., Kaloupek, D.G., Keane, T.M., Marx, B.P., 2018. The Clinician-Administered PTSD Scale for DSM-5 (CAPS-5): Development and initial psychometric evaluation in military veterans. Psychol Assess 30 (3), 383–395. https://doi.org/10.1037/pas0000486.
Wilkinson, S., Dodgson, G., Meares, K., 2017. Predictive processing and the varieties of psychological trauma. Front. Psychol. 8 (OCT). https://doi.org/10.3389/fpsyg.2017.01840.
Wilson, R., Collerton, D., Freeston, M., Christodoulides, T., Dudley, R., 2016. Is seeing believing? The process of change during cognitive-behavioural therapy for distressing visual hallucinations. Clin. Psychol. Psychother. 23 (4). https://doi.org/10.1002/cpp.1962.
Williams, J., Bucci, S., Berry, K., Varese, F., 2018. Psychological mediators of the association between childhood adversities and psychosis: A systematic review. Clin. Psychol. Rev. 65, 175–196. https://doi.org/10.1016/j.cpr.2018.05.009.