The Psychology of Persecutory Ideation II

A Virtual Reality Experimental Study

Daniel Freeman, PhD, Philippa A. Garety, PhD,* Paul Bebbington, PhD,† Mel Slater, DSc,‡
Elizabeth Kuipers, PhD,* David Fowler, MSc,§ Catherine Green, BSc,* Joel Jordan, BSc,‡
Katarzyna Ray, MSc,‖ and Graham Dunn, PhD¶*

Abstract: A cognitive model of persecutory delusions is used to predict the occurrence of nonclinical paranoid thoughts in a virtual reality environment. Scorers across the range of paranoia entered a virtual reality scene populated by five computer characters programmed to behave neutrally (N = 30). Many appraisals of the computer characters were positive or neutral. However, there were also persecutory thoughts about the characters. Providing evidence of the validity of the experimental method, persecutory ideation was predicted by higher trait paranoia and a greater sense of presence in the environment. The psychological variables from the cognitive model that predicted persecutory ideation were anxiety, timidity, and hallucinatory predisposition. Further, hallucinatory predisposition distinguished the prediction of paranoid thoughts from social anxiety in virtual reality. It is concluded that nonclinical paranoid thoughts are most closely associated with emotional disturbances and anomalous experiences. Extreme reasoning bias may particularly contribute to the development of clinical phenomena.

*Department of Psychology, Institute of Psychiatry, King's College London, London, and South London and Maudsley NHS Trust, United Kingdom; †Department of Psychiatry and Behavioural Sciences, University College London, Royal Free and University College Medical School, London, and Camden and Islington Mental Health and Social Care NHS Trust, United Kingdom; ‡Department of Computer Science, University College London, London, United Kingdom; §School Of Medicine, Health Policy and Practice, University of East Anglia, Norwich, and Norfolk Mental Health Care NHS Trust, United Kingdom; ‖Department of Biostatistics and Computing, Institute of Psychiatry, King's College London, London, United Kingdom; and ¶Biostatistics Group, Division of Epidemiology and Health Sciences, University of Manchester, Manchester, United Kingdom.

Send reprint requests to Daniel Freeman, PhD, Department of Psychology, P. O. Box 77, Institute of Psychiatry, King's College London, Denmark Hill, London SE5 8AF, United Kingdom.

Questionnaire studies of paranoia enable data to be obtained from a large number of participants, but an obvious weakness is that it is not known whether the persecutory experiences assessed are unfounded. The interest for the study of abnormal psychology is the understanding of the processes associated with persecutory ideation for which there is no or insufficient basis. Questionnaire studies may include an unknown proportion of persecutory ideation that is realistic and therefore well judged and appropriate. An experimental research design is the best method of overcoming this weakness. Situations that trigger unfounded persecutory ideation can be used to identify causal factors. In this context, virtual reality has the potential to be a particularly powerful research tool. With virtual reality, the environment is controlled; individuals can therefore enter an identical situation, so appraisals for the same event can be assessed and psychological factors associated with particular appraisals identified. This design provides an experimental method of testing the key cognitive idea of the importance of the appraisal of events (Beck, 1976).

In applying this method to the study of persecutory ideation, virtual characters (avatars) in a virtual environment can be programmed to exhibit only behavior that most people would assess as neutral. Individuals' appraisals of the avatars can then be assessed and the psychological factors that lead some individuals to have persecutory thoughts determined. We have piloted the use of virtual reality as a means of developing the theoretical understanding of persecutory ideation (Freeman et al., 2003). We found that some (nonclinical) individuals had thoughts of a persecutory nature about neutral avatars in a library scene: unfounded persecutory ideation was being triggered. Higher levels of anxiety and interpersonal sensitivity predicted the occurrence of persecu-

tory thoughts, consistent with the idea that emotional processes contribute to the development of persecutory ideation.

Nonclinical persecutory ideation is likely to be related to delusional experiences, and therefore, we use the occurrence of persecutory ideation in virtual reality to test the predictions from a cognitive model of delusions (Freeman and Garety, 2004; Freeman et al., 2002). In this article, a study is reported that was designed to replicate and build on the pilot investigation. Three main improvements to the experimental design were made. The first improvement concerned the recruitment of study participants. Participants in the pilot were a convenience sample and had low levels of trait paranoia. A better estimate of the validity of the methodology will be obtained by including individuals across the full range of trait paranoia. Therefore, in the current investigation, scorers across the range of paranoia, identified by a questionnaire study (Freeman et al., In press), were selected to take part in the virtual reality experiment. The second improvement on the pilot study was that a more comprehensive assessment of participants was conducted. The main factors in the cognitive model were assessed. We investigated the prediction of unfounded persecutory ideation in virtual reality by trait paranoia, the presence of anomalous experiences (hallucinatory experiences, perceptual anomalies), reasoning biases (need for closure, jumping to conclusions), and emotional processes (anxiety, depression, stress, self-focus, interpersonal sensitivity). The third main improvement was that both paranoid thoughts and anxiety caused by the virtual environment were measured. This allowed an examination of differential predictors of persecutory and anxious ideation. Although we hypothesize that anxiety has a central role in the causation of persecutory ideation, it is important to identify the factors that make anxiety and persecutory ideation distinct.

METHODS

This study closely followed the methods of that reported in Freeman et al. (2003).

Participants

Thirty participants from the survey respondents were tested in a 3-month period. Care was taken to recruit scorers covering the whole range of the Paranoia Scale (PS). The mean PS score of this subsample was 46.9 (*SD* = 16.6; minimum-maximum, 22–84; 25th percentile = 32.0; 50th percentile = 46.5; 75th percentile = 59.3). An equal number of males and females took part.

MATERIALS

The virtual environment was displayed in an immersive projection system commonly referred to as a CAVE (Fakespace Systems, Iowa; Cruz-Neira et al., 1993), with four projection walls (three walls and the floor). The specific system was a ReaCTor (Trimension, West Sussex). Participants have their head position and orientation tracked with an inertial/ultrasonic system (IS900 VET tracking system; Intersense, Massachusetts). They also carry a tracked (Intersense) joystick in their right hand. They wear lightweight CrystalEye LCD shutterglasses (StereoGraphics, California), which deliver a stereo view of the virtual world that surrounds them on four sides. They can move through the virtual environment with a combination of walking and whole body turning, and also by pressing a button on the joystick, which moves them forward in the virtual space in the direction in which they are pointing. For a separate study concerning virtual environments, the participants were fitted with a Procomp+ device (Thought Technology, Ltd.) to monitor their galvanic skin response and blood volume pulse.

Measures

The participants had completed on the Internet the PS (Fenigstein and Vanable, 1992), the Launay Slade Hallucination Scale (LSHS; Launay and Slade, 1981), the Structured Interview for Assessing Perceptual Anomalies (SIAPA; Bunney et al., 1999), the Need for Closure Scale (NFC; Kruglanski et al., 1993), the Depression Anxiety Stress Scales (DASS; Lovibond and Lovibond, 1995), the Interpersonal Sensitivity Measure (IPSM; Boyce and Parker, 1989), and the Private Self Consciousness Scale (PSCS; Fenigstein et al., 1975). For details of these measures, see Freeman et al. (2005).

Two measures were taken before participants entered the virtual environment: an experimental task assessing probabilistic reasoning and a measure of social anxiety. After being in the virtual environment, participants completed measures of persecutory ideation, anxiety, and sense of presence in the virtual environment.

Probabilistic Reasoning Task

The probabilistic reasoning task (Garety et al., 1991) assesses data gathering style. The standard 85:15 beads task was used. The key variable is the number of items requested before a decision is made. Individuals with delusions typically require only one item before making a decision in this task, indicating the presence of a data gathering bias (Garety and Freeman, 1999).

Social Avoidance and Distress Scale

The Social Avoidance and Distress Scale (SAD; Watson and Friend, 1969) is a 28-item instrument used to assess social anxiety. A true-false format is used for each item, and scores can range from 0 to 28. Higher scores indicate higher levels of social anxiety.

VR-SAD

The SAD was modified to assess social anxiety in the virtual environment. Participants were asked to fill in the questionnaire with reference to their experience in the virtual

room. Where necessary, SAD items were reworded. For example, the item "I usually feel relaxed when I am with a group of people" was changed to "I felt relaxed with the group of people." The same true-false response format was used. Higher scores indicate greater social anxiety in the virtual environment.

VR Questionnaire

The measure of persecutory ideation in virtual reality used by Freeman et al. (2003) was modified on the basis of the pilot study. The self-report questionnaire (see Appendix) consisted of 15 items, each rated on a 1 to 4 scale (1 = do not agree, 2 = agree a little, 3 = agree moderately, 4 = totally agree). Five items assessed persecutory ideation (VR-persecution), and were derived from the definition of persecutory delusions by Freeman and Garety (2000). Five items assessed neutral ideation about the virtual reality characters (VR-neutral). Five items assessed positive ideation about the virtual reality characters (VR-positive). The higher the score on a subscale, the more the items were endorsed. There are no standardized measures of state persecutory ideation. To check the validity of the VR-persecution subscale, two additional assessments were made. The first was that participants were also asked to rate on visual analogue scales (1) how much they felt anxious, (2) how much they thought at the time that someone was trying to persecute them, and (3) how much they felt paranoid. The second additional assessment was a semistructured interview to elicit spontaneous impressions of the virtual environment. The interview was videotaped. The interviews were rated (blind to responses on the questionnaires) for persecutory content on a 6-point scale by the first author, a clinical psychologist experienced in the assessment of persecutory delusions.

Sense of Presence

Presence refers to the extent to which the participant experiences a sense of being in the virtual world (Slater et al., 1998). A questionnaire was used that assesses presence on three main criteria: the sense of being there in the environment depicted by the computer displays, a sense of having visited a place rather than just having seen images, and the extent to which the virtual world dominated, so that behavior was relative to the virtual world rather than the real world in which the participants were actually located. It consists of six questions each rated on a scale of 1 to 7, with higher numbers indicating greater reported presence (Slater et al., 1998).

Procedure

Ethical approval for the study was received from the local research ethics committee. A standard procedure was used. Written informed consent was first obtained. The study was described to potential participants as examining people's reactions to virtual environments, with the aim to develop the

understanding of "everyday worries about other people." Participants then completed the probabilistic reasoning task and SAD scale. Administration of questionnaires before entering virtual reality was shown not to affect participants' reactions to the avatars in the pilot study (Freeman et al., 2003). After training in the use of the VR equipment, participants entered the virtual environment, which was the library scene used in the pilot study. The instructions were, "Please explore the room, and try to form some impression of what you think about the people in the room and what they think about you." There were five avatars (virtual people) in the library: three seated at one desk, and two at another desk on the opposite side of the room. Occasionally the avatars showed potentially ambiguous behavior (e.g., smiling, looking, talking among each other). After 4 minutes, participants were told to leave the virtual room. All participants then completed the questionnaires and a short semistructured interview concerning their experience in the virtual environment. Individuals were then debriefed and paid a small amount for their time.

Analysis

There were no missing data. All analyses were conducted using SPSS for Windows (version 10.0; SPSS, 2000). All significance test results are quoted as two-tailed probabilities.

RESULTS

Demographic Data

The mean age of the participants was 22 ($SD = 5$). The median age was 21, the range was 19, and the interquartile range was 6. The ethnicity of the participants was white ($N = 21$), Asian ($N = 5$), African ($N = 1$), and other ($N = 3$).

Persecutory Ideation in VR

There was appreciable endorsement of VR Questionnaire persecutory items. The mean VR-persecution score was 7.6 ($SD = 2.4$), the mean VR-neutral score was 11.6 ($SD = 3.4$), and the mean VR-positive score was 11.5 ($SD = 3.0$). Only seven of the participants completely rejected all the persecutory items (i.e. they disagreed with all five of the items). Nonetheless, the scores on this scale were skewed toward the lower end. As would be expected, higher endorsement of persecutory items was associated with lower endorsement of neutral ($r = -.60$; $p < 0.001$) and positive items ($r = -.52$; $p = 0.003$). The Cronbach α for the VR-persecution scale was .66, indicating adequate internal consistency. Convergent validity checks were made with the blind ratings from interview and the visual analogue scale ratings. Higher endorsement of persecutory items on the VR Questionnaire was associated with higher ratings of paranoia from interview ($r = .55$; $p = 0.002$) and higher visual analogue ratings of persecution ($r = .48$; $p = 0.008$) and anxiety ($r = .39$; $p =$

0.033), but not significantly with higher ratings of paranoia ($r = .22$; $p = 0.246$).

Predictors of VR Persecutory Ideation

VR-persecution scores were correlated with the scores from the other measures (Table 1). There were five significant correlations and 16 nonsignificant correlations. Persecutory ideation in virtual reality was predicted by higher levels of paranoia, anxiety, timidity, hallucinatory experiences, and sense of presence. On the probabilistic reasoning task, none of the participants jumped to conclusions (i.e., decided after one piece of evidence), and all produced the correct answer. Only three participants decided after two pieces of evidence in this task. There was therefore little evidence of jumping to conclusions in this population.

Predictors of VR Anxiety

The mean SAD score for the group was 7.4 ($SD = 7.4$). Social anxiety about the virtual characters was assessed by the VR-SAD measure. The mean VR-SAD score was 7.3 ($SD = 7.6$). Participants scored across the whole range of the scale from the lowest and highest scores possible. The VR-SAD scores were correlated with the other measures (Table 2). There were 14 significant correlations and seven nonsig-

nificant correlations. Social anxiety in virtual reality was predicted by higher levels of social avoidance and distress, depression, interpersonal awareness, anxiety, NFC-discomfort with ambiguity, stress, interpersonal sensitivity, paranoia, separation anxiety, NFC-preference for predictability, private self-consciousness, fragile inner self, and timidity, and lower levels of NFC-decisiveness.

DISCUSSION

Intriguingly, neutral computer characters can elicit persecutory thoughts. This replicates the results from the first study of virtual reality and paranoia (Freeman et al., 2003). Of most interest is that the persecutory ideation elicited is known to be unfounded. The computer characters were not programmed to have hostile intentions, yet many participants perceived this in the avatars' neutral behavior, particularly if the participants were immersed in the virtual environment (had a stronger sense of presence). Persecutory ideation in virtual reality is therefore closer to the clinical phenomena than that elicited in questionnaire studies in which the evidential basis for the endorsed items is unknown. Nonetheless, it was found that the persecutory ideation experienced in virtual reality by the participants was associated with having

TABLE 1. Correlations Among the Persecutory Ideation Ratings in Virtual Reality and the Other Measures

	Correlation (r) with VR-persecution	p Value
PS	.55	0.002**
LSHS	.46	0.010*
Perceptual anomalies	.29	0.122
NFC-total	−.09	0.634
NFC-preference for order	.05	0.790
NFC-preference for predictability	−.14	0.451
NFC-decisiveness	−.06	0.750
NFC-discomfort with ambiguity	.00	0.989
NFC-closed mindedness	−.18	0.351
DASS-anxiety	.54	0.002**
DASS-depression	.36	0.054
DASS-stress	.36	0.050
IPSM-total	.28	0.137
IPSM-interpersonal awareness	.07	0.714
IPSM-need for approval	.25	0.191
IPSM-separation anxiety	.28	0.135
IPSM-timidity	.47	0.009**
IPSM-fragile inner self	.06	0.752
Private self-consciousness	.19	0.313
Social avoidance and distress	.18	0.353
Sense of presence	.39	0.033*

*$p < 0.05$; **$p < 0.01$.

TABLE 2. Correlations Among the VR-SAD Ratings and the Other Measures

	Correlation (r) with VR-SAD	p Value
PS	.52	0.004**
LSHS	.03	0.870
Perceptual anomalies	.01	0.965
NFC-total	.31	0.097
NFC-preference for order	.31	0.092
NFC-preference for predictability	.43	0.018*
NFC-decisiveness	−.54	0.002**
NFC-discomfort with ambiguity	.60	<0.001***
NFC-closed mindedness	.03	0.875
DASS-anxiety	.61	<0.001***
DASS-depression	.64	<0.001***
DASS-stress	.56	0.001**
IPSM-total	.52	0.003**
IPSM-interpersonal awareness	.62	<0.001***
IPSM-need for approval	−.00	0.988
IPSM-separation anxiety	.47	0.009**
IPSM-timidity	.38	0.036*
IPSM-fragile inner self	.41	0.026*
Private self-consciousness	.41	0.025*
Social avoidance and distress	.75	<0.001***
Sense of presence	−.19	0.323

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

such thoughts in the real world (i.e., higher PS scores). Importantly, therefore, we have obtained evidence that this methodology is capable of being used to inform the understanding of paranoia in daily life.

Persecutory ideation in virtual reality was also predicted by higher levels of anxiety, timidity, and hallucinations. This is consistent with the theoretical model of persecutory delusions. We consider each of the three predictors in turn. However, we do add an obvious note of caution for the interpretation of the study results: the sample size was small, and further, multiple correlations were conducted, which is liable to lead to Type I errors (detecting an effect when none exists). Anxiety had the closest association of these predictors with persecutory ideation. This is evidence for our proposal that anxiety and associated processes provide the threat content of persecutory ideation. The result not only adds to similar findings in cognitive studies with clinical groups but also is supported by epidemiological data (Freeman and Garety, 2004). For example, Jones et al. (1994) report that anxiety at age 15 predicted later psychosis in a longitudinal survey of a UK general population birth cohort.

In the pilot study, we found that paranoia was associated with interpersonal sensitivity. The fuller assessment of interpersonal sensitivity has identified timidity as the key component. Timidity refers to difficulties in behaving assertively because of fears of offending others and eliciting a negative response such as rejection. An expectation of negative responses and feelings of vulnerability in relation to others could plausibly lead to a person being susceptible to persecutory ideation. Moreover, several of the questionnaire items concern an unwillingness to express anger outwardly (e.g., "I don't get angry with people for fear that I may hurt them"). Rather than the anger being expressed to others, the individual may ruminate and feel aggrieved. This will maintain an agitated state in which external attributions and anomalous experiences are more likely, thus leading to the persistence of persecutory ideation. It is of note that here, also, there are similar findings in the epidemiological literature. In a further analysis of their UK population cohort, Jones and Croudace (2000) report that of the teacher ratings of the children at age 15, the combination of timidity and daydreaming best predicted later onset of schizophrenia.

Hallucinatory predisposition was also a predictor of persecutory ideation, consistent with Maher's (1974) suggestion that delusions are based upon anomalous experiences. Interestingly, the prediction of persecutory ideation and social anxiety in virtual reality shared many of the same factors—and this is unsurprising given the similarities in their threat content—but what set apart the prediction of persecutory ideation from that of social anxiety was this role of hallucinatory experience. The findings support the view that emotional disturbance can lead to social anxiety but that the addition of anomalous experiences such as hallucinations

makes persecutory ideation more likely. To our knowledge, no other study has considered the differential predictors of persecutory ideation and social anxiety. Although we have emphasized that there are similarities between emotional and delusional experiences that have been neglected—and the results of this study do indicate a close relationship—this does not mean that the pendulum should swing fully the other way and that the differences between them are then in turn neglected. We also note from the correlation coefficients that the measures used in the virtual reality study explained a large proportion of the variance of social anxiety but much less of the persecutory ideation. So, although there is considerable overlap in the factors that predicted social anxiety and persecutory ideation, the factors explained considerably more of the social anxiety. Other psychological variables besides hallucinatory predisposition will therefore also be important in differential prediction.

What about the role of reasoning, the other main element of the cognitive model? We assessed probabilistic reasoning and need for closure. There was no association of persecutory ideation with biased probabilistic reasoning. None of the individuals in this sample showed the extreme jumping to conclusions reasoning style characteristic of delusions (i.e., reached a certain decision after gathering one piece of evidence), and only three reached a decision after two items. In future studies, it will be valuable to include harder probabilistic tasks that have a greater potential to discriminate a tendency to jump to conclusions in nonclinical populations (e.g., Dudley et al., 1997); indeed, in a recent study of individuals who met criteria for being at high risk of developing psychosis, the task used here (85:15) did not discriminate, whereas harder tasks did (60:40; Broome et al., 2003). It would also be important to relate reasoning biases, if found, specifically to high levels of conviction in persecutory ideation, rather than simply occurrence, because it is hypothesized that these reasoning biases contribute to higher levels of delusional conviction.

Need for closure in delusions has received little research attention, and the concept has been assessed by questionnaire in this population rather than experimental tasks; higher scores on the measure have been found to be associated with higher nonclinical delusional ideation (Colbert and Peters, 2002) and with current or remitted persecutory delusions (Bentall and Swarbrick, 2003). Scores on the scale did not predict the occurrence of persecutory ideation in virtual reality. Perhaps this is a result of the focus upon a single type of delusional theme, persecution, rather than delusional ideation in general. However, subscales of the measure did predict anxious reactions in virtual reality, indicating a potential confound of anxiety in previous studies of delusions and need for closure. In sum, in this small sample, we found no exper-

imental evidence for a role for reasoning biases in the occurrence of nonclinical persecutory ideation.

The broad theoretical conclusion we draw from our questionnaire and experimental studies is that both processes occurring in emotional disorders and processes specific to psychosis contribute to persecutory ideation. However, it appears clear that emotion is the strongest predictor of nonclinical persecutory ideation. The contribution of anomalous experiences and reasoning processes to the prediction of persecutory ideation across the studies was clearly much less than that of emotion. Nevertheless, hallucinatory predisposition, a tendency to have low-level hallucinatory experiences, was associated with paranoia in both studies, and was the only variable specific to the prediction of persecutory ideation. The evidence for the contribution of reasoning processes to the prediction of nonclinical persecutory ideation was especially weak. Perhaps part of the answer to the question of the difference between the nonclinical paranoia assessed in the study and clinical symptoms found in patient groups may lie in these findings. The study participants may be protected against the emergence of persecutory delusions by the absence of extreme reasoning biases.

The research described has been about not only trying to explain persecutory ideation but also the methodologies to achieve this. We consider that virtual reality can be a significant research tool in developing the understanding of persecutory ideation and may be applied to other clinical phenomena (e.g., Pertaub et al., 2001). Another aspect of our approach to the psychology of paranoia that is evident in the two studies is that explanation of paranoid ideation by one psychological process has not been attempted. Yet it is clear from the analyses that only a modest amount of the variance in paranoia was explained. This indicates that other potential explanatory factors remain to be determined in the psychological understanding of paranoia. In future studies, other elements included in the multifactorial model of delusions will also need to be assessed. Finally, we note that in the studies, paranoid thoughts were assessed on a single dimension. However, it is a multidimensional experience (e.g., Kendler et al., 1983). It will therefore be important to assess separately the frequency, conviction, preoccupation, and distress associated with persecutory thoughts. It is plausible, although often overlooked, that different factors may contribute to different dimensions of delusional experience (Freeman and Garety, 2004). Explaining paranoia is complex, and multifactorial models of the kind we have been testing that explicitly address the different dimensions of delusional experience are required.

ACKNOWLEDGMENTS

REFERENCES

Beck AT (1976) *Cognitive Therapy and the Emotional Disorders*. New York: International Universities Press.

Bentall RP, Swarbrick R (2003) The best laid schemas of paranoid patients: autonomy, sociotropy and need for closure. *Psychol Psychother*. 76:163–171.

Boyce P, Parker G (1989) Development of a scale to measure interpersonal sensitivity. *Aust N Z J Psychiatry*. 23:341–351.

Broome MR, Brett C, Johns L, Wolley J, Peters PA, Garety PA, McGuire PK (2003) Cognitive biases and delusion formation in the "at risk mental state" for transition to psychosis. *Schizophr Res*. 60:12.

Bunney WE, Hetrick WP, Bunney BG, Patterson JV, Jin Y, Potkin SG, Sandman CA (1999) Structured interview for assessing perceptual anomalies (SIAPA). *Schizophr Bull*. 25:577–592.

Colbert SM, Peters ER (2002) Need for closure and jumping-to-conclusions in delusion-prone individuals. *J Nerv Ment Dis*. 190:27–31.

Cruz-Neira C, Sandin DJ, DeFanti TA (1993) Surround-screen projection-based virtual reality: The design and implementation of the CAVE. *ACM Comput Graphics (SIGGRAPH) Proc*. 27:135–142.

Dudley REJ, John CH, Young AW, Over DE (1997) Normal and abnormal reasoning in people with delusions. *Br J Clin Psychol*. 36:243–258.

Fenigstein A, Scheier MF, Buss AH (1975) Public and private self-consciousness: Assessment and theory. *J Consult Clin Psychol*. 43:522–527.

Fenigstein A, Vanable PA (1992) Paranoia and self-consciousness. *J Pers Soc Psychol*. 62:129–138.

Freeman D, Dunn G, Garety PA, Bebbington PE, Slater M, Kuipers E, Fowler D, Green C, Jordan J, Ray K (2005) The psychology of persecutory ideation I: A questionnaire study. *J Nerv Ment Dis*. 193:302–308.

Freeman D, Garety PA (2000) Comments on the content of persecutory delusions: Does the definition need clarification? *Br J Clin Psychol*. 39:407–414.

Freeman D, Garety PA (2004) *Paranoia: The Psychology of Persecutory Delusions*. Hove: Psychology Press.

Freeman D, Garety PA, Kuipers E, Fowler D, Bebbington PE (2002) A cognitive model of persecutory delusions. *Br J Clin Psychol*. 41:331–347.

Freeman D, Slater M, Bebbington PE, Garety PA, Kuipers E, Fowler D, Met A, Read C, Jordan J, Vinayagamoorthy V (2003) Can virtual reality be used to investigate persecutory ideation? *J Nerv Ment Dis*. 191:509–514.

Garety PA, Freeman D (1999) Cognitive approaches to delusions: A critical review of theories and evidence. *Br J Clin Psychol*. 38:113–154.

Garety PA, Hemsley DR, Wessely S (1991) Reasoning in deluded schizophrenic and paranoid patients: Biases in performance on a probabilistic inference task. *J Nerv Ment Dis*. 179:194–201.

Jones PB, Croudace TJ (2000) The prediction of later psychosis in teenagers: Lessons from population-based research. Shizofrenija: od zgodnjih do poznih epizod. Zbornik predavanj. Zdruzenje psihiatrov Slovenije, Ljubljana.

Jones P, Rodgers B, Murray R, Marmot M (1994) Child developmental risk factors for adult schizophrenia in the British 1946 birth cohort. *Lancet*. 344:1398–1402.

Kendler KS, Glazer WM, Morgenstern H (1983) Dimensions of delusional experience. *Am J Psychiatry*. 140:466–469.

Kruglanski AW, Webster DM, Klem A (1993) Motivated resistance and openness to persuasion in the presence or absence of prior information. *J Pers Soc Psychol*. 65:861–876.

Launay G, Slade P (1981) The measurement of hallucinatory predisposition in male and female prisoners. *Pers Individ Diff*. 2:221–234.

Lovibond PF, Lovibond SH (1995) The structure of negative emotional states: comparison of the depression anxiety stress scales (DASS) with the Beck depression and anxiety inventories. *Behav Res Ther*. 33:335–343.

Maher BA (1974) Delusional thinking and perceptual disorder. *J Individ Psychol*. 30:98–113.

Pertaub D-P, Slater M, Barker C (2001) An experiment on public speaking anxiety in response to three different types of virtual audience. *Presence Teleoperators Virtual Environ*. 11:68–78.

Slater M, Steed A, McCarthy J, Maringelli F (1998) The influence of body movement on subjective presence in virtual environments. *Hum Factors*. 40:469–477.

SPSS (2000) *SPSS Base 10.0 User's Guide*. Chicago (IL): SPSS Inc.

Watson D, Friend R (1969) Measurement of social-evaluative anxiety. *J Consult Clin Psychol*. 33:448–457.

APPENDIX

Items in the VR Questionnaire

Persecutory items:

Someone in the room was hostile towards me.

Someone in the room would have harmed me in some way if they could.

Someone in the room had it in for me.

Someone in the room was trying to make me distressed.

Someone in the room had bad intentions towards me.

Neutral items:

The people in the room were neutral towards me.

The people in the room did not have any intentions towards me.

The people in the room were unconcerned by my presence.

I wasn't really noticed by the people in the room.

The people in the room had no particular feelings about me.

Positive items:

The people in the room were friendly towards me.

The people in the room were pleasant people.

The people in the room were trustworthy.

The people in the room had kind intentions towards me.

I felt very safe in their company.