Behavioural and Cognitive Psychotherapy, 2015, 43, 89–107
First published online 8 October 2013 doi:10.1017/S1352465813000830

How Do People with Persecutory Delusions Evaluate Threat in a Controlled Social Environment? A Qualitative Study Using Virtual Reality

Miriam Fornells-Ambrojo

University College London, UK

Daniel Freeman

University of Oxford, UK

Mel Slater

ICREA-University of Barcelona, Spain, and University College London, UK

David Swapp, Angus Antley and Chris Barker

University College London, UK

Background: Environmental factors have been associated with psychosis but there is little qualitative research looking at how the ongoing interaction between individual and environment maintains psychotic symptoms. **Aims:** The current study investigates how people with persecutory delusions interpret events in a virtual neutral social environment using qualitative methodology. **Method:** 20 participants with persecutory delusions and 20 controls entered a virtual underground train containing neutral characters. Under these circumstances, people with persecutory delusions reported similar levels of paranoia as non-clinical participants. The transcripts of a post-virtual reality interview of the first 10 participants in each group were analysed. **Results:** Thematic analyses of interviews focusing on the decision making process associated with attributing intentions of computer-generated characters revealed 11 themes grouped in 3 main categories (evidence in favour of paranoid appraisals, evidence against paranoid appraisals, other behaviour). **Conclusions:** People with current persecutory delusions are able to use a range of similar strategies to healthy volunteers when making judgements about potential threat in a neutral environment that does not elicit anxiety, but they are less likely than controls to engage in active hypothesis-testing and instead favour experiencing "affect" as evidence of persecutory intention.

Reprint requests to Miriam Fornells-Ambrojo, Research Department of Clinical, Educational and Health Psychology, University College London, 1–19 Torrington Place, London WC1E 7HB, UK. E-mail: miriam.fornells-ambrojo@ucl.ac.uk

© British Association for Behavioural and Cognitive Psychotherapies 2013

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

Keywords: Paranoia, persecutory delusions, safety behaviours, cognitive behaviour therapy for psychosis, virtual reality

Introduction

Environmental factors such as "urbanicity" have been associated with increased incidence of schizophrenia (Pedersen and Modersen, 2001; Sundquist, Frank and Sundquist, 2004; van Os, 2004). People with a genetic liability to the disorder might be less likely to show adaptive social and cognitive functioning when coping with unsafe and stressful social environments (Weiser et al., 2007). In the case of paranoid delusions[1], insecure attachment and experiences of victimization are argued to contribute to excessive dopamine-mediated threat anticipation, poor theory of mind skills, externalizing biases and a negative sense of self (Bentall and Fernyhough, 2008; Freeman, 2007).On a day-to-day basis, it is hypothesized that events in the social environment, as well as internal representations, are experienced as salient (Kapur, 2003), while jumping-to-conclusions data-gathering (JTC) biases and safety behaviours, such as avoidance of situations perceived to be dangerous or confrontation of persecutors, contribute to the maintenance of paranoia by preventing belief disconfirmation and shaping the environment (Freeman, 2007; Freeman, Garety et al., 2007).

Despite the consistent epidemiological data pointing to the role of the social environment in psychosis, there has been remarkably little research aiming to understand the ongoing interaction between individual and environment influencing the course of the disorder. A few quantitative studies have started to address the question about the ongoing interplay between self and environment using innovative experimental paradigms. The Camberwell walk study recently showed that brief exposure to a deprived urban environment resulted in increases in anxiety, JTC, negative beliefs about others, and paranoia in people with persecutory delusions (Ellett, Freeman and Garety, 2008). The experience of social threat in daily life has also been shown to be dependent on social context (degree of familiarity with social company) among people who are low or medium in trait paranoia (Collip et al., 2011). However, in the study by Collip et al. (2011), people high in trait paranoia reported similar levels of social threat either in the presence of familiar or unfamiliar company. Although the experience sampling methodology allows moment-to-moment assessment in normal daily life, Collip et al. (2011) note that the subjective nature of these reports was a methodological limitation in their study. Without any objective information about the social environment it is not possible to conclude that the perceived higher social threat reported by the high trait paranoia group in relation to "familiar" company (e.g. family members) was unfounded, particularly in light of

[1] In the current study, the terms paranoia, paranoid/persecutory beliefs/ideation are used interchangeably to refer to "threat beliefs", as defined by Freeman, Garety, Bebbington, Smith, et al. (2005) in the paranoia hierarchy (i.e. exclude ideas of reference or negative social evaluation), and refer to beliefs that are reported across the continuum in the general population. Threat beliefs can relate to mild threat (e.g. people are trying to cause irritation), moderate threat (e.g. people are trying to get me) or severe threat (e.g. people are trying to cause significant harm), but must meet the core criteria proposed in Freeman and Garety's (2000) definition of persecutory delusion: a) the individual believes that harm is occurring, or is going to occur, to him or her; and b) the individual believes that the persecutor has the intention to cause harm. The term "delusion" is used when referring to beliefs that are in conflict with evidence, and whose level of conviction, distress, preoccupation and disruption to daily functioning are such that warrant attention from mental health services (Freeman et al., 2004).

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

the literature suggesting associations between paranoia and increased incidence of traumatic interpersonal events (Gracie et al., 2007).

In the only qualitative study examining interpersonal threat in people with persecutory delusions, Stopa, Denton, Wingfield and Taylor (2012) found vivid accounts of a sense of imminent danger that included affective, sensory and perceptual experiences, as well as coping behaviours initiated in response to threat, including attempts to avoid, escape or control the experience. Although this study provides valuable information about how rich and compelling the experience of interpersonal threat can be, the role of environmental factors was not controlled for, as participants were asked to recount a recent situation involving interpersonal threat that caused distress.

Virtual reality (VR) offers the possibility of complete experimental control as well as ecological validity, as there is extensive evidence showing that people respond to computer-generated characters (avatars) as if they were social agents (Garau, Slater, Pertaub and Razzaque, 2005; Pertaub, Slater and Barker, 2002; Slater, Pertaub, Barker and Clark, 2006). Crucially, participants' own mistrustful or unusual behaviour (i.e. safety behaviours) cannot elicit hostile responses from avatars. Therefore if a neutral social situation in VR elicits paranoid appraisals about avatars it is certain that these are unfounded. This technology offers a unique opportunity to investigate the interpretation of events in the same environment in more detail using qualitative methodology. To date, virtual reality has been used to investigate paranoia in the general population (Freeman et al., 2003; Freeman, Garety, Bebbington, Slater et al., 2005,; Freeman et al., 2008), in people with an at-risk mental state (Valmaggia et al., 2007) and in people with persecutory delusions (Fornells-Ambrojo et al., 2008; Freeman, Pugh, Vorontsova, Antley and Slater, 2010). Persecutory ideation in VR is predicted by anxiety, worry, interpersonal sensitivity, cognitive inflexibility and perceptual abnormalities (Freeman, Garety, Bebbington, Slater et al. 2005; Valmaggia et al., 2007).

Intriguingly, when people with early psychosis who report persecutory delusions in their everyday lives are presented with an ecologically valid neutral virtual environment, their paranoid appraisals resemble those of non-clinical controls (Fornells-Ambrojo et al., 2008). It appears that when not faced with an environment that elicits anxiety, as in the example of the urban exposure to a deprived neighborhood (Ellett et al., 2008), and by not being able to shape the social environment with their own safety-seeking behaviours, the judgement of neutral virtual agents by people with ongoing persecutory ideation who are experiencing their first episode of psychosis is preserved.

The current qualitative study aims to understand the decision making process involved in the formation of unfounded paranoid beliefs in people with psychosis. In particular, we aim to understand the type of evidence provided in favour of and against persecutory ideas, as well as the behavioural choices of people with persecutory delusions while immersed in a neutral social virtual environment. The paper reports a secondary analysis using previously unpublished qualitative data from the sample used by Fornells-Ambrojo et al. (2008).

Method

Design

This study used data from interviews conducted with people with early psychosis and non-clinical participants after exposure to a neutral virtual reality scenario for a quantitative

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

study assessing safety and feasibility of virtual reality use in people with persecutory beliefs (Fornells-Ambrojo et al., 2008). The study received approval from a NHS research ethics committee.

Measures

In the main study participants completed measures before and after entering the virtual environment (Fornells-Ambrojo et al., 2008). Pre-virtual reality assessment measures included the Positive and Negative Syndrome Scale (PANSS; Kay, Fiszbein and Opfer, 1987), a 30-item well established symptom rating scale in schizophrenia research; the Wechsler Test of Adult Reading (WTAR; Ginsberg, 2003), which is designed to estimate premorbid intellectual functioning in individuals aged 16 to 89; and the state scale of the Spielberger State-Trait Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg and Jacobs, 1983), which has 20 items that measure current level of anxiety (e.g. "I feel nervous") on a 4-point scale. Post-virtual reality assessment included a repeat completion of the state anxiety measure to determine whether the virtual environment had caused any distress (STAI; Spielberger et al., 1983), as well as the State Social Paranoia Scale (SSPS; Freeman, Pugh et al., 2007), a 20-item self-report questionnaire assessing thoughts in relation to the virtual characters on a 5-point-scale, with 10 items measuring persecutory thoughts (e.g. "someone had it in for me") and 10 items assessing neutral and positive thoughts. Lastly, participants completed a semi-structured interview that is the focus of the current study.

Interpersonal experiences in VR interview. The VR semi-structured interview (Freeman et al., 2003) was administered to participants at the post-virtual reality assessment stage. This is a 10 minute interview that focuses on interpersonal experiences with computer-generated characters. The interview includes questions about participants' thoughts regarding the intentionality of the characters and the evidence in favour and against such judgements. The semi-structured format allowed for participants to expand on questions. The interviewer prompted participants to discuss the following aspects of their VR experience: general (e.g. "what did you think of your virtual reality experience?"), interpersonal (e.g. "what did you think of the people in the virtual environment?", "do you think people in the virtual Tube had intentions towards you?") and evidence (e.g. "what made you think that?", "what evidence did you base your thoughts on?"). The interviews were audio-recorded.

Participants

Participants with early psychosis were recruited from two specialist early intervention services in London. The inclusion criteria for the study were: diagnosis of non-affective psychosis; a score of at least moderate severity (4) on the Suspiciousness item (P6) of the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987); and a current persecutory delusion as defined by Freeman and Garety (2000). The exclusion criteria were: primary diagnosis of substance misuse or learning disability. Age-matched non-clinical participants were recruited from participant panels at the Institute of Psychiatry, King's College London and University College London (UCL). The inclusion criteria were no previous psychiatric history and a negative screen for psychotic symptoms on the Psychosis Screening Questionnaire (Bebbington and Nayani, 1995). Exclusion criteria for

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

Table 1. Clinical characteristics of the persecutory delusions group ($n = 10$)

Diagnosis[a]	
F20 Schizophrenia	4 (40%)
(F20.0 Paranoid schizophrenia)	(3 (30%))
F29 Unspecified non-organic psychosis	6(60%)
PANSS	
Positive symptoms	18.9 (2.8)
Item P6 Suspiciousness/persecution	4.2 (0.6)
Negative symptoms	13.5 (3.0)
General psychopathology	37.2 (4.6)
Item G2 Anxiety	3.3 (0.9)
Mean duration of contact with mental health services in months (*SD*)	15.3 (11.4)
Antipsychotic medication[b]	
High dose	0
Medium dose	1 (10%)
Low dose	7 (70%)
Not on medication	2 (20%)

[a] ICD-10 (World Health Organization); [b] Levels of Chlorpromazine equivalents

both clinical and non-clinical participants were: poor command of English, and a history of epilepsy.

The main study included a sample of 20 participants in each group (Fornells-Ambrojo et al., 2008). Following sample size recommendations for phenomenological studies (Creswell, 1998; Morse, 1994), the tapes of the first 10 non-clinical and the first 10 clinical participants post virtual reality interviews were transcribed. The mean age was 24.2 ($SD = 2.3$) for the group with persecutory delusions ($n = 10$) and 23.8 ($SD = 2.3$) for the healthy volunteers group ($n = 10$), t (14.7) $= 0.3$, $p = .789$). All of the 10 clinical, and eight out of 10 of the non-clinical participants were male. Pre-morbid IQ as assessed by the Wechsler Test for Adult Reading (WTAR; Ginsberg, 2003) was significantly lower in the clinical ($M = 92.1$; $SD = 10.1$) than in the non-clinical group ($M = 107.3$, $SD = 6.6$, t (16) $= -3.6$, $p = .002$). Nine out of 10 and 8 out of 10 of the clinical and non-clinical participants were from Black or other ethnic minorities. Table 1 summarizes the clinical characteristics of the group with persecutory delusions.

Virtual environment

Apparatus. The virtual environment was displayed in an immersive projection system typically referred to as CAVE (Cruz-Neira, Sandin and DeFanti, 1993), specifically a Trimension ReacCTor. Lightweight CrystalEyes LCD shutterglasses delivered a stereo view of the virtual world. Participants had their head position and orientation tracked with an inertial/ultrasonic system (Intersense IS900) that was fitted on top of the glasses. They also carried a joystick. Participants moved around the virtual space with a combination of walking and whole body turning based on the head tracking as well as by using the joystick.

Environment. The experimental environment consisted of a virtual train carriage modelled on the London Underground, colloquially known as the Tube (see Figure 1).

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press



Figure 1. (Colour online) Virtual reality tube image

Participants boarded the virtual train and disembarked after two stops, 4 minutes later. Participants were instructed to explore the environment, and to try to form an impression of the people in the virtual carriage. Background noises associated with being in the London Underground were played (e.g. background rumble of the moving train).

Avatars. The environment was designed to be neutral. The carriage was populated with 20 computer-generated characters. Both genders and a range of ethnicities were represented. Avatars were programmed to exhibit only neutral behaviour. They glanced up and around the train carriage and occasionally they changed their facial expressions but they did not display any overtly hostile or friendly behaviour. Eight of the 20 avatars had mobility. For avatars that moved, there was an 80% chance of looking in the direction of the head tracker and a 10% chance of looking left or right. Specifically, 80% of avatar movement was contingent on the location of the participant but not to his/her specific behaviour or actions in the virtual carriage (i.e. the avatar looked in the direction of the participant whether he/she was looking at the avatar or not, whether he/she was near or far away).

Qualitative analyses

Thematic analyses (Joffe and Yardley, 2004) were conducted on the interviews about the virtual reality experience. The transcripts were analysed one at a time by the first author. The interview covered two main domains: general views about virtual reality, and intentionality appraisals. Only the latter are reported here. Themes about the understanding of other people's

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

intentions were identified using an iterative process. The focus was on the content and the evidence behind persecutory appraisals, the behaviour of the participant in the virtual environment, and interactions with computer generated characters. Themes were generated from the interviews, and emerging themes were constantly compared and grouped intro superordinate themes. The software NVivo-7 (QSR International, 2006) was used to make notes about text, and to create and organize emerging themes. The emerging themes were then cross-checked to ensure that the analysis was grounded in the interviews. Planned credibility checks (Elliott, Fischer and Rennie, 1999) included assessing correspondence between qualitative and quantitative analyses (e.g. sense of presence questionnaire, distress assessed by anxiety questionnaire, and VR-persecutory ideation assessed by questionnaire) and auditing of two cases by an independent researcher (EH, a trainee clinical psychologist with experience with people with psychosis) who examined the correspondence between the themes that had been extracted and the original source.

Results

Persecutory ideation in VR: thematic analyses

The thematic analyses of the transcripts yielded 11 themes that were grouped into 3 main categories: (a) evidence in favour of paranoid appraisals; (b) evidence against paranoid appraisals; and (c) other behaviour of participants in the virtual environment. The data suggest that all participants appeared to consider a range of alternative explanations in relation to virtual characters (e.g. is behaviour intentionally hostile/friendly/neutral?) and provided evidence of their decision making process. Table 2 shows verbatim excerpts from interviews with participants in each group and the numbers of participants who mentioned each theme.

Participants provided four main types of evidence in support of paranoid beliefs in the virtual environment: "mood/impression" evidence refers to descriptions of participants' negative emotions and negative initial perceptions of avatars (Theme 1); "actions of avatars" include interpretations of the head movement of avatars as evidence of rejection (e.g. avatar turning head "away from me") or threat (e.g. avatar coming too close) (Theme 2); "negative evaluations" contain comments that suggest the participant believed avatars viewed them in a negative light (Theme 3); and "comparison to everyday paranoid ideas" includes reference to pre-existing beliefs about threat in daily interactions used to anticipate threat in the virtual scenario (Theme 4).

The evidence against paranoid interpretations included three main themes: "social scripts about Tube etiquette" were used by participants to discuss circumstantial explanations for the behaviour of avatars (Theme 5); "disconfirmation after hypothesis testing" involved concluding that avatars were not reacting in relation to one's movements after actively attempting to cause a reaction (Theme 6); "safety of the virtual environment" included comments contrasting the virtual Tube to a less safe and unpredictable real world (Theme 7); "friendly interactions" described positive exchanges with the avatars (Theme 8); and "neutral behaviour" referred to inconsequential behaviour from avatars, not overtly positive or negative (Theme 9).

Lastly, participants engaged in two main types of additional behaviours: "exploration" of the environment without a particular goal (Theme 10); and "avoidance" of avatars that were

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

perceived negatively by staying physically far away from them in the virtual Tube carriage (Theme 11).

Overall, thematic analyses indicate that similar types of evidence and behaviour were reported by clinical participants and healthy volunteers. People with persecutory delusions, like healthy volunteers, showed the ability to take into account the computer characters' point of view when interacting with them in the virtual Tube (Theme 5).

The data displayed in Table 2, however, indicates that not all themes were equally common in each group. More participants with persecutory delusions discussed evidence in favour of persecutory appraisals in VR that related to affect (Theme 1) or referred to pre-existing (not delusional) beliefs about paranoia in everyday life (Theme 4). On the other hand, active hypothesis testing (Theme 6) was less frequently used by clinical group members.

Quantitative data: anxiety and state paranoia

As in the main study (Fornells-Ambrojo et al., 2008), participants in the persecutory delusion group reported higher levels of state anxiety as assessed by the STAI (Mean pre-VR anxiety = 36.9; $SD = 6.54$) prior to entering the virtual environment compared to healthy volunteers (Mean pre-VR anxiety = 26.9; $SD = 5.76$, Mann-Whitney $U = 10.0$, $p = .002$), but neither of the groups reported an increase in anxiety post-VR (Persecutory group mean post VR anxiety = 36.3; $SD = 7.27$), Wilcoxon signed-ranks $Z = -0.28$, $p = .779$; Healthy volunteers group mean post VR anxiety = 24.9; $SD = 3.93$), Wilcoxon signed-ranks $Z = -1.48$, $p = .137$). Overall, the neutral virtual environment did not cause distress or increased levels of anxiety.

Similarly, the environment was generally perceived as non-threatening, as suggested by frequent reports of positive or neutral appraisals about avatars as assessed by the State Paranoia Scale (SSPS; Freeman, Pugh et al., 2007) in the clinical ($M = 23.9$; $SD = 5.72$)) and non-clinical groups ($M = 27.8$; $SD = 6.68$). Of interest for the current study is that the mean number of VR-persecution scores as assessed by this scale (SSPS; Freeman, Pugh et al., 2007) did not significantly differ between the groups (Persecutory group mean = 15.6; $SD = 6.2$; Healthy volunteers group mean = 14.0; $SD = 5.83$), (Mann-Whitney $U = 44.5$, $p = .663$), suggesting that both groups reported similar endorsement of paranoid thoughts about the computer-generated characters. The equivalent figures for the main study are: Persecutory group ($n = 20$; $M = 14.9$; $SD = 5.56$); Healthy volunteers group ($n = 20$; $M = 13.3$; $SD = 4.56$), (Mann-Whitney $U = 169.5$, $p = .414$). In sum, the quantitative data for the subset of participants included in the current study are similar to the whole sample reported (Fornells-Ambrojo et al., 2008).

Correspondence with quantitative reports or paranoia in VR

Six out of 10 clinical participants (Cp1, Cp3, Cp6, Cp7, Cp9 and Cp10) and 5 out 10 healthy volunteers (Hp2, Hp4, Hp6, Hp7 and Hp10) whose interview is included in thematic analyses had endorsed at least one item of persecutory ideation in the SSPS (Freeman, Pugh et al., 2007) as reported in Fornells-Ambrojo et al. (2008). All the participants who endorsed an item of persecutory ideation in the SSPS questionnaire provided evidence in favour of their belief during the interview (see Table 2), showing correspondence between both types of analyses. However, two clinical participants (Cp2 and Cp5) who did not endorse any item suggesting paranoid ideation in VR in the SSPS (Freeman, Pugh et al., 2007) had entertained

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

Table 2. Themes and quotations for the "intentionality appraisals in VR"

Category	Themes	Persecutory group (n=10)	Healthy volunteers (n=10)
a) Evidence for paranoid appraisals	1. Mood/ impression	"Frightening … I cannot describe it … just felt weird." (Cp1) Cp1, Cp3, Cp5, Cp6 & Cp9 (5)	"I think that he stared back at me … and that gave me an unpleasant feeling … " Hp2 (1)
	2. Actions of the avatar	"When I looked at them, they looked at me and then they looked away." (Cp7) Cp2, Cp6, Cp7, Cp9 & Cp10 (5)	"A guy that came up in my face" (Hp10) Hp2, Hp6, Hp7 & Hp10 (4)
	3. Avatar's negative evaluations	"He just didn't like me, the sight of me." (Cp6) Cp1, Cp6 (2)	"He (the avatar) just thought … I was going to try and rob him or something" Hp4 (1)
	4. Comparison with everyday paranoid ideas	"And sometimes I feel threatened … I was thinking 'why are you looking at me?' and if they kept persisting looking at me … I might say something, 'why are you looking?' And I'm still like that, you know …" (Cp10) Cp3, Cp6, Cp7 & Cp10 (4)	"…because me being me … the way I dress and whatever … I get that all the time in the Tube … pretty much every day, I've seating in a booth seat by myself … the Tube could be full, but no-one would seat by my side …" (Hp4) Hp4, Hp7 (2)
b) Evidence against paranoid appraisals	5. Tube social scripts inform explanations from the avatars' point of view	"People might be looking up to see if their stops were coming up, so they need to get up, they might be thinking that … or they could be thinking 'I'm late for work' …" (Cp7) Cp1, Cp2, Cp4, Cp6 & Cp7 (5)	"they were looking at someone that was walking past, as it normally happens on the Tube …it's quite a closed space" (Hp9) Hp1, Hp3, Hp8, Hp9 & Hp10 (5)
	6. Disconfirmation after active hypothesis testing	"… a lady lift the head like this, so I don't know if she was reacting … I tried again to see, but she didn't react …" (Cp5) Cp5,Cp7 & Cp8 (3)	"…so I just moved back, to see his reaction, and then …he never did anything so I let go" (Hp10) Hp1, Hp2, Hp5, Hp6, Hp7 & Hp10 (6)

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

Table 2. Continued.

Category	Themes	Persecutory group (n=10)	Healthy volunteers (n=10)
	7. VR is safer/ more predictable than real world	"Also in the real world people are much more unpredictable … I knew I was not going to be harmed … I felt a lot more relaxed and stuff … in the real world … I'd be a lot more withdrawn …. And that is just a safety mechanism … just stay away … " (Cp2) Cp2, Cp5 (2)	- (0)
	8. Friendly interactions	"Everybody seemed pretty friendly and people were minding they own business" (Cp2) Cp2, Cp3, Cp4 & Cp6 (4)	"… There were a few people smiling … they were genuine smiles …" (Hp7) Hp1, Hp6, Hp7, Hp8 & Hp9 (5)
	9. Neutral behaviour	"I didn't feel that there was any interaction" (Cp5) Cp2, CP4, Cp5, Cp10 (4)	"I felt like they didn't notice me really" (Hp5) Hp1, Hp2, Hp5, Hp9, Hp10 (4)
c) Other behaviour	10. Generally exploring the environment	"I was just looking around, looking at people, just observing them …" (Cp1) Cp1, Cp2, Cp3, Cp4, Cp6, Cp10 (6)	"… I just tried to look at different people, look at their facial expressions … their body language …" (Hp7) Hp3, Hp4, Hp6, Hp7 & Hp10 (5)
	11. Avoiding others	"I moved every way, just walked up and down, moved away from them" (Cp3) Cp3, Cp6 & Cp9 (3)	"He just seemed unsteady … I just moved to the other side of the train" (Hp3) Hp3 & Hp10 (2)

()* Number of participants with the theme in each group

the possibility of evidence in favour of persecutory ideas (e.g. see Themes 1 and 2) but discarded it using evidence against paranoid interpretation. In particular, they both argued that VR felt safer than the real world (Theme 7) and provided other additional evidence against paranoid interpretation of events (see Table 2 for details).

Discussion

The present study is the first to investigate how people with persecutory delusions evaluate threat in a controlled social environment using qualitative methodology. The rationale for using an experimentally controlled environment to investigate paranoia is that interpersonal exchanges can be programmed to be neutral. Crucially, the behaviour of participants does not elicit hostile intent in avatars and therefore paranoid thoughts in VR are unfounded. Under these circumstances, people with early psychosis who experience persecutory delusions reported similar levels of paranoia to non-clinical participants (Fornells-Ambrojo et al., 2008) and the current qualitative study showed that they are able to use a range of strategies when evaluating potential interpersonal threat. However, the thematic analyses also suggested that people with persecutory delusions are more likely to use their own affect as evidence of persecution and less inclined to use active-hypothesis testing than healthy volunteers when assessing threat. The findings are next discussed in relation to current cognitive and psychosocial models of persecutory delusions, and hypotheses for further research are put forward.

Role of environmental factors in maintaining paranoia

Evaluating evidence of threat in a controlled social environment that does not elicit anxiety. Increases in anxiety have been shown to predict onset of paranoid thinking in daily life (Thewissen et al., 2011). Moreover, the Camberwell study (Ellett et al., 2008) showed that exposure to a deprived urban environment results in increases in anxiety and jumping to conclusions (JTC) reasoning biases, which in turn were associated with exacerbations in paranoid thinking among people with persecutory delusions.

However, qualitative analyses in the current study revealed that when anxiety is not raised by the social environment, people with psychosis with current persecutory delusions are able to use a range of strategies when assessing potential threat, as shown by them providing a range of evidence in favour and against paranoid interpretations of the virtual environment. This hypothesized preserved ability to accurately judge the social threat under these circumstances is consistent with experimental evidence that emotional arousal exacerbates reasoning biases in people with psychosis (Dudley, John, Young and Over, 1997; McGuire, Junginger, Adams, Burright and Donovick, 2001). Although emotions and reasoning biases have been shown to make independent contributions to delusional conviction (Garety et al., 2005; So, Freeman and Garety, 2008) there is also evidence that jumping-to-conclusions data gathering biases (JTC) partly mediate the association between anxiety and paranoia in non-clinical controls (Lincoln, Lange, Burau, Exner and Moritz, 2010).

Both groups reported using previous beliefs about the world and others when making sense of their environment. This is in accordance with cognitive models of persecutory delusions (Bentall, Corcoran, Howard, Blackwood and Kinderman, 2001; Chadwick, Birchwood and Trower, 1996; Freeman, Garety, Kuipers, Fowler and Bebbington, 2002), and also general

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

cognitive theories of non-psychotic disorders (Beck, 1976; Gilbert, 1992; Teasdale and Barnard, 1993) as well as non-clinical social cognitive theories that emphasize the role of the perceiver's pre-existing schemas in forming impressions of others (Baldwin, 1992; Fiske and Taylor, 1991; Schneider, 1973). Circumstantial, as opposed to intentional, explanations of events were provided by both groups, and explicit reference made to social scripts about "Underground behaviour", which again is in line with general social cognitive theories (Abelson, 1981).

Further research using a virtual environment that raises state anxiety is needed to investigate the hypothesis that the lack of increases in anxiety in the current neutral environment was associated with preserved accuracy of decision making when evaluating interpersonal threat.

Evaluating threat in a controlled virtual scenario in contrast to the malleable and stressful social everyday environment. The virtual environment employed in the current study was programmed to be neutral and the behaviour of participants could not elicit hostility or suspiciousness in avatars. Implications for further research focusing on understanding the impact of safety behaviours and environmental factors in the maintenance of paranoia are discussed next.

It would have been useful to include an assessment of safety behaviours (Freeman, Garety et al., 2007) in the current study in order to ascertain if people with persecutory delusions who did not endorse paranoid items in VR would tend to behave in a manner that might lead to suspicious reactions in other people in the real world, which they could interpret as further evidence of their paranoia. For instance, they might act on their delusional beliefs and display safety behaviours intended to reduce harm (e.g. they might repeatedly look at, or move away from, a person on the street who appears threatening to them) or they might show aggression towards others (e.g. shouting or physical aggression towards people believed to be a threat against the self) (De Pauw and Szulecka, 1988; Freeman, Garety et al., 2007; Link and Stueve, 1994; Swanson, Borum, Swartz and Monahan, 1996) with the unfortunate consequence of eliciting concerned looks or retaliation that could be taken as confirmatory evidence for original threat belief. This they were not able to do in the current controlled virtual environment as avatars remained neutral throughout.

Similarly, the virtual environment depicted in the current study was clearly less threatening than the real environment in which people with psychosis live. Life events involving experiences of humiliation, victimization and powerlessness have been associated with paranoia (Chisholm, Freeman and Cooke, 2006; Melo, Taylor and Bentall, 2006; Mirowski and Ross, 1984; Raune, Bebbington, Dunn and Kuipers, 2006).The theme that VR was "safer" than the real world emerged from the thematic analyses from interviews with the clinical group. For instance, one participant commented that the streets of Brixton were more dangerous than the virtual Tube scenario. This interpretation would support current multifactorial models of persecutory delusions in which adverse life events are proposed to interact with affective and cognitive processes in maintaining paranoid ideation (Bentall et al., 2001; Freeman et al., 2002). Further research using virtual reality should investigate the role of environmental factors by systematically manipulating aspects of the virtual environment and by evaluating the role of anxiety using randomized controlled designs (Freeman, 2008), as the current virtual scenario, although an ecologically valid representation of a tube journey that is typically characterized by neutral social interactions, was not designed to replicate a

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

socially deprived inner London borough setting, in which potentially threatening events could take place (e.g. street crime, drug or alcohol consumption, gang related activities).

Environmental risk factors could also be controlled in future studies by matching participants on their geographical living arrangements. In fact, non-clinical participants were recruited using participant panels in academic institutions and therefore could be potentially living in any area of London, whereas participants from the clinical group were living in areas of London characterized by high levels of deprivation (Index of Multiple Deprivation, 2004). Further studies should collect information about current socio-economic status and level of deprivation in the borough where participants live. In the only other virtual reality quantitative study looking at paranoia using a clinical sample, Freeman et al. (2010) used an updated version of the current tube scenario with a head-mounted display and showed that people with persecutory delusions from a psychosis sample, not exclusively early episode, reported significantly higher levels of unfounded persecutory ideation than healthy volunteers, demonstrating that virtual reality can be used to validate the groups. Interestingly, non-clinical participants were recruited from the same geographical area as clinical participants using leaflets distributed to local postcodes surrounding local psychiatric services.

Emotion as evidence for persecutory ideation and reduced hypothesis testing

Although both groups reported similar themes in their decision making, the qualitative analyses suggest a trend for two group differences in the type of evidence used in VR appraisals. The group with persecutory delusions provided more "affective" evidence in favour of their paranoid thoughts in VR (i.e. described their own emotion as evidence of intentionality in avatar behaviour), which is coherent with current thinking about psychosis in which affective processes are proposed to be at the core of psychotic symptoms (Bentall, Kaney and Dewey, 1991; Bentall, Kinderman and Kaney, 1994; Bentall et al., 2001; Birchwood, 2003; Freeman et al., 2002; Garety, Kuipers, Fowler, Freeman and Bebbington, 2001) and with the notion of aberrant salience (Kapur, 2003), in which a neutral event (e.g. a gesture of an avatar) is "experienced" as an aversive event and elicits a search for meaning. People with persecutory delusions were also less likely to use active hypothesis testing to disconfirm hypotheses about paranoid intentions in VR than non-clinical controls, which fits with evidence on reasoning biases in people with delusions (e.g. Garety et al., 2005).

The qualitative findings in the current study are consistent with data from a recent quantitative study in which persecutory ideation was found to be associated with greater use of experiential reasoning, typically defined as "affect as heuristic" (e.g. gut feeling) and reduced use of rational-analytical thinking in a self-report questionnaire (Freeman, Evans and Lister, 2012). Dual-processing theory (Evans and Over, 1996; Sloman, 1996; Stanovich and West, 2000) may provide a useful framework for cognitive therapy for paranoia in which deliberate analytic reasoning could be promoted to compensate for the reported reliance on intuition and affect, as well as the JTC data-gathering bias typically associated with delusions in empirical studies. Accordingly, Waller, Freeman, Jolley, Dunn and Garety (2011) recently reported a pilot intervention specifically targeting reasoning biases in people with delusions that resulted in improvements in JTC, belief flexibility and reduced delusional conviction.

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

Limitations and further research

A number of methodological limitations ought to be taken into account when considering the findings. People with persecutory delusions in the current study were living in the community and were engaged with community services, so it is possible that individuals in a more acute state of illness requiring hospitalization might be less sensitive to the ongoing social environment when making threat appraisals, as was the case with the high paranoid group in the experience sampling study by Collip et al. (2011). Moreover, participants had willingly decided to take part in the research project, presumably because, in spite of their persecutory delusions, they felt it was "safe enough" to do so. However, all fulfilled the criteria of persecutory delusions (Freeman and Garety, 2000) and had a score of at least moderate severity in the PANSS (Kay et al., 1987) and therefore the current research is a valid investigation in the spectrum of persecutory delusions. It is, however, possible that people with a higher degree of severity of persecutory delusions and emotional disturbance (e.g. inpatients) would have been more likely to endorse paranoid thinking and described a reduced range of decision-making strategies than the current sample.

Paranoid thoughts about virtual characters were not assessed as a dimensional experience in the main study (Fornells-Ambrojo et al., 2008). This is an important limitation since research investigating the continuum of delusional beliefs has shown that, although non-clinical samples endorse delusional items, they tend to report less conviction, distress and preoccupation than clinical participants (Peters, Day, McKenna and Orbach, 1999; Peters, Joseph and Garety, 1999; Peters, Joseph, Day and Garety, 2004). Moreover, the instructions prompted participants to form an impression of the computer-generated characters before they entered the VE, and it is possible that healthy volunteers might have been less likely to spontaneously focus on understanding the intentions of others if they had not been instructed to do so (Fornells-Ambrojo et al., 2008). However, reports of paranoid ideation in non-clinical samples are consistent with the proposition that paranoia lies on a continuum that runs from normality to the extreme experiences of people suffering from psychosis (e.g. Freeman, Freeman and Garety, 2006). The use of an interview about decision making also relied on participants' ability to reflect on their own reasoning processes, which often do not involve awareness. This is important in the light of reduced narrative coherence noted by Stopa et al. (2012) when they interviewed participants about experiences of interpersonal threat. However, it is encouraging that the findings in the current study were coherent with existing findings using quantitative data (Freeman et al., 2012).

Another limitation of the current study that warrants further research relates to the lack of an additional virtual environment as a control condition. Manipulations on the visual responsivity of avatars have been shown to have an impact on the sense of personal contact with them when compared to environments in which avatars are static or simply moving (Garau et al., 2005). Eight avatars in the virtual environment used in the current study were programmed to look left or right 10% of the time and to look in the direction of the participant's eyes (i.e. towards the tracker device on their 3D glasses) 80% of the time. Thus, 80% of avatar movement was contingent on the location of the participant but not to his/her specific behaviour or actions in the virtual carriage (i.e. the avatar looked in the direction of the participant whether he/she was looking at the avatar or not, whether he/she was near or far away). Future studies could examine what aspects of the social environment trigger paranoid thoughts by using different virtual environments as well as by extending the work of Ellett et al. (2008) to learn about the

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

psychological effects of different real urban environments by varying specific aspects (e.g. density, level of deprivation, threatening behaviour).

Clinical implications

VR has the potential to be incorporated into cognitive behavioural interventions for psychosis as has occurred with anxiety disorders (Carlin, Hoffman and Weghorst, 1997; Difede and Hoffman, 2002; Emmelkamp et al., 2002; Garcia-Palacios, Hoffman, Carlin, Furness and Botella, 2002; Krijn, Emmelkamp, Olafsson and Biemond, 2004; Powers and Emmelkamp, 2008; Rothbaum, Hodges, Smith, Lee and Price, 1995; Wallach, Safir and Bar-Zvi, 2009). The current study showed that people with persecutory delusions are able to describe the decision making process involved in appraising threat in a virtual encounter, which suggests that VR could be used as a therapeutic tool. A series of virtual scenarios that are increasingly anxiety-provoking could be used while the client is encouraged to continue using a range of strategies to evaluate evidence in favour and against a possible threat (e.g. active hypothesis testing, use of social scripts). This rehearsal process could provide clients with experiential evidence and increase their confidence when evaluating stressful environments in everyday life. Additionally, targeting increases in arousal when facing everyday social situations is likely to be a fruitful intervention strategy as it could enable participants to gather information about the environment and to reach more accurate decisions about levels of threat.

Lastly, when assessing why people make paranoid interpretations in their everyday life, in addition to conducting a thorough assessment of individual factors, such as affective and cognitive processes involved in their decision making, and a functional analysis of the impact of safety behaviours, the role of the ongoing environment in maintaining paranoia should not be underestimated. For instance, when discussing elevated rates of psychosis among the African-Caribbean population in England, Sharpley, Hutchinson, McKenzie and Murray (2001) point out that persecutory delusions are likely to reflect an appraisal of life events in the light of patterns of continuous adversity experienced in relation to an ethnic minority status. As mentioned in the introduction, Ellett et al. (2008) found that a mere 10 minutes walking in Camberwell, located in Southwark, one of the most deprived inner London boroughs, was enough to exacerbate reasoning biases and increase anxiety and paranoia. It is no coincidence that in an incidence study in South East London, Kirkbride et al. (2007) found evidence for elevated rates of non-affective psychosis in deprived neighbourhoods, including Camberwell, when compared to less deprived areas. This heterogeneous distribution was present after adjustment for individual factors, supporting the hypothesis that neighbourhood-level environmental risk factors may be relevant to the etiology of non-affective psychoses. One of the recommendations emerging from this study is to conduct a careful assessment of the social environment, including experiences of discrimination and social disadvantage, when conducting further research and in clinical settings.

References

Abelson, R. P. (1981). Psychological status of the script concept. *American Psychologist*, *36*, 715–729.

Baldwin, M. W. (1992). Relational schemas and the processing of social information. *Psychological Bulletin*, *112*, 461–484.

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

Bebbington, P. and Nayani, T. (1995). The Psychosis Screening Questionnaire. *International Journal of Methods in Psychiatric Research*, *5*, 11–19.

Beck, A. T. (1976). *Cognitive Therapy and the Emotional Disorders.* Oxford: International University Press.

Bentall, R. P., Corcoran, R., Howard, R., Blackwood, N. and Kinderman, P. (2001). Persecutory delusions: a review and theoretical integration. *Clinical Psychology Review*, *21*, 1143–1192.

Bentall, R. P. and Fernyhough, C. (2008). Social predictors of psychotic experiences: specificity and psychological mechanisms. *Schizophrenia Bulletin*, *34*, 1012–1020.

Bentall, R. P., Kaney, S. and Dewey, M. E. (1991). Paranoia and social reasoning: an attribution theory analysis. *British Journal of Clinical Psychology*, *30*, 13–23.

Bentall, R. P., Kinderman, P. and Kaney, S. (1994). The self, attributional processes and abnormal beliefs: towards a model of persecutory delusions. *Behaviour Research and Therapy*, *32*, 331–341.

Birchwood, M. (2003). Pathways to emotional dysfunction in first-episode psychosis. *British Journal of Psychiatry*, *182*, 373–375.

Carlin, A. S., Hoffman, H. and Weghorst, S. (1997). Virtual reality and tactile augmentation in the treatment of spider phobia: a case report. *Behaviour Research and Therapy*, *35*, 153–158.

Chadwick, P., Birchwood, M. and Trower, P. (1996). *Cognitive Therapy for Delusions, Voices and Paranoia.* Chichester: John Wiley.

Chisholm, B., Freeman, D. and Cooke, A. (2006).Identifying potential predictors of traumatic reactions to psychotic episodes. *British Journal of Clinical Psychology*, *45*, 545–559.

Collip, D., Oorschot, M., Thewissen, V., van, O. J., Bentall, R. and Myin-Germeys, I. (2011). Social world interactions: how company connects to paranoia. *Psychological Medicine*, *41*, 911–921.

Creswell, J. W. (1998). *Qualitative Inquiry and Research Design: choosing among five traditions*. Thousand Oaks, CA: Sage.

Cruz-Neira, C., Sandin, D. J. and DeFanti, T. A. (1993). Surround-screen 498 projection-based virtual reality: the design and implementation of the CAVE. *Proceedings of the 20th Annual Conference on Computer Graphics and Interactive Techniques,* 135–140.

dePauw, K. W. and Szulecka, T. K. (1988). Dangerous delusions: violence and the misidentification syndromes. *British Journal of Psychiatry*, *152*, 91–96.

Difede, J. and Hoffman, H. (2002). Virtual reality exposure therapy for World Trade Centre post-traumatic stress disorder: a case report. *Cyberpsychological Behavior*, *5*, 529–535.

Dudley, R., John, C. H., Young, A. W. and Over, D. (1997). The effect of self-referent material on the reasoning of people with delusions. *British Journal of Clinical Psychology*, *36*, 575–584.

Ellett, L., Freeman, D. and Garety, P. A. (2008). The psychological effect of an urban environment on individuals with persecutory delusions: the Camberwell walk study. *Schizophrenia Research*, *99*, 77–84.

Elliott, R., Fischer, C. and Rennie, D. (1999). Evolving guidelines for publication of qualitative research studies in psychology and related fields. *British Journal of Clinical Psychology*, *38*, 215–229.

Emmelkamp, P. M. G., Krijn, M., Hulsbosch, A. M., de Vries, S., Schuemie, M. J. and van der Mast, C. A. P. G. (2002). Virtual reality treatment versus exposure in vivo: a comparative evaluation in acrophobia. *Behaviour Research and Therapy*, *40*, 509–516.

Evans, J. and Over, D. A. (1996). *Rationality and Reasoning*. Hove: Psychology Press.

Fiske, S. T. and Taylor, S. E. (1991). *Social Cognition* (2nd ed.). New York: McGraw-Hill.

Fornells-Ambrojo, M., Barker, C., Swapp, D., Slater, M., Antley, A. and Freeman, D. (2008). Virtual reality and persecutory delusions: safety and feasibility. *Schizophrenia Research*, *104*, 228–236.

Freeman, D. (2007). Suspicious minds: the psychology of persecutory delusions. *Clinical Psychology Review*, *27*, 425–457.

Freeman, D. (2008). Studying and treating schizophrenia using virtual reality: a new paradigm. *Schizophrenia Bulletin*, *34*, 605–610.

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

Freeman, D., Evans, N. and Lister, R. (2012). Gut feelings, deliberative thought, and paranoid ideation: a study of experiential and rational reasoning. *Psychiatry Research*, *197*, 119–122.

Freeman, D., Freeman, J. and Garety, P. A. (2006). *Overcoming Paranoid and Suspicious Thoughts*. London: Robinson Constable.

Freeman, D. and Garety, P. A. (2000). Comments on the content of persecutory delusions: does the definition need clarification? *British Journal of Clinical Psychology*, *39*, 407–414.

Freeman, D., Garety, P. A., Bebbington, P. E., Slater, M., Kuipers, E., Fowler, D., et al. (2005). The psychology of persecutory ideation II: a virtual reality experimental study. *The Journal of Nervous and Mental Disease*, *193*, 309–315.

Freeman, D., Garety, P. A., Bebbington, P. E., Smith, B., Rollinson, R., Fowler, D., et al. (2005). Psychological investigation of the structure of paranoia in a non-clinical population. *British Journal of Psychiatry*, *186*, 427–435.

Freeman, D., Garety, P. A., Fowler, D., Kuipers, E., Bebbington, P. E. and Dunn, G. (2004).Why do people with delusions fail to choose more realistic explanations for their experiences? An empirical investigation. *Journal of Consulting and Clinical Psychology*, *72*, 671–680.

Freeman, D., Garety, P. A., Kuipers, E., Fowler, D. and Bebbington, P. E. (2002). A cognitive model of persecutory delusions. *British Journal of Clinical Psychology*, *41*, 331–347.

Freeman, D., Garety, P. A., Kuipers, E., Fowler, D., Bebbington, P. E. and Dunn, G. (2007). Acting on persecutory delusions: the importance of safety seeking. *Behaviour Research and Therapy*, *45*, 89–99.

Freeman, D., Pugh, K., Antley, A., Slater, M., Bebbington, P., Gittins, M., et al. (2008). A virtual reality study of paranoid thinking in the general population. *British Journal of Psychiatry*, *192*, 258–263.

Freeman, D., Pugh, K., Green, C., Valmaggia, L., Dunn, G. and Garety, P. A. (2007). A measure of state persecutory ideation for experimental studies. *Journal of Nervous and Mental Disease*, *195*, 781–784.

Freeman, D., Pugh, K., Vorontsova, N., Antley, A. and Slater, M. (2010). Testing the continuum of delusional beliefs: an experimental study using virtual reality. *Journal of Abnormal Psychology*, *119*, 83–92.

Freeman, D., Slater, M., Bebbington, P. E., Garety, P. A., Kuipers, E., Fowler, D., et al. (2003). Can virtual reality be used to investigate persecutory ideation? *The Journal of Nervous and Mental Disease*, *191*, 509–514.

Garau, M., Slater, M., Pertaub, D.-P. and Razzaque, S. (2005). The responses of people to virtual humans in an immersive virtual environment. *Presence: Teleoperators and Virtual Environments*, *14*, 104–116.

Garcia-Palacios, A., Hoffman, H., Carlin, A. S., Furness, T. A. and Botella, C. (2002). Virtual reality in the treatment of spider phobia: a controlled study. *Behaviour Research and Therapy*, *40*, 983–993.

Garety, P. A., Kuipers, E., Fowler, D., Freeman, D. and Bebbington, P. E. (2001). A cognitive model of the positive symptoms of psychosis. *Psychological Medicine*, *31*, 189–195.

Garety, P. A., Freeman, D., Dunn, G., Bebbington, P. E., Fowler, D., Kuipers, E., et al. (2005). Reasoning, emotions, and delusional conviction in psychosis. *Journal of Abnormal Psychology*, *114*, 373–384.

Gilbert, P. (1992). *Depression: the evolution of powerlessness.* Hove: Lawrence Erlbaum.

Ginsberg, J. P. (2003). Wechsler test of adult reading. *Applied Neurophysiology*, *10*, 182–184.

Gracie, A., Freeman, D., Green, C., Garety, P., Kuipers, E., Ray, K., et al. (2007). The association between traumatic experience, paranoia and hallucinations: a test of the predictions of psychological models. *Acta Psychiatrica Scandinavica*, *116*, 1–10.

Index of Multiple Deprivation (2004). Summary (revised). Office of the Deputy Prime Minister. http://www.communities.gov.uk/archived/publications/communities/indicesdeprivation [http://www.communities.gov.uk/index.asp?id=1128442]

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

Joffe, H. and Yardley, L. (2004).Content and thematic analysis. In D. Marks and L. Yardley (Eds.), *Research Methods for Clinical Health Psychology*. London: Sage.

Kapur, S. (2003). Psychosis as a state of aberrant salience: a framework linking biology, phenomenology, and pharmacology. *American Journal of Psychiatry*, *160*, 13–23.

Kay, S. R., Fiszbein, A. and Opfer, L. A. (1987). The Positive and Negative Syndrome Scale (PANSS) for Schizophrenia. *Schizophrenia Bulletin*, *13*, 261–276.

Kirkbride, J. B., Fearon, P., Morgan, C., Dazzan, P., Morgan, K., Murray, R. M., et al. (2007). Neighborhood variation in the incidence of psychotic disorders in Southeast London. *Social Psychiatry and Psychiatric Epidemiology*, *42*, 438–445.

Krijn, M., Emmelkamp, P. M. G., Olafsson, R. P. and Biemond, R. (2004). Virtual reality exposure therapy of anxiety disorders: a review. *Clinical Psychology Review*, *24*, 259–281.

Lincoln, T. M., Lange, J., Burau, J., Exner, C. and Moritz, S. (2010). The effect of state anxiety on paranoid ideation and jumping to conclusions: an experimental investigation. *Schizophrenia Bulletin*, *36*, 1140–1148.

Link, B. G. and Stueve, A. (1994). Psychotic symptoms and the violent/illegal behavior of mental patients compared to community controls. In J. Monahan and H. Steadman (Eds.), *Violence and Mental Disorder: developments in risk assessment.* Chicago, IL: University of Chicago Press.

McGuire, P. K., Junginger, J., Adams, S. G., Burright, R. and Donovick, P. (2001). Delusions and delusional reasoning. *Journal of Abnormal Psychology*, *110*, 259–266.

Melo, S. S., Taylor, J. L. and Bentall, R. P. (2006). "Poor me" versus "bad me" paranoia and the instability of persecutory ideation. *Psychology and Psychotherapy: Theory, Research and Practice*, *79*, 271–287.

Mirowsky, J. and Ross, C. (1983). Paranoia and the structure of powerlessness. *American Sociological Review*, *48*, 228–239.

Morse, J. M. (1994). Designing funded qualitative research. In N. K. Denzin and Y. S. Lincoln (Eds.), *Handbook of Qualitative Research* (pp. 220–235). Thousand Oaks, CA: Sage.

Pedersen, C. B. and Mortensen, P. B. (2001). Evidence of a dose-response relationship between urbanicity during upbringing and schizophrenia risk. *Archives of General Psychiatry*, *58*, 1039–1046.

Pertaub, D. P., Slater, M. and Barker, C. (2002). An experiment on public speaking anxiety in response to three different types of virtual audience. *Presence Teleoperators Virtual Environment*, *11*, 68–78.

Peters, E. R., Day, S., McKenna, J. and Orbach, G. (1999). The incidence of delusional ideation in religious and psychotic populations. *British Journal of Clinical Psychology*, *38*, 83–96.

Peters, E. R., Joseph, S. A. and Garety, P. A. (1999). Measurement of delusional ideation in the normal population: introducing the PDI (Peters et al. Delusions Inventory). *Schizophrenia Bulletin, 25*, 553–576.

Peters, E., Joseph, S. A., Day, S. and Garety, P. A. (2004). The Peters et al. Delusions Inventory (PDI): new norms for the 21-item version. *Schizophrenia Bulletin*, *30*, 1005–1022.

Powers, M. B. and Emmelkamp, P. (2008) Virtual reality exposure for anxiety disorders: a meta-analysis. *Journal of Anxiety Disorders*, *22*, 561–569.

QSR International. (2006). *NVivo. Getting started with your NVivo Project.* Crystal Reports. Retrieved from http://www.qsrinternational.com/support_getting-started.aspx

Raune, D., Bebbington, P., Dunn, G. and Kuipers, E. (2006). Event attributes and the content of psychotic experiences in first-episode psychosis. *Psychological Medicine*, *36*, 221–230.

Rothbaum, B. O., Hodges, L., Smith, S., Lee, J. H. and Price, L. A. (2000). A controlled study of virtual reality exposure therapy for fear of flying. *Journal of Consulting and Clinical Psychology*, *68*, 1020–1026.

Schneider, D. J. (1973). Implicit personality theory: a review. *Psychological Bulletin*, *5*, 294–309.

Sharpley, M., Hutchinson, G., McKenzie, K. and Murray, R. M. (2001). Understanding the excess of psychosis among the African-Caribbean population in England. *The British Journal of Psychiatry*, *178*, s60–s68.

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press

Slater, M., Pertaub, D. P., Baker, C. and Clark, D. M. (2006). An experimental study on fear of public speaking using a virtual environment. *CyberPsychology and Behavior*, *9*, 627–633.

Sloman, S. A. (1996).The empirical case for two systems of reasoning. *Psychological Bulletin*, *119*, 3–22.

So, S. H., Freeman, D. and Garety, P. (2008). Impact of state anxiety on the jumping to conclusions delusion bias. *Australian and New Zealand Journal of Psychiatry*, *42*, 879–886.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R. and Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Stanovich, K. E. and West, R. F. (2000). Individual differences in reasoning: implications for the rationality debate? *Behavioral and Brain Sciences*, *23*, 645–665.

Stopa, L., Denton, R., Wingfield, M. and Taylor, K. N. (2012). The fear of others: a qualitative analysis of interpersonal threat in social phobia and paranoia. *Behavioural and Cognitive Psychotherapy*, *13*, 1–22.

Sundquist, K., Frank, G. and Sundquist, J. (2004). Urbanisation and incidence of psychosis and depression: follow-up study of 4.4 million women and men in Sweden. *The British Journal of Psychiatry*, *4*, 293–298.

Swanson, J. W., Borum, R., Swartz, M. S. and Monahan, J. (1996). Psychotic symptoms and disorders and the risk of violent behaviour in the community. *Criminal Behaviour and Mental Health*, *6*, 309–329.

Teasdale, J. D. and Barnard, P. J. (1993). *Affect, Cognition, and Change: re-modelling depressive thought.* Hove: Lawrence Erlbaum.

Thewissen, V., Bentall, R. P., Oorschot, M., Campo, A., van, L. T., van, O. J., et al. (2011). Emotions, self-esteem, and paranoid episodes: an experience sampling study. *British Journal of Clinical Psychology*, *50*, 178–195.

Valmaggia, L., Freeman, D., Green, C., Garety, P., Swapp, D., Antley, A., et al. (2007). Virtual reality and paranoid ideations in people with an "At risk mental state" for psychosis. *British Journal of Psychiatry*, *51*, s63–8.

van Os, J. (2004). Does the urban environment cause psychosis? *The British Journal of Psychiatry*, *184*, 287–288.

Wallach, H. S., Safir, M. P. and Bar-Zvi, M. (2009). Virtual reality cognitive behaviour therapy for public speaking anxiety: a randomized controlled trial. *Behaviour Modification*, *33*, 314–338.

Waller, H., Freeman, D., Jolley, S., Dunn, G., and Garety, P. (2011). Targeting reasoning biases in delusions: a pilot study of the Maudsley Review Training Programme for individuals with persistent, high conviction delusions. *Journal of Behavior Therapy and Experimental Psychiatry*, *42*, 414–421.

Weiser, M., van Os, J., Reichenberg, A., Rabinowitz, J., Nahon, D., Kravitz, E., et al. (2007). Social and cognitive functioning, urbanicity and risk for schizophrenia. *The British Journal of Psychiatry*, *191*, 320–324.

https://doi.org/10.1017/S1352465813000830 Published online by Cambridge University Press