CAN VIRTUAL REALITY BE USED TO UNDERSTAND PERSECUTORY DELUSIONS?

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This thesis focuses on understanding persecutory delusions from an interpersonal perspective. It is divided into three parts. Part I provides a critical review of the literature on interpersonal processes in paranoia by discussing theoretical approaches and the empirical evidence. The evidence is reviewed in five areas: interpersonal life events, attachment, relational schemas, social cognition and interpersonal behaviour. Part II describes an empirical investigation on persecutory delusions under controlled laboratory conditions. Virtual reality (VR) has previously been used to study paranoid ideation in non-clinical individuals and in individuals at high risk of psychosis. The current study is the first to investigate the applicability of the method to people with current persecutory delusions. Its main aims were to assess the acceptability and safety of using VR with individuals with persecutory delusions and to determine whether they experienced paranoid thoughts in VR. Lastly, part III is a critical appraisal of the research process. The challenges and opportunities of using a novel technology with a clinical population who has severe psychopathology are discussed. The thesis ends with a reflection on how my understanding of paranoia has evolved as a result of conducting this work.

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ABSTRACT

Persecutory delusions can be conceptualised as beliefs about the intentions of others. Contemporary models of persecutory delusions have different approaches to understanding interpersonal processes in paranoia. The current paper provides a critical review of the theoretical approaches and the empirical evidence on interpersonal processes across the continuum of paranoia. The three main models of persecutory delusions (Bentall and colleagues' *Delusions-as-defence model*, Freeman and Colleagues' *Threat anticipation model* and Trower and Chadwick *Interpersonal theory of the self*) propose that the social environment is involved in the development of persecutory delusions but they put forward different mechanisms to explain this. The evidence on interpersonal processes is organised in five main areas: interpersonal life events, attachment, schematic beliefs about relationships, social cognition and interpersonal behaviour. The review concludes with a summary of the evidence in relation to the three theoretical approaches, a discussion of methodological issues and the implications for future research.

INTRODUCTION

Persecutory delusions have been recently defined using two main criteria: the individual believes not only that "harm is occurring, or going to occur, to him or her" but also that "the persecutor has the *intention* to cause harm" (Freeman & Garety, 2000). In other words, the belief that the Earth is in danger of being hit by a meteorite would not qualify as persecutory ideation (Bentall, Corcoran, Howard, Blackwood and Kinderman, 2001). This definition highlights that an intentional agent is a core part of a persecutory delusion, and it is perhaps this interpersonal theme of paranoia[1] that has fuelled attempts to understand the meaning of symptoms of psychosis originally labelled as "incomprehensible" (Berrios, 1991; Jaspers, 1913).

Initial psychoanalytic views proposed that persecutory delusions could be understood as projection: self-inadequacies and an unfulfilled longing for another person are proposed to result in a transformation of affect *"I do not love him. I hate him, he hates me"* (Freud, 1910/2002 in Lacan, 1993). More recently, the meaning of persecutory delusions has been understood in the context of life events and conscious beliefs about self and others (Freeman, Garety, Kuipers, Fowler & Bebbington, 2002; Garety, Kuipers, Fowler, Freeman & Bebbington, 2001; Morrison, Frame & Larkin, 2003). Moreover, there is a common recognition among models of persecutory delusions that this phenomenon lies on a continuum with normality and that therefore the study of paranoid ideation reported by the general population in relation to everyday interactions with people is likely to inform the development of cognitive models of the clinical symptoms (Bentall, et al,. 2001; Fenigstein & Vanable, 1992; Freeman et al., 2002; Freeman et al., 2005).

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[1] The term 'persecutory delusion' and 'paranoia' are used inter-changeably in this review. Sub-clinical paranoia and sub-clinical persecutory ideation are used to refer to this phenomenon in non-clinical samples.

However, contemporary models of persecutory delusions have different approaches to understanding interpersonal issues in paranoia (Bentall, et al,. 2001; Freeman, et al. 2002; Morrison et al., 2003; Trower & Chadwick, 1995). The contribution of interpersonal life events to the development and maintenance of persecutory delusions is implied by the different models, but theoretical accounts of the nature of this hypothesised association vary. The interpersonal mechanisms put forward in the literature include schematic beliefs about self as vulnerable and others as hostile (Fowler et al., 2006; Freeman, et al. 2002; Smith et al., 2006), attribution of blame to others to defend against unstable self-esteem (Bentall et al., 2001), insecure and alienation threats to self construction from others (Trower & Chadwick, 1995) and the belief that paranoia is a useful strategy to avoid aversive interpersonal events (Morrison, et al., 2003; Morrison et al., 2005).

The aim of this paper is to critically review the theoretical approaches and the empirical evidence on interpersonal processes in paranoia. Recent reviews evaluate a broader range of psychological mechanisms, ranging from reasoning biases and anomalous experiences to general affective processes that are included in multifactorial models of persecutory delusions (Bentall et al., 2001; Freeman, 2007). The present paper narrows the focus to interpersonal processes in order to review data on an aspect of paranoia that has attracted interest but that has been investigated in a fragmented manner. Increasing our understanding of interpersonal processes in paranoia could also inform clinical interventions, as core relational schemas and interpersonal behaviour are regular ingredients in clinical formulations of symptoms of psychosis within Cognitive-Behavioural Therapy and Family Interventions (Barrowclough & Tarrier, 1998; Bebbington & Kuipers, 1994; Freeman & Garety, 2002; Garety et al., 2001; Haddock & Tarrier, 1998).

The review is organised as follows. The first section describes how interpersonal processes are understood within current models of paranoia. A summary of the evidence follows in section two, which is divided into studies investigating life events, attachment, cognitive factors influencing social perception, interpersonal beliefs and behaviour. The final section provides a theoretical integration and suggestions for future research. The questions which the review will address are:

1)   Is there an association between interpersonal life events and persecutory delusions?

2)   Is there evidence of characteristic insecure attachment patterns among people with persecutory delusions?

3)   Are persecutory delusions associated with dysfunctional schematic beliefs about others and relationships?

4)   Does social cognition(e.g. theory of mind, attributional biases) contribute to persecutory delusions?

5)   Is there evidence that people with paranoia exhibit specific interpersonal behaviours?

The review includes studies with samples of (1) people with psychosis who have persecutory delusions and (2) healthy volunteers with subclinical levels of paranoia. Studies with samples of people with psychosis were only included if persecutory delusions or subclinical paranoia were specifically investigated as a subgroup. A PsycINFO search was undertaken using the keywords *paranoia, persecutory delusions, psychosis, trauma, attachment, schemas, interpersonal problems*, and further studies were identified from reference lists of relevant studies.

THEORETICAL REVIEW: INTERPERSONAL PROCESSES IN CURRENT COGNITIVE MODELS OF PERSECUTORY DELUSIONS

This first section discusses the role of interpersonal processes in three main models of persecutory delusions. After a discussion of the current emphasis on the role of the social environment in psychosis, the core elements of each model are then described alongside the proposed mechanisms linking environmental interpersonal events and persecutory delusions.

The social environment and psychosis

Current models of psychosis implicate the social environment in the development and maintenance of psychotic symptoms (Bentall et al., 2001; Freeman et al., 2002; Garety et al., 2001; Morrison et al., 2003; Trower & Chadwick, 1995). Bowlby (1982) originally proposed that early childhood attachment shapes the representations of self and others that he labelled "internal working models". *Secure* attachment is characterised by both autonomy and the ability to have close relationships. However, when the infant's emotional behaviour does not elicit contingent responses from caregivers, insecure attachment patterns are hypothesised to develop. *Preoccupied* (also referred to as anxious-ambivalent) insecure attachment refers to a sense of dependency on others and preoccupation with their approval, *fearful* (also called avoidant) attachment is used to describe apprehension and distress about relationships and fear of rejection, whereas in *dismissive* attachment the individual adopts defensive autonomy from others (Bartholomew,1990). Attachment styles have been shown to be relatively stable across the lifespan (Fraley, 2002). In a recent review of the role of attachment in psychosis, Berry, Barrowclough & Wearden (2007) found that people with psychosis showed a pattern of insecure attachment (dismissing and fearful-avoidant) in relation to healthy volunteers and people with affective diagnoses.

Other facets of the family environment have also been investigated. High levels of expressed emotion (criticism, hostility and emotional over-involvement) among caregivers have been found to increase the likelihood of psychotic relapse (Bachman et al., 2002; Bebbington & Kuipers, 1994; Butzlaff & Hooley, 1998; Wearden, Tarrier, Barrowclough, Zastowny & Rahill, 2000). People with psychosis are also more likely to report early experiences of parenting characterised by 'overprotection' and 'low care' than healthy controls (Berry et al., 2007). In a large population study, Janssen et al. (2004) found that low parental care (but not overprotection) predicted onset of psychotic symptoms two years later. However, the effect of low parenting care on psychosis was eliminated when exposure to childhood trauma (defined as emotional, physical, psychological or sexual abuse before age 16 years) was taken into account.

In a recent review, Read, van Os, Morrison and Ross (2005) concluded that childhood abuse is involved in the aetiology of psychosis and more specifically, in auditory hallucinations. Prospective studies have shown evidence that trauma precedes the onset of psychotic symptoms (Janssen et al., 2004; Spauwen et al., 2006). There is also some evidence that the content of traumatic experiences, in particular childhood physical and sexual abuse, is related to the content of auditory hallucinations (Read, Agar, Argyle & Aderhold, 2003). More recently, Hardy et al. (2005) reported that thematic associations (e.g. humiliation, intrusiveness, threat) between traumatic events and auditory hallucinations were more frequent than specific content associations (e.g. literal correspondence between event and psychotic experience).

General social disadvantage has also been linked to psychosis. Exposure to a deprived urban environment in childhood and adulthood increases the risk of psychosis (Lewis et al., 1994; Mortensen et al., 1999) and higher incidence of schizophrenia has been specifically associated with increased socio-economic

inequality in an inner London borough (Boydell, van Os, McKenzie & Murray, 2004).

Bughra, Leff, Mallett & Derr (1997) have linked social adversity to an increased

risk of psychosis among immigrants (Boydell, et al., 2004; Harrison, Owens,

Holton, Neilson & Boot, 1988) with some ethnic minority groups (African-

Caribbean and Black Africans in the UK) showing a particularly high risk (Fearon et

al., 2006). Stressful life events have been found to precipitate and influence the

course of psychotic disorder (Bebbington et al., 1993; Romme & Escher, 1989).

Adverse interpersonal life events in which the person experiences victimisation,

hostility, powerlessness and deprivation are argued to promote paranoia (Bentall

et al., 2001; 2007; Freeman et al., 2001; Trower & Chadwick, 1995). Current

models of persecutory delusions acknowledge the role of interpersonal life events

in the development of paranoia but they focus on different aspects of

development and put forward different mechanisms for the association, including

insecure attachment patterns, impact of other people in constructing/threatening

a sense of self, theory of mind development and schemas about others and

relationships. Table 1 provides a summary of the interpersonal processes for each

of the models that are discussed in the next section.

Table 1   *Summary of interpersonal processes in current models of paranoia*

Model and authors	Influence of interpersonal life events	Hypothesised mechanisms of influence	Key interpersonal factors
Attributions-self-representation cycle Bentall et al., (2001)	· Adverse social environment involving victimisation, powerlessness and specific trauma · Adverse family relationships and deprivation	· Parental modelling of externalising attributional style · Defence of vulnerable self involves externalising blame and internalised success · Dismissive avoidant attachment style implicated in development of theory-of-mind · Theory-of-mind difficulties prevent adjusting situational explanations when externalising blame, so people are blamed instead	· Attributions of blame to another person but occasional self-blame · Preserved but unstable self-esteem · Dysfunctional defensive schemas for evaluating self-worth: 'autonomy from others' · Minimal 'actual-ideal self' discrepancies and high discrepancies between 'actual self-other self' (esp. parents' views about oneself)
The threat anticipation model of persecutory delusions Freeman et al., (2002)	· Adverse social environments including intrusive life events, hostile environments (e.g. bullying) and social isolation · Trauma · Unsupportive family environments	· Interpersonal anxieties and anticipation of threat interact with general reasoning biases to explain anomalous experiences · Theme of persecutory delusions directly reflects schemas (cognitive affective meaning) · Negative schemas about self and others are developed from adverse interpersonal life events	· Biased attention to social threat Negative schemas about other people as hostile/dangerous and self as vulnerable from others · Interpersonal safety behaviours maintaining paranoia include avoidance and escape from others, aggression, compliance · Interpersonal sensitivities and self-focus · Worry and beliefs about the usefulness of paranoia in interpersonal interactions
Interpersonal theory of the self Trower & Chadwick (1995)	· Parental style characterised by unavailability and neglect (poor me paranoia) · Parental style characterised by criticism and intrusiveness (bad me paranoia)	· The self is "constructed": the subjective self (agent) becomes an objective self by behaving for the other. Insecure attachment results in two types of vulnerability or threats to self-construction: If the person is vulnerable to rejection and indifference, the interpersonal strategy is "to pursue" but if the threat is of 'being taken over' by others the strategy is avoidance	*Poor me paranoia:* · Insecure threats to self from absence of others · High negative other-to-self and self-to-other evaluations *Bad me paranoia:* · Alienated threats to self from intrusive others · High negative other-to-self and low self-to-other evaluations

Attributions-self-representation cycle (ASRC) model of persecutory delusions

Bentall and colleagues (Bentall et al., 1991; Bentall, Kinderman & Kaney, 1994) proposed a motivational account of persecutory delusions. Building on Zigler & Glick's (1988) claim that paranoia is a form of camouflaged depression and on Winter & Neale's (1985) manic defence hypothesis, Bentall and colleagues argue that persecutory beliefs are an extreme form of a more general tendency to blame other people for negative events in order to maintain high self-esteem. Paranoia serves as a *defence* so that unwanted feelings of inadequacy remain out of consciousness. Negative life events, particularly negative evaluations by others and failure experiences, that are likely to activate negative beliefs about the self, are said to trigger attributions of threatening events to the actions of the persecutor. Bentall et al., (1994) use Higgins's self-discrepancy theory (Higgins, 1987) to describe the mechanisms of this *defensive projection* in terms of a trade-off between self-representations. Discrepancies between the 'actual self' and the 'ideal self' that are characteristic of people with depression (Strauman, 1989; Scott & O'Hara, 1993) are avoided by attributing negative outcomes to others and positive events to one's own actions (self-serving bias). The negative consequence of this defensive manoeuvre is an increased discrepancy between the 'actual self' and the 'other actual self', which refers to beliefs about other's representations of the actual self (e.g. parental criticism).

Bentall et al. (2001) recently highlighted the instability of this defence mechanism and proposed that attributions and self-representations interact cyclically. This latest version of the model proposes that people with persecutory delusions generally attribute blame to other people but on occasions when negative self-representations are more consciously accessible (e.g. after a failure event), the defence mechanism fails and the individual self-blames, which in turn further

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reduces self-esteem. The only study to date assessing attributional lability found an increase on internalisation of blame after participants were exposed to a mild stressor (anagram task) in both paranoid and depressed participants whereas there was no change in attributions among healthy volunteers (Bentall & Kaney, 2005).

Bentall, Fernyhough, Morrison, Lewis & Corcoran (2007) advocate using a developmental psychology framework to explain pathways to psychotic symptoms. They focus on the role of the social environment in shaping socio-cognitive development and highlight the Theory of Mind (ToM) construct (Bentall, et al., 2001; Bentall, 2003). ToM is defined as a mental activity involved in interpreting the behaviour of others in terms of intentional mental states (e.g. feelings, beliefs, goals). In a recent review, Fonagy, Gergely & Target (2007) concluded that secure attachment and Theory of Mind (ToM) flourish under parenting characterised by a tendency to attribute mental states to the infant accurately, tolerance and reflectiveness about affective states. Bentall & Kinderman (1999) suggested that ToM deficits could explain the paranoid personalising attributional bias: blame is placed on another person because situational factors are not taken into account. Bentall et al., (2007) also hypothesise that parental modelling might be implicated in the development of attributional biases in paranoia on the basis of literature on intergenerational similarities in attributional style in depression (e.g. Alloy et al., 2001).

The threat anticipation model of persecutory delusions

The second model proposes a non-defensive account of persecutory delusions (Freeman et al., 2002). Persecutory delusions are conceptualised as threat beliefs that directly reflect the person's views of the self and other people. Anxiety, an emotion that evolves around the anticipation of danger, is put forward as a key

emotion in the formation and maintenance of paranoia. Moreover, anxiety, interpersonal sensitivity and depression are thought to be directly associated with the content of persecutory delusions, such as viewing oneself as a vulnerable target and other people as hostile. Data gathering biases associated with psychosis influence a search for meaning that is triggered by anomalous experiences or ambiguous social information. The threat belief is maintained by a failure to generate alternative explanations and a confirmatory bias (Freeman, Garety, McGuire & Kuipers, 2005). Safety behaviours are actions carried out with the aim of reducing the perceived threat (e.g. withdraw from feared persecutor) which prevent disconfirmation of beliefs (Freeman, Garety & Kuipers, 2001; Salkovskis, 1991).

Early adverse experiences and stressful life events are argued to shape the content of psychotic symptoms (Freeman et al., 2002; Garety et al., 2001; Morrison et al., 2003). The themes of psychotic symptoms are regarded as representations of cognitive affective meaning or schema that people use to make sense of the self and the world (Garety et al., 2001). In the case of paranoia, Freeman et al., (2002) propose that negative schemas about the self (e.g. vulnerable, powerless) and others (e.g. hostile) develop from adverse interpersonal experiences and can remain accessible in the current adverse environment. In this context, paranoid thoughts are also maintained by meta-cognitive beliefs about paranoia being a 'survival strategy' (e.g. "bad things happen, so it helps to be paranoid") and about the uncontrollability of worrying about threat (Freeman & Garety, 1999; Morrison et al., 2003).

An interpersonal theory of the self: poor me and bad me paranoia

Trower & Chadwick (1995) propose an understanding of persecutory beliefs in the context of an interpersonal theory of the self. Some people with persecutory delusions are said to believe that they do not deserve to be persecuted. This 'poor me' paranoia is characterised by seeing oneself as an innocent victim while condemning others for the persecution. Trower and Chadwick (1995) suggest that 'poor me' paranoia is a reflection of an *insecurely constructed self*. The threat to the self comes from the lack of an *objectifying other*, the defence involves transforming indifference or rejection into *persecution*. As a result, the individual maintains high self-esteem, feels anger and views the persecutor as bad and inferior.

However, these authors report that there is a proportion of people with persecutory delusions who behave more like depressives: they tend to have low levels of self-esteem and they blame themselves rather than others. In 'bad me' or punishment paranoia, the individual states that s/he is deservedly punished for previous misdemeanours and feels guilty. Feelings of worthlessness are associated with perceived disapproval. This reflects an *alienated self* that passively receives negative self-labelling imposed by the *other*.

Trower & Chadwick (1995) argue that 'poor me' paranoia arises from a preoccupied attachment pattern. Paranoia is a coping mechanism against dependency and fear of abandonment from others. The presence of persecutor's intentions helps to escape from "Sartre's existential pit of nothingness" (p.270) and to construct a sense of self. On the other hand, *fearful* attachment characterised by excessive intrusiveness and control from others is linked to 'bad me' paranoia. In this latter case, others are avoided because they are experienced as critical of the self.

How does the theory of two types of paranoia fit within the two previous models of persecutory delusions? Freeman et al. (2002) discuss Trower & Chadwick's (1995) theory in the context of understanding emotional distress in paranoia: people who believe they deserve to be persecuted ('bad me' paranoia) are likely to feel depressed and show low self-esteem. On the other hand, Bentall and colleagues view Trower and Chadwick (1995)'s theory of two types of paranoia as an alternative explanation to their "volatility" account for the inconsistent data on self-esteem. They suggest that longitudinal research would help to understand whether poor me and bad me paranoia correspond to two types of threats to the self to be found in different individuals as *traits* (Trower & Chadwick, 1995); or if the two types of paranoia are simply two different *states* in the attribution self-representation cycle. In the latter case the bad me paranoia phenomena would occur when external attributions for negative events occasionally fail to prevent negative self-evaluations from reaching consciousness.

EVIDENCE ON INTERPERSONAL PROCESSES IN PARANOIA

The majority of existing studies investigating interpersonal processes have focussed on the schematic beliefs and cognitive biases that are at the core of cognitive models of persecutory delusions introduced in the theoretical review (Bentall et al., 2001; Freeman et al., 2002; Chadwick, Birchwood & Trower, 1996; Trower & Chadwick, 1996). The evidence on interpersonal processes in paranoia summarised in this section is divided into five areas (life events, attachment, beliefs, social cognition and interpersonal behaviour).

Life events

Traumatic life events have been associated with hallucinations (Janssen et al., 2004; Read et al., 2005; Spauwne et al., 2006) but the evidence for delusions is less clear. In a study with people with a diagnosis of schizophrenia, Kilcommons & Morrison (2005) did not find an association between delusions and a history of physical or sexual abuse. However, Scott et al., (2007) recently analysed data from the 1997 National Survey in Australia (over 10,000 participants) and found that people who had been exposed to a traumatic event were more likely to report delusional experiences, an effect that was exacerbated among people who had developed post traumatic stress disorder (PTSD). The type of delusional experiences assessed included ideas of persecution but, like Kilcommons & Morrison (2005), no analyses were carried out on paranoia separately.

Table 2 includes a summary of studies investigating life events in paranoia. All studies are cross-sectional. Only one of the studies summarised in Table 2 specifically investigated the relationship between trauma history and paranoia. Gracie et al. (2007) found that paranoid thoughts were associated with having experienced a higher number of traumatic interpersonal events (e.g. sexual physical, emotional abuse in childhood and adulthood) in healthy volunteers. On the contrary, perceptual anomalies in response to environmental stimuli (e.g. hearing, sight) were only higher among those participants who had experienced sexual assault type of trauma in either childhood or adulthood. Gracie et al. (2007) concluded that these data suggests that the "sheer weight of adversity" (p.6), rather than specific types of trauma, contributes to persecutory thinking. War-related trauma research has however pointed at some specific associations between paranoia and traumatic stress disorder (PTSD). Sautter et al. (1999)

Table 2 *Studies investigating life events, trauma and stressors associated with paranoia*

Study	Participants	Assessment	Hypothesis relevant to paranoia & key findings
Campbell et al. (2007)	41 war veterans	Appraisals of combat trauma PTSD symptoms *Cross-sectional*	*Is there a relationship between trauma, appraisals and delusional ideation?* Negative post-trauma cognitions and dysfunctional beliefs about paranoia were associated with PTSD and delusions.
Chisholm et al. (2006)	36 people with schizophrenia or non-affective psychosis in remission (19 persecutory delusions)	Current symptoms of PTSD disorder *Cross-sectional*	*Are traumatic reactions a result of persecutory delusions?* Individuals with persecutory delusions did not show higher levels of PTSD than people with other delusion types. Among people with persecutory delusions (n=19), higher levels of PTSD symptoms were associated with higher perception of power in the persecutor, inability to cope, low ratings of control, greater awfulness of the threat and believing that the persecution was deserved.
Gracie et al. (2007)	228 healthy volunteers (students)	Traumatic life events PTSD symptoms *Cross-sectional*	*Are there specific mechanisms by which trauma impacts on predisposition to hallucinations and paranoia?* Number of traumatic events and negative schematic beliefs about self and others were most strongly associated with paranoia whereas re-experiencing symptoms of PTSD related more strongly to hallucinatory predisposition.
Melo et al. (2006)	44 people with persecutory delusions (26 'poor me'; 18 'bad me') 21 non-clinical controls	Daily Events Interview (in the last 2/3 weeks) *Cross-sectional*	*Are certain life events related to beliefs about the deservedness of persecution?* 'Bad me' paranoia group reported a higher number of 'failure' events than the 'poor me' and non-clinical groups. The 'poor me' had significantly more 'failure' events than controls. 'Poor me' paranoia group reported more 'loss of control' events than the other two groups. Deservedness of persecution was negatively correlated with 'loss of control' and 'rejection' daily events i.e. these type of life events were related to increased likelihood of 'poor me' paranoia.
Mirowski & Ross (1984)	463 healthy volunteers (residents Mexico/ US border)	Socio-cultural variables *Cross-sectional*	*Is socio-economic status associated with paranoia via alienation from others?* Structural equation model provided evidence consistent with the following hypothesis: Low socio-economic status is associated with powerlessness and victimisation which can lead to an external sense of control and mistrust. Although mistrust might be a useful strategy against victimisation, when combined with external locus of control it leads to paranoia.
Raune et al. (2004)	34 people with persecutory delusions with early psychosis (onset no longer than 12 months)	Stressful life events *Cross-sectional*	*Are there thematic links between life events and persecutory delusions?* Persecutory delusion theme is correlated with humiliating, intrusive and self-esteem impairing life events, but principal component analysis used to deal with overlap in themes of delusions (e.g. grandiosity and persecution) and life events (e.g. intrusiveness and loss) reveled that intrusive events, but not dangerous events, are associated with paranoia.
Sautter et al. (1999)	Veterans of Vietnam war 3 groups PTSD & psychosis (24) PTSD (22) Psychosis (16)	· Severity of PTSD · Violent thoughts, feelings and behaviour *Cross-sectional*	*Investigation of psychotic symptoms among people with combat-related PTS:* The group with PTSD and psychotic symptoms showed higher levels of symptoms of psychosis in general and paranoia in particular, reported more violent thoughts, feelings and behaviour and displayed higher general psychopathology than the two other groups.

found that paranoid thoughts and violent behaviour were higher among Vietnam veterans who presented to mental health services with symptoms that met the diagnostic criteria for both psychosis and post traumatic stress disorder (DSM-IV, in relation to participants who only met the criteria for one of the two diagnoses. More recently, Campbell & Morrison (2007) found that negative appraisals about combat-related trauma (e.g. negative views of the self) and dysfunctional beliefs about paranoia (e.g. paranoia as a survival strategy, paranoid thoughts being out of control) were associated with PTSD symptoms and with increased delusional thoughts as assessed by the Peters Delusions Inventory (Peters et al., 2004). These findings relate exclusively to combat-related type of trauma and, rather than providing evidence for a causal role of traumatic events in developing persecutory thinking, build on the literature pointing at co-morbidity of PTSD and psychotic symptoms (see Morrison et al., 2003 and Read et al. 2005 for recent reviews).

The nature of relationship between trauma, psychosis and PTSD is still a matter of debate, but Morrison and colleagues (Cambpell & Morrison, 2007; Morrison et al., 2003) proposed that psychosis and PTSD can be seen as part of a spectrum of responses to trauma with common cognitive and behavioural maintenance processes such as high levels of arousal, selective attention to threat, intrusive thoughts and safety behaviors, in particular avoidance. It is of note that these processes, alongside with dysfunctional beliefs about paranoia, have been specifically implicated in cognitive models of persecutory delusions (Bentall et al., 2001; Freeman et al., 2002; Morrison et al., 2005). Interestingly, Gracie et al. (2007) found support for two routes between trauma and predisposition to psychosis: re-experiencing symptoms of PTSD linked trauma and hallucinatory predisposition whereas negative schematic beliefs about self and other mediated the relationship between trauma and paranoia. The latter route indicates that

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negative beliefs about the self and others reflecting adverse social environments might bias interpretation of events as threatening and give raise to paranoid interpretations (Bebbington, et al., 2002; Freeman et al., 2002).

The data summarised on Table 2 suggest that there is more consistent evidence on thematic links between life events and paranoia. Interpersonal themes emerging from these studies include powerlessness of self in relation to the persecutor, humiliation, intrusiveness, lack of control and victimization (Chisholm et al., 2006; Melo et al., 2006; Mirowski & Ross, 1984; Raune, Bebbington, Dunn & Kuipers, 2006). Intrusive life events had previously been found to be more commonly experienced by people with psychosis than by non-clinical controls (Harris, 1987). Raune et al. (2006) define intrusive events as events that *"involve interference and attempted control of the person by outsiders or people where there is no evidence of closeness.... (and can involve)... harmful consequences, and will be often committed by a figure of authority"* (p.224). These thematic links highlight the role of experiencing interpersonal events in which other people can be perceived as hostile and threatening and one has little control of power to face such threats (Bentall et al., 2001; Freeman et al., 2002). Two recent qualitative studies on the phenomenology of persecutory delusions reported that negative interpersonal experiences (examples given include betrayal events) and past violence were identified as influences on current paranoid thinking (Boyd & Gumley, 2007; Campbell & Morrison, 2007).

Attachment

After a review of the evidence on insecure attachment patterns in people with paranoia, the following section discusses evidence of dysfunctional schematic

beliefs about the self and others that have been hypothesised to bridge environmental experiences and psychotic symptoms.

Insecure attachment patterns figure among the mechanisms that have been put forward to explain links between social adversity and the development of psychotic symptoms. There is evidence that insecure attachment is common among psychiatric, and in particular, psychotic samples (Berry et al., 2007), but data pointing at a specific association between persecutory delusions and disrupted attachment are meagre. Berry, Wearden, Barrowclough & Liversidge (2006) recently conducted an Internet study in which 323 healthy volunteers completed measures on attachment style, interpersonal experiences and measures of schizotypy, which included the Paranoia Scale (Fenigstein & Vanable, 1992). Higher paranoia scores were positively associated with attachment anxiety items (e.g. "I frequently ask other people to reassure me that they care about me") and other-avoidance items (e.g. " I try to cope with stressful situations on my own") in a new measure specifically developed for people with psychosis (Psychosis Attachment Measure). Correlations were stronger for the attachment anxiety items than for avoidance, and remained significant after controlling for negative affect. However, paranoia was not the only sub-clinical psychotic phenomenon associated with attachment difficulties. After controlling for negative affect, predisposition to hallucinations was also significantly associated with attachment anxiety whereas social anhedonia increased with avoidant attachment behaviour. The cross-sectional design of this study limits conclusions about the causality and the findings need to be considered as informative of subclinical paranoia in a sample of healthy volunteers, who are likely to have less interpersonal difficulties. Nevertheless, the finding that attachment anxiety and avoidance are, albeit not exclusively, related to paranoid ideation supports the notion that persecutory

delusions can be conceptualised within interpersonal processes influencing

thinking and behaviour. Further evidence comes from a study on perceptions of

parental bonding in childhood and early adulthood in groups of people with

current persecutory delusions, remitted persecutory delusions and non-clinical

controls (Rankin, Bentall, Hill & Kinderman, 2005). Currently ill and remitted

paranoid participants reported low parental care and overprotectiveness in

childhood in relation to healthy volunteers. A standardised retrospective interview

on parental behaviours also revealed that both clinical groups experienced more

criticism, discord, influence (defined as intrusive attempts to influence the

children without negotiation) currently, and during early adulthood (16-20 year

age period). Remitted and currently paranoid participants also reported less

mutually satisfactory intimate relationships with their parents than the non-

clinical group. Rankin et al. (2006) conclude that the finding that negative

parental relationships were reported in both remitted and currently paranoid

people with psychosis suggest that dysfunctional parental interactions are not

solely a response to current disrupted interpersonal behaviour associated with

active paranoia but could potentially be involved in the development of

persecutory delusions. However, the authors acknowledge that the study does not

show evidence that reported family relationships are exclusive to paranoia. The

lack of other control groups (e.g. psychosis group without paranoia, affective non-

psychotic disorder) precludes from concluding that the observed pattern of

interactions is not a result of other underlying factors such as the experience of

caring for a relative with mental illness.

In sum, research on attachment and persecutory ideation is scarce and it seems

likely that patterns of insecure attachment are not an exclusive feature of

paranoid thinking. However, descriptions of low parental care, critical family

environments, over-intrusiveness and the resulting attachment style characterised by anxiety about others' approval and avoidance are coherent with theoretical models of paranoia (Bentall et al., 2001; Freeman et al., 2002; Trower & Chadwick, 1995). One of the hypothesised mechanisms by which attachment is argued to influence the development of paranoia is via schematic beliefs about the self and others. Platts, Mason and Tyson (2005) found evidence that insecure attachment was associated with maladaptive schemas in a psychiatric (non-psychotic) sample. Fearful attachment was associated with 'defectiveness/shame', 'social isolation' and 'emotional inhibition' maladaptive schemas whereas preoccupied attachment was linked to 'abandonment', 'subjugation' and 'emotional deprivation' dysfunctional schemas. Although no study to date has investigated associations between attachment style and schematic beliefs in psychosis, the most prolific area of research on interpersonal process in paranoia has been the study of beliefs, the cornerstone of cognitive approaches to psychopathology (Beck, 1964).

Beliefs about relatedness, self and others

Core beliefs about the self, others and relationships have been incorporated into models of persecutory delusions (Bentall et al., 2001; 2007; Chadwick, et al.,1996; Freeman et al., 2002; Trower & Chadwick, 1995). The studies reviewed in this section are organised in four main areas: evaluations about others, beliefs about others' evaluations of the self, beliefs about the self as a social object and evaluations about the value of relationships. As the focus is on interpersonal constructs, studies investigating self-esteem or global self-worth are excluded. A recent review of the literature on self-esteem concluded that, although there have been some reports of preserved self-esteem in people with persecutory delusions; paranoia tends to be associated with low self-esteem (see Freeman,

2007). It is beyond the scope of the present paper to discuss the psychometric

properties of each of the measures employed to assess schemas, but a brief

introduction of the main constructs assessed will be provided below. Table 3

shows a summary of the studies organised by the measure used to assess

interpersonal constructs. With the exception of three of the measures (Brief Core

Schema Questionnaire; Fowler et al., 2006; Evaluative Beliefs Scale; Chadwick,

Dagnan & Trower, 1999; and the Self and Other Scale; Dagnan, Trower & Gilbert,

2002) the measures were originally developed to investigate dysfunctional

interpersonal beliefs in depression, but have since been employed on people with

psychosis.

Evaluating others

Two measures have been used to assess beliefs about others in paranoia. The Brief

Core Schema Questionnaire (BCSS; Fowler et al., 2006) is a 24-item self-report

rating scale that assesses positive and negative schemas about the self (e.g. "I'm

vulnerable", "I am valuable) and others (e.g. "Other people are harsh", "Other

people are fair"). The scale was developed to assess beliefs concerning self and

others that are theoretically relevant to models of psychosis (Freeman et al.,

2002; Garety et al., 2001) and some of the items emerged from the authors'

clinical experience with people with persecutory delusions (Fowler et al., 2006).

The second measure is the Evaluative Beliefs Scale (EBS, Chadwick, et a., 1999),

an 18-item self-report measure that assesses themes identified by cognitive

models of depression and anxiety including worthlessness, unlovability, weakness,

badness, failure, and inferiority. Negative person evaluations are expressed in

three directions, depending on who is evaluating whom: self-to-self evaluations

(e.g. "I'm worthless"), self-to-other evaluations (e.g. "Other people are

worthless") and other-to-self evaluations (e.g. "People see me as worthless").

Table 3 shows that negative beliefs about others have been associated with persecutory delusions and high subclinical paranoia in healthy volunteers (Chadwick, Trower, Juusti-Butler & Maguire, 2005; Chadwick & Trower, 1995; Fowler et al., 2006; Smith et al., 2006). Although people with persecutory delusions as a whole report significantly more negative evaluations about others than depressed controls (Chadwick & Trower, 1997), a subgroup of people with 'bad me' paranoia was found to show a reduced tendency to negatively evaluate others than the 'poor me' paranoia subgroup (Chadwick et al., 2005). This latter finding provides support for Trower & Chadwick (1995)'s proposal that 'bad me' paranoia is characterised by guilt: the persecution is a deserved punishment and the persecutor is held in a positive light.

Other people evaluating the self

Research investigating whether paranoia merely reflects the content of schematic beliefs about the self and others, or serves a defensive function by externalising blame, has focussed on investigating self-evaluations whereas less attention has been paid to the views of other people about the self. Trower & Chadwick's (1995) interpersonal theory of paranoia proposes that this is a core feature of persecutory ideation, in which others fail to provide positive mirroring so that a sense of secure self can develop. In a recent study investigating the relationship between family attitudes and symptoms of psychosis, Barrowclough et al. (2003) found that parental criticism was associated with increased psychotic symptoms (hallucinations, delusions) via negative self-evaluations (this study did not analyse the impact on persecutory delusions separately). Table 3 however shows that people with persecutory delusions, like people with unipolar

Table 3   Studies investigating beliefs and attitudes towards others and relatedness

Study	Participants	Measures of interpersonal constructs	Key finding on interpersonal constructs

Schemas about self and others

Study	Participants	Measures of interpersonal constructs	Key finding on interpersonal constructs
Fowler et al. (2006)	· 252 non-affective psychosis · 754 NC	BCSS	Group with psychosis had extreme negative self and other schemas in relation to healthy volunteers. Multiple regression analyses revealed that in the non-clinical group, paranoia was predicted by negative schemas about others, reduced positive schemas about others, anxiety and negative self-schemas.
Smith et al. (2006)	· 100 non-affective psychosis (55 persecutory delusions)	BCSS	Negative schemas about self and others and low self-esteem were positively correlated with dimensions of persecutory delusions (severity, preoccupation and distress). Multivariate analyses revealed that negative schemas about self (but not negative schemas about others, self-esteem or depression) were independently and significantly associated with persecutory delusions.

Evaluations of self-other

Study	Participants	Measures of interpersonal constructs	Key finding on interpersonal constructs
Chadwick, et al. (2005)	· 53 PerDel (36 'poor me' paranoia;14 'bad me')	EBS	The 'bad me' paranoia group had lower self-esteem, more negative self-evaluations, lower negative evaluations about others, higher depression and anxiety than the 'poor me' paranoia group. Differences on self-evaluations remained after controlling for depression. Against predictions, the groups did not differ on anger.
Chadwick & Trower (1997)	· 23 PerDel · 22 depression · 22 NC	EBS	Paranoia group had higher negative self-other evaluations than the depressed and non-clinical groups. Both clinical groups reported more negative other-self evaluations (e.g. threat) than healthy volunteers. Negative self-self evaluation was highest among the depressed group, followed by the paranoia group, whose scores were also higher than the NCs.
Kinderman & Bentall (1996)	· 22 PerDel · 22 depression · 22 NC	PQQ	Group with persecutory delusions showed small discrepancies between how they described themselves (actual self) and how they'd like to be (ideal self) or should be (ought self) but reported marked discrepancies between their actual self and how they believed their parents saw them. Non-clinical participants showed fairly consistent actual-ideal-ought-parent-actual selves. Depressed group showed marked discrepancies between actual, ideal, ought selves and parental views of self. In the paranoid group (but not in the other two groups) parent-actual self descriptions were predominantly negative. Only 5% of the parental negative comments were related to mental health/psychiatric condition.
Gilbert et al. (2005)	· 71 clinical sample (includes depression, anxiety; excludes psychosis)	SC SPD	Paranoid ideation is associated with social anxiety and specifically social phobia (fear of scrutiny from others). After controlling for depression, regression analysis revealed that higher paranoia scores were predicted by social rank variables: more frequent submissive behaviours and viewing the self as *more* powerful than others.

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Table 3 Studies investigating beliefs and attitudes towards others and relatedness (cont.)

Study	Participants	Measures of interpersonal constructs	Key finding on interpersonal constructs
			Relational schemas
Valmaggia et al. (in press)	· 21 at risk of psychosis	IPSM	Persecutory ideation in a neutral virtual environment was associated with one aspect of interpersonal sensitivity: fragile inner self (but not with interpersonal awareness, need for approval, separation anxiety and timidity).
Freeman et al. (2005a)	· 327 NC	IPSM	Paranoid ideation was associated with interpersonal awareness, separation anxiety, timidity, fragile inner self. Stepwise regression analysis on paranoia scores revealed separation anxiety as the strongest predictor. Fragile inner self was also among the significant predictors.
Freeman et al. (2005b)	· 33 NC	IPSM	Persecutory ideation in a neutral virtual environment was associated with one aspect of interpersonal sensitivity: timidity (but not with interpersonal awareness, need for approval, separation anxiety and fragile inner self).
Freeman et al. (2003)	· 23 NC	BSI- IP	Interpersonal sensitivity was associated with paranoid ideation in a virtual environment.
Melo et al. (2006)	· 44 PerDel (26 'poor me' 18 'bad me) · 21 NC	SOS PSI	'Poor me' and 'bad me' groups scored significantly higher on alienation threat (SOS) and sociotropy (PSI) than healthy volunteers. The 'bad me' group (but not the 'poor me') scored significantly higher on frequency of insecurity threat than non-clinical participants. The 'poor me' (but not the 'bad me') reported higher autonomy scores than healthy volunteers. There were no significant differences between the two paranoia subgroups on any relational schemas.
Bentall & Swarbrick (2003)	· 33 PerDel (cu) · 34 PerDel (re) · 57 NC	PSI	People with current persecutory delusions scored significantly higher on dysfunctional autonomy schemas than the other two groups. However, these group differences disappeared when depression scores were entered as covariate, with depression having a significant effect on autonomy scores. There were no group differences on sociotropy schemas.
Ouimette, et al. (1994)	· 138 clinical (depression/ personality disorder; excl. psychosis)	PSI RDEQ	After controlling for depression, autonomy and criticism were significantly associated with paranoid traits (and also with all major personality traits. Diagnoses of paranoid and borderline personality disorder (DSM-III-R) were specifically associated with autonomy and criticism whereas diagnosis of histrionic, dependant and avoidant related to dysfunctional schemas of sociotropy and dependency.
Combs & Penn (2004)	· 60 NC	SSC	High subclinical paranoia group had significantly higher scores on public, private self-consciousness and social anxiety than low paranoia group.
vonGemmingen et al.(2003)	· 107 NC	SSC	Paranoia was correlated with private, public self-consciousness but not with social anxiety.
Smari et al.(1994)	· 30 PerDel	SSC	Social anxiety, private but not public self-consciousness correlated to paranoia scale scores.
Fenigstein & Vanable (1992)	· 581 NC	SSC	Paranoia is associated with public self-consciousness, even after controlling for the effects of private self-consciousness.

Table 3   Studies investigating beliefs and attitudes towards others and relatedness (cont.)

Study	Participants	Measures of interpersonal constructs	Key finding on interpersonal constructs
			Dysfunctional attitudes
Moorhead et al. (2005)	· 26 schizophrenia	DAS	Interpersonal schemas (love, approval) were significantly associated with thoughts of persecution and other psychotic phenomena (voices, passivity and thought disruption).The only dysfunctional schema uniquely correlated with paranoia was 'achievement'.
Rector (2004)	· 56 diagnosis of schizophrenia	DAS	After controlling for depression, paranoid ideation was uniquely associated with the interpersonal attitude of "need-for-approval" whereas negative symptoms of psychosis were related to dysfunctional attitudes towards performance.
Fear, Sharp & Healy (1996)	· 29 PerDel · 9 psychosis without PerDel · 20 NC ·	DAS	Total DAS scores were lower among non-clinical controls but did not significantly differed between groups with delusional disorder with or without persecutory delusions. There is no report of specific interpersonal schemas in the DAS.
Bentall & Kaney (1996)	· 10 PerDel and depression · 10 PerDel not depressed · 20 depression · 20 NC	DAS	Group with persecutory delusions and depression had higher scores on DAS than non-clinical controls. Depressed group had the highest scores. The two groups with persecutory delusions did not differed on DAS scores so the authors conclude that depression does not fully account for dysfunctional attitudes. There is no report of specific interpersonal schemas in the DAS.

PerDel: participants with persecutory delusions; NC: non-clinical participants

Measures: BCSS: Brief core schema questionnaire; EBS: Evaluative Beliefs Scale; SC Social comparison, SPD: social power differential

IPSM: Interpersonal sensitivity measure; SCS: Self-consciousness; SOS: Self and other scale; PSI: Personality style inventory; RDEQ: revised depressive experiences questionnaire; DAS: Dysfunctional Attitude Scale; BSI Brief symptom inventory- Interpersonal sensitivity; PQQ: Personal Qualities questionnaire

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depression, are more likely to believe that other people view them in a negative light than healthy volunteers (Chadwick et al., 2005; Chadwick & Trower, 1995; Kinderman & Bentall, 1996). Gilbert et al. (2005) also recently showed that paranoid ideation in a non-psychotic clinical sample was related to social anxiety and fears of scrutiny from others. Kinderman & Bentall (1996) in particular reported that both depressed and persecutory deluded groups showed high discrepancies between their actual sense of self and how they believed their parents saw them. In comparison, healthy volunteers did not show such discrepancies. Persecutory delusions were particularly associated with reports of predominantly negative parental descriptions.

The EBS (Chadwick et al., 1999) introduced in the previous section and the Personal Qualities Questionnaire (PQQ; Kinderman & Bentall, 1997) have been the two main measures used to investigate beliefs about "what other people think of me". The PQQ (Kinderman & Bentall, 1997) invites participants to generate attributes to describe the person they actually are (self-actual), would like to be (self-ideal), should be (self-ought) and attributes they believe reflect their parents' perceptions of them in a similar fashion (parent-actual, parent-ideal and parent-ought). Discrepancies between concepts are then calculated assessing the correspondence between attributes in the different categories (e.g. synonyms, antonyms). The PQQ is based on Higgins' (1987) self-discrepancy theory which proposes that awareness of discrepancies produces negative mood (depression or anxiety, depending on the type of discrepancy).

Awareness of self as a social object

An underlying theme of current models of paranoia is that interpersonal schemas are dysfunctional among people with paranoia. Hypotheses about heightened interpersonal sensitivities, need for others' approval, fear of being

overwhelmed by others' views of oneself and an avoidant/dismissive coping style are among the relational schemas that have been investigated in people with persecutory delusions (Bentall et al., 2001; Freeman et al., 2002; Trower & Chadwick, 1995). This section focuses on mere awareness of the self as a social object whereas the last section will discuss associations between paranoia and the value attached to interpersonal concerns.

The Interpersonal Sensitivity Measure (IPSM; Boyce & Parker, 1989) is a 36 item self-report measure assessing interpersonal awareness (e.g. " I worry about the effect I have on other people"), need for approval (e.g. "I will go out of my way to please someone I am close to), separation anxiety (e.g. "I worry about losing someone close to me), timidity (e.g. "I avoid saying what I think for fear of being rejected) and fragile inner self (e.g. "If other knew the real me, they would not like me"). This measure was developed to investigate the role of personality traits, in this case, interpersonal sensitivity, in depression. Boyce & Parker (1989) found that excessive awareness and sensitivity to the needs and behaviour of others in order to minimise criticism and rejection are prevalent in people with depression. Evidence summarised in Table 3 from healthy volunteers and people who are at risk of developing psychosis suggest that high paranoia is related to interpersonal sensitivities, in particular 'interpersonal awareness', 'separation anxiety', 'timidity' and 'fragile inner self' in the IPSM (Freeman et al., 2005a; Freeman et al., 2005b; Freeman et al., 2003; Valmaggia et al., in press).

Fenigstein et al. (1975) argue that public self-consciousness relates to Mead (1934)'s argument that "consciousness of self comes about when the person becomes aware of another's perspective...(and)... views himself as a social object, p. 525). The Self-Consciousness Scale (SCS; Fenisgtein, Scheier & Buss, 1975) is a

23-item scale that measures private self-consciousness, which involves awareness of inner aspects of the self, such as thoughts and feelings (e.g. "I'm alert to changes in my mood"), public self-consciousness, which involves awareness of the self as an object of awareness of others, in particular others' scrutiny of one's appearance (e.g. "I'm concerned about the way I present myself") and social anxiety (e.g. "I get embarrassed very easily"). Fenigstein et al. (1975) proposed that social anxiety develops when public self-consciousness is paired with anticipation of negative evaluations. Three studies with non-clinical samples (see Table 3) have found that high paranoia is associated with public self-consciousness (Combs & Penn, 2004; Fenigstein & Vanable, 1992; von Gemmingen, Sullivan & Pomerantz, 2003). However, Smari, Stefansson & Thorgilsson (1994) found that social anxiety and private self-consciousness but not public self-consciousness, were related to paranoia scores in people with persecutory delusions. Mittal and Balasubramanian (1987) noted that the public self-consciousness subscale focuses on appearance and style, which might be not a particularly concern for people with a diagnosis of schizophrenia.

Beliefs about the importance of relationships

This last section gathers evidence from studies using three measures. Two of them were developed to investigate beliefs relevant to depression (Dysfunctional Attitude Scale, DAS; Weissman & Beck (1978) and the Personal Style Inventory, PSI; Robins et al.(1994)) whereas the latter (Self and Other Scale, SOS; Dagnan, et al., 2002) was developed to assess social threats to self-construction in a range of disorders, including depression, social anxiety and paranoia.

The DAS (Weissman & Beck, 1978) contains 40 items that assess dysfunctional cognitive assumptions characteristic of depression in a range of domains including approval, love, achievement, perfectionism, entitlement, omnipotence and

autonomy. Examples of items assessing interpersonal dysfunctional beliefs include "My value as a person depends greatly on what others think of me" (Need for approval), "I cannot find happiness without being loved by another person" (Need for love).

The PSI (Robins et al., 1994) is a 48-item self-report measure which includes two subscales: sociotropy and autonomy. The sociotropy subscale include concerns about what others think (e.g. "I am easily persuaded by others"), dependency (e.g. "It's hard for me to break a relationship even if it is making me unhappy") and pleasing others (e.g. "I often put other people's needs before my own"). The autonomy items revolve around perfectionism/self-criticism (e.g. "It bothers me when I feel that I am only average and ordinary), need for control (e.g. "I am easily bothered by other people making demands on me") and defensive separation (e.g. "I tend to keep other people at a distance").

Lastly, the SOS (Dagnan, et al., 2002) is a 14-item self-report questionnaire that assesses frequency and endorsement intensity of two main threats to self construction. *Insecure self* items relate to fear of exclusion (e.g. "When I am alone I feel the need to contact someone") whereas *alienation self* items relate to fear of intrusion from others (e.g. "I can feel suffocated if I am too close to someone").

There is an overlap on the constructs assessed by these three scales. 'Need for approval and love' in the DAS (Weissman & Beck, 1978) resemble the 'sociotropy' subscale on the PSI (Robins et al., 1994) and the 'insecure threat' in the SOS (Dagnan, et al., 2002). The main underlying construct assessed by these three subscales is the need for other people's attention and approval. Similarly, the fear

of being overwhelmed by other people's attention is captured by the 'alienation threat' items in the SOS (Dagnan, et al., 2002) and by some of the components ('need for control' and 'defensive separation') in the autonomy scores in the PSI (Robins et al., 1994).

Data summarised in Table 3 suggest that people with persecutory delusions as a whole report a fear of over-intrusion from significant others (alienation threat in the SOS) in relation to healthy controls (Melo et al., 2006) but do not show significantly higher autonomy schemas in the PSI (Robins et al., 1994) than control groups after controlling for depression (Bentall & Swarbrick, 2003; Melo et al., 2006). However, Ouimette et al. (1994) found that both criticism and autonomy schemas were related to paranoid traits in a clinical non-psychotic sample (diagnosis of depression/ personality disorder). Ouimette et al. (1994) also conducted analyses controlling for depression but it is of note that autonomy schemas were also found to be higher among participants with borderline personality disorder. These apparently inconclusive findings of the SOS (Dagnan, et al., 2002) and the PSI (Robins et al., 1994) might be explained by the inclusion of the "perfectionism/self-criticism" element in the autonomy scale (PSI, Robins et al., 1994) which does not specifically assess the impact of other people's attention.

In terms of 'need for approval', two studies found an association between persecutory delusions and this type of interpersonal dysfunctional attitudes as assessed by the DAS (Moorhead et al., 2005; Rector, 2004). The picture provided by the other two other measures is less clear. Melo et al. (2006) found that their paranoid group scored higher on sociotropy schemas (dependency, pleasing others) than healthy volunteers but this finding was not supported by Bentall & Swarbrick

(2003). Similarly, insecure threat (fear of rejection) was only found to be higher among people with a 'bad me' paranoia subgroup in relation to non-clinical controls (Melo et al., 2006). Little support was provided for Trower & Chadwick's (1995) hypothesis that 'bad me' and 'poor me' paranoia are respectively associated with insecure and alienated threats to the self, as there were no differences between these subgroups on any of the relational schemas (Melo et al., 2006).

In sum, the studies reviewed in this section suggest that people with persecutory delusions tend to hold negative beliefs about others but also perceive that other people evaluate them negatively. The latter might be related to a sense of alienation or feeling that others are over-intrusive. There is mixed evidence for the hypothesis that people with paranoia have insecurity in the social arena, show dependency or need others' approval more than healthy volunteers. These data will be discussed in relation to current cognitive models after studies investigating social cognition and interpersonal behavior in paranoia are reviewed.

Social cognition and reasoning biases

Current cognitive models of paranoia have suggested that biases in social information processing are involved in the formation and maintenance of persecutory delusions (Bentall et al., 2001; Freeman et al., 2002). In the interpersonal domain, biases in attributional style characterised by blaming other people for negative events have been investigated, with mixed results. Qualitative analyses of spontaneous attributions and on the type of information gathered on an inductive reasoning task have shown that people with paranoia have a preference for other-person information when compared to healthy volunteers (Lee, Randall, Bentall, 2004; Merrin, Kinderman & Bentall, 2007). People with

persecutory delusions were originally shown to have a personalising bias when compared to healthy volunteers (Kinderman & Bentall, 1997) and high trait paranoia has also been associated with this personalising bias in non-clinical samples (Kinderman & Bentall, 1996) but attempts to replicate these initial findings have been inconclusive (Humphreys & Barrowclough, 2006; Langdon, Corner, McLaren, Ward & Coltheart, 2005; Martin & Penn, 2002; McKay et al., 2005; Randall, Corcoran, Day & Bentall, 2003). Moreover, Diez-Alegria, Vazquez, Nieto-Moreno, Valiente and Fuentenebro (2006) found that a personalising attribution bias was not specific to persecutory delusions, but common among people with any acute delusions. The role of co-morbid symptoms of depression and grandiosity on attributions has also been recently investigated. Jolley et al. (2006) found that an externalising attributional bias was only present among people with persecutory delusions who also had grandiose beliefs and Melo et al. (2006) similarly reported a bias towards externalisation of blame in people with 'poor me' paranoia but not among those with punishment or 'bad me' paranoia.

Theory of mind (ToM) deficits have also been linked to paranoia in a series of studies (Corcoran, Mercer & Frith, 1995; Corcoran et al., 1997; Craig, Hatton, Craig & Bentall, 2004; Frith & Corcoran, 1996; Harrington, Langdon, Siegert & Mcclure, 2005; Langdon et al., 2006; Randall et al., 2003; Russell et al., 2006) and Bentall and colleagues also found support for the hypothesis that ToM deficits are positively correlated with a personalising attributional bias for negative events (Kinderman, Dunbar & Bentall, 1998; Taylor & Kinderman, 2002; Randall et al 2003; but see also failures to replicate in Langdon et al., 2005).

However, ToM deficits are not always found in people with persecutory delusions (Drury, Robinson & Birchwood, 1998; Pickup & Frith, 2001; Walston et al., 2000)

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and they have also been specifically associated with negative symptoms of

psychosis (e.g. blunted affect) and thought disorder (e.g. Langdon et al., 1997;

Pickup & Frith, 2001; Sarfati & Hardy-Bayle, 1999; Sarfati et al., 1997). In fact,

people with persecutory delusions do not fail to understand that others have

intentions but instead tend to attribute malevolent intentions to others: they have

a tendency to "over-mentalize" (Frith, 2004). For instance, Blakemore, Sarfati,

Bazin &Decety (2003) found that people with persecutory delusions ascribe

intentions to non-contingent behaviour that healthy participants view as random

or mechanical. This tendency to over-attribute intentions to the actions of agents

could lead to paranoid delusions in everyday life situations (Frith, 2004).

Interpersonal behaviour

Dennis Comb, David Penn and colleagues (Combs, et al., 2007; Combs & Penn,

2004; Peer et al., 2004; Pinkham & Penn, 2006) have investigated the relationship

between social cognition and interpersonal behaviour in people with

schizophrenia. Pinkham & Penn (2006) found that interpersonal skill in a

conversation role-play exercise was explained by social cognition variables

(emotion perception, ToM, social knowledge) and Combs et al. (2007) reported

that after an intervention designed to improve social cognition, the treatment

group showed improvements on a range of cognitive measures (e.g. ToM, emotion

and social perception) and on social behaviour (e.g. increased social functioning

and reduced aggressive incidents) in relation to controls. Only two studies have

looked at paranoia specifically. Combs & Penn (2004) found significant differences

on actual social behaviour between people who are high versus those who are low

on subclinical paranoia. The high paranoia group sat significantly farther away

from the experimenter, showing social discomfort, and also spent a longer amount

of time reading the consent form than low scorers on the Paranoia Scale

(Fenigstein & Vanable, 1992). The first group also scored poorly on an emotion perception test and on an in vivo social perception task.

Both interpersonal skills and motivational factors (anhedonia, avolition) have been proposed to account for social impairments in schizophrenia (Bellack, Morrison, Wixted & Mueser, 1990). Social skills deficits that have been investigated in paranoia include the above-mentioned biases in interpreting social cues and emotion recognition (Bellack, Mueser, Gingerich & Agresta, 1997). There are however specific motivational factors driving the interpersonal behaviour of people with persecutory delusions. The Positive and Negative Syndrome Scale (PANSS; Kay, Fiszbein & Opler, 1987) distinguishes between passive social avoidance, which is related to negative symptoms such as avolition, and active social avoidance, in which the person chooses not to interact with other people out of fear or suspiciousness. In fact, actions designed to minimise perceived threat of persecution have been found to be highly prevalent among people with persecutory delusions (Freeman et al., 2001; Freeman et al., 2007). These safety behaviours include avoidance and active actions such as escaping the situation, help seeking and aggression (Freeman et al. 2001; 2007). In a similar vein, Gilbert and colleagues have proposed using ranking theory as a framework to understand the nature of the relationship between the individual and the persecutor in people with hallucinations and paranoia (Birchwood, Meaden, Trower, Gilbert & Plaistow, 2000). In ranking theory, social comparison and appraising the other person as more powerful promotes submissive behaviour towards the higher rank person. A recent study showed that the majority of people with persecutory delusions (80%) believe that the persecutor is more powerful than themselves (Green et al., 2006). Gilbert et al (2005) found that paranoid ideation in healthy volunteers was predicted by more frequent submissive behaviours and Allan & Gilbert (1997)

similarly found a high correlation between submissive behaviour and paranoid ideation and depressive symptoms in a mixed group of clinical participants. 'Bad me' paranoia has been particularly linked to higher compliance safety behaviours (Freeman et al., 2001). Recent research looking at persecutory delusions from an experiential perspective have also highlighted that people with paranoia attempt to minimise perceived threat with isolation, being vigilant to threat, hostility and fight or flight responses (Boyd & Gumley, 2007; Campbell & Morrison, 2007).

A recent national study of 1410 people with schizophrenia living in the community found that the six-month prevalence of violent behaviour was 19.1%, with around 4% of participants reporting serious violent behaviour (defined as assault resulting in injury or involving a lethal weapon, or sexual assault) (Swanson et al., 2006). Persecutory delusions/suspiciousness, as well as other positive symptoms of psychosis (e.g hostility, hallucinations, grandiosity and excitement) significantly increased the risk of minor and serious violence. Delusions in general had also been previously associated with higher rates of violence (Buchanan, 1997; Link, Andrews & Cullen, 1992; Monahan, 1992). Among the range of delusional beliefs, *perception of threat against the self*, delusions of misidentification and delusions of control have been found to increase the risk of violence in comparison to other psychotic symptoms (De Pauw & Szulecka, 1988; Link & Stueve, 1994; Swanson, Borum, Swartz & Monahan, 1996). Consistent with these data, 20% to 24% of participants with persecutory delusions reported using at least one safety behaviour involving aggression in the last month (Freeman et al. 2001; 2007). These included verbal confrontation and shouting at people believed to be persecutors and physical aggression towards inanimate objects belonging to the persecutor rather than more severe forms of violence. Aggressive safety behaviours were designed to reduce the likelihood of perceived threat.

Although not specifically looking at the role of persecutory delusions, two studies have investigated the function and precipitants of psychiatric inpatient aggressive behaviours in people with schizophrenia in general (Daffern, Howells & Ogloff, 2007; Whittington & Wykes, 1996). The most common function was to respond to approaches or physical contact by staff, frustration and activity demands. Some aggressive incidents occurred in the absence of apparent aversive stimulation. These "unprovoked" incidents could have been triggered by internal anomalous experiences (e.g. hallucinations) or misinterpretation of non-aversive staff behaviour (Whittington & Wykes, 1996). Daffern et al., (2007) also found that anger expression, punishing others perceived as provocative and maintaining social status were among common functions of aggression.

SUMMARY AND CONCLUSIONS

The current paper has reviewed the theory and evidence on interpersonal process on persecutory delusions in five main areas: life events, attachment, schemas, social cognition and interpersonal behaviour. This final section starts with summarising the answers to questions that have been addressed in the review. After a brief discussion of methodological limitations, the conclusions are discussed alongside implications for further research. The review ends with a discussion on clinical implications.

Five questions on interpersonal process in paranoia: summary of the evidence

Table 4 provides a summary of the evidence reviewed and highlights the relevance of the findings for the three models of persecutory delusions (see also Table 1 for original hypotheses). Overall, the findings are consistent with hypotheses that are often shared between the three models.

Adversity, and in particular life events characterised by themes such as humiliation and intrusiveness, have been associated with persecutory delusions. In particular, low parental care and parental criticism have been linked to paranoid beliefs. There is also some preliminary data suggesting that negative schemas about others might mediate the relationship between trauma and paranoia, supporting Freeman et al.'s (2002) hypothesis about direct associations between psychotic phenomena, previous experiences and beliefs about the world. Data on schemas about others provides further support: paranoia is associated with seeing others in a negative light and by believing that other people view one critically.

Healthy volunteers who are high on trait paranoia have also been shown to have attachment anxiety characterised by need for others, fear of rejection and need for reassurance, which features characteristics of both *preoccupied* and *fearful* attachment styles (Bartholomew, 1990). Similarly, schematic beliefs about relatedness in people with persecutory delusions show, although not consistently, a tendency to report dependency and need for approval from others in relation to non-clinical groups.

Trower & Chadwick's (1995) unique proposition that people with persecutory delusions face a fear of alienation from excessive attention from others is backed by the data on attachment and beliefs. The review of the evidence suggests that over-protection, criticism, and attachment style characterised by avoiding others due to apprehension about close relationships were related to paranoia. There was however little support for Trower & Chadwick's (1995) proposal that 'poor me' and 'bad me' types of paranoia were specifically associated with parental style characterised by neglect and intrusiveness respectively. On the contrary, it seems that both types of insecure attachment patterns and the corresponding threats to self construction are important in making sense of interpersonal

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Table 4   Summary of evidence reviewed and coherence with the three models of paranoia

Five domains	Findings	Attributions-self-representation model Bentall et al., (2001)	The threat anticipation model Freeman et al., (2002)	Interpersonal theory of the self Trower & Chadwick (1995)
Life events	· Adversity (num. of traumatic events)	√	√	√
	· War-related trauma	√	√	-
	· Life events involving experiences of powerlessness, humiliation, intrusiveness, lack of control and victimization	√	√	√
	· Negative beliefs about others mediate trauma and paranoia	-	√	-
Attachment	· Attachment anxiety (need for others, reassurance, fear of rejection)	-	-	√
	· Parental over-protectiveness	-	-	√
	· Other-avoidance attachment style	√	-	√
	· Parental criticism	√	√	√
	· Low parental care	√	√	√
Schemas	· Negative views of others	√	√	√
	· Belief others evaluate the self negatively	√	√	√
	· Heightened interpersonal awareness	√	√	√
	· Alienation threat: others are over-intrusive	-	-	√
	· Insecurity threat: fear of rejection	-	-	√
Social cognition	· Some (inconsistent) evidence for a personalising attribution bias	√	-	-
	· ToM: bias or over-attribution of intentionality	√	-	-
	· Personalising attributions and ToM are related	√	-	-
Behaviour	· Suspicious social behaviour (distancing, caution)	-	√	-
	· Safety behaviours: avoidance, escape, help seeking, aggression	-	√	-
	· Submissive behaviour	-	√	-

√: Indicates piece of evidence is consistent with hypotheses in the model
- : Indicates piece of evidence does not relate to specific hypotheses in the model or is not inconsistent with the model
√: Indicates a unique prediction of the model in relation to the other two that is supported by evidence

processes in people with persecutory delusions. In fact, the longitudinal study by

Melo et al. (2006) found that beliefs about deservedness of persecution were

unstable across time and different rates of 'poor me' and 'bad me' paranoia have

been reported in early psychosis in relation to more chronic samples (Chadwick &

Trower, 1995; Chadwick, et al., 2005; Fornells-Ambrojo & Garety, 2005; Freeman

et al., 2001; Green et al., 2006; Peters & Garety, 2006; Startup, Owen, Parsonage

& Jackson, 2003).

Bentall and colleagues' distinctive contribution to understanding interpersonal

processes in paranoia has been to highlight social information processing biases

(Bentall et al., 1991; 1994; 2001). The evidence is not conclusive, but there is

some indication that people with persecutory delusions show a personalising

attribution bias, which could be accounted for by difficulties in understanding the

intentions of others, or more likely, by a tendency to over-attribute intentions to

non-contingent behaviour (Frith, 2004).

Lastly, Freeman et al.'s (2002) original work on safety behaviours, such as

avoidance, aggression and compliance, that aim to reduce the perceived the

social threat, draw attention to the behavioural dimension of paranoia. These

behaviours not only prevent disconfirmation of beliefs but also are likely to elicit

responses in others that serve to perpetuate previous suspicions.

Methodological issues

There are a number of methodological limitations on the evidence reviewed that

prevent making strong causal inferences about interpersonal factors involved in

persecutory delusions. The vast majority of the studies are cross-sectional and

assess life events, trauma and parenting during childhood retrospectively. Although it is of note that Chisholm et al. (2006) did not find that traumatic reactions were a result of experiencing persecutory delusions, it is possible that schematic beliefs and/or current persecutory delusions might have influenced perceptions and reports of past traumatic events and current relationships (Berry et al., 2007; Gracie et al., 2007). Moreover, the experience of psychosis itself is likely to influence relationships and attachment behaviour.

Recent research on early psychosis suggests that expressed emotion in family members (rejection, over-protectiveness) is a reaction to the onset of psychosis, rather than a trait of family members (McFarlane & Cook, 2007) and feelings of loss following onset of psychosis have been linked to over-involvement in carers of people with early psychosis (Patterson, Birchwood & Cochrane, 2000). There is only one study in the review (Bentall & Swarbrick, 2003) that included a control group of people with remitted persecutory delusions, which again prevents the remaining studies from making causal inferences, as it is not possible to establish if active paranoia was behind the interpersonal biases reported. Longitudinal research will be needed to establish if the adverse experiences and other interpersonal processes identified in this review have a causal role in the development of persecutory delusions. Lastly, conclusions about causality can only be tentatively drawn since there is no strong evidence on the specificity of interpersonal difficulties in paranoia. For instance, insecure attachment has been reported in psychotic samples and other psychiatric conditions (Berry et al., 2007), theory of mind difficulties are related to other symptoms of psychosis and developmental disorders such as autism (e.g. Langdon et al., 1997) and in some cases dysfunctional interpersonal schemas are shared by samples with unipolar

depression (e.g. Chadwick & Trower, 1995) or seem to be accounted for by depressed mood in people with persecutory delusions (Bentall & Swarbrick, 2003). Moreover, the role of co-morbid symptoms of psychosis (e.g. grandiosity) might be key in understanding cognitive biases once thought to be linked to persecutory delusions (Jolley et al.,2006).

Conclusions: further research and clinical implications

"Social threats can take a variety of forms, including threats to a child from parental abandonment, threats from more dominant or powerful others, threats of defection and deception, threats of exclusion and ostracism from other in-group members, and threats of persecution from out-group members...According to the nature of the social threat, animals will adopt different defensive behaviors, e.g. submitting to a dominant but threatening a subordinate, or distress calling and searching for a lost parent."

(Gilbert, Boxall, Cheung & Irons, 2005, p.124,)

In the light of the theory and evidence reviewed about interpersonal processes in paranoia, the review ends with three main conclusions. Firstly, as Gilbert et al.'s (2005) quotation above suggests, persecutory delusions can be conceptualised as social threats.

Negative social evaluations and intrusiveness from others have been reported in relation to persecutory delusions and interpersonal relationships. It will be of interest to investigate differential predictors of persecutory ideation and social anxiety. The inclusion of clinical control groups with social anxiety/social phobia will be useful in this respect. Preliminary evidence from an analogue study using virtual reality suggests that anomalous experiences (e.g. hallucinations) might be implicated in differentiating delusional beliefs about intention to harm from general worry about negative evaluations (Freeman et al., 2005). Additional

factors, such as biases in judging non-contingent action (Bentall et al., 2001; Frith, 2004) might interact with perceptions of other-negative evaluations to build a picture of intentional behaviour towards the self.

The second main message from this review is that interpersonal behaviour and ways of coping with (perceived or actual) social threats have been under-researched in people with persecutory delusions. Interpersonal behaviour elicits responses in others that tend to confirm previous beliefs and serve to maintain dysfunctional patterns, in a self-perpetuating interpersonal cycle (Alden &Taylor, 2004). Safety behaviours aimed at reducing threat from persecution, not only prevent disconfirmation of delusional beliefs but also have the adverse consequence of increasing isolation and promoting social withdrawal. Interpersonal behaviours based on beliefs that others have negative intentions towards the self are also likely to have a negative impact on other people, as a consequence of subordination, aggression or mere rejection. Attachment theory can be used as a framework to conceptualise ways of coping with interpersonal anxieties (Berry et al., 2007). Further research is needed to understand the role of behaviour in developing and maintaining paranoia. Qualitative methodologies, including observational methods and interviews with people with paranoia and those who interact with them are likely to be informative when developing hypotheses. Additionally, experimental designs could be used to identify conditions in which paranoid appraisals about non-contingent actions of others emerge.

Lastly, the key clinical implication of this review is that interpersonal processes ought to be taken into account in psychological interventions with people with persecutory delusions. CBT typically includes assessment of beliefs about self and others as well as identification of behaviours that are involved in the maintenance

of current psychotic symptoms to develop a formulation and inform the intervention (Freeman & Garety, 2002; Haddock & Tarrier, 1998; Kingdon, 1998; Kinderman & Benn, 2002). The importance of focusing on negative schemas when working psychologically with psychosis has been recently highlighted (Kuipers et al., 2006). Recent therapeutic approaches, such as Cognitive Analytic Therapy (Ryle, 2002) and Schema Therapy (Young, 2003) that put relationship issues at the core of the intervention, might also prove a fertile ground for therapeutic techniques.

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PART 2: EMPIRICAL PAPER

CAN VIRTUAL REALITY BE USED TO UNDERSTAND PERSECUTORY DELUSIONS?

ABSTRACT

Virtual reality (VR) has previously been used to study paranoid ideation in non-clinical individuals and in individuals at high risk of psychosis. The next step is to investigate the applicability of the method to people with current persecutory delusions. The main aims of the present study were to assess the acceptability and safety of using VR with individuals with persecutory delusions and to determine whether they experienced paranoid thoughts in VR. Twenty people with persecutory delusions and 21 healthy volunteers spent four minutes in a virtual reality underground train ride containing neutral computer characters. The VR experience did not raise levels of anxiety or symptoms of simulator sickness and there were no side effects reported at a one week check. Sixty-five percent of the clinical group had persecutory thinking about the computer characters, although this rate was not higher than the non-clinical group. The study indicates that virtual reality is safe and acceptable to people with psychosis. VR has the potential to be incorporated into cognitive behavioural interventions as has occurred with anxiety disorders. However more needs to be learnt about the specific environmental factors that trigger paranoid thinking.

Persecutory delusions are currently conceptualised as phenomena that lie on a continuum that runs from normality to the extreme experiences of people suffering from psychosis (Claridge, 1987; Peters, Joseph & Garety, 1999). The prevalence of paranoid thoughts in the general population is estimated to be between 5 and 30% (Eaton, Romanoski, Anthony & Nestadt, 1999; Freeman et al., 2005; Johns et al., 2004; Peters et al., 1999). However, not all paranoid thoughts are endorsed equally by members of the general population. Freeman et al. (2005) propose a hierarchy of paranoia in which the most common type of belief relates to themes of social evaluation, followed by ideas of reference and then by persecutory ideas of increased severity and less frequent endorsement. At the top of the hierarchy are beliefs about conspiracies with intent to cause severe harm: i.e. beliefs fulfilling Freeman & Garety's (2000) definition of persecutory delusion. For instance, in Freeman et al.'s (2005) study, between 10 and 30% of the sample endorsed thoughts of a mild persecutory nature (e.g. "people deliberately try to irritate me") but only 5% reported more severe feelings of persecution (e.g. "there is a conspiracy against me"). More extreme thoughts that are endorsed by fewer people are typically associated with higher distress, preoccupation and conviction (Campbell & Morrison, 2007; Freeman et al., 2005).

Research on sub-clinical paranoia can provide insights into understanding persecutory delusions found in clinical samples by testing hypotheses derived from cognitive models (Combs & Penn, 2004; Fenigstein & Vanable, 1992; Freeman et al., 2005). Cognitive models of persecutory delusions emphasise the role of anomalous experiences, reasoning biases and emotional process in the formation and maintenance of psychotic symptoms (Bentall, Corcoran, Howard, Blackwood &

Kinderman, 2001; Freeman, Garety, Kuipers, Fowler & Bebbington, 2002; Morrison, 2001). Studies using self-report and interview measures have found that low self-esteem, depression, interpersonal anxieties, unusual perceptions, beliefs about paranoia being protective, safety and submissive behaviours are among the psychological factors associated with endorsement of paranoid thoughts in non-clinical samples (Campbell & Morrison, 2007; Combs & Penn, 2004; Ellett, Lopes & Chadwick, 2003; Freeman et al., 2005; Garcia-Montes et al., 2005; Gilbert, Boxall, Cheung & Irons, 2005; Martin & Penn, 2001; Morrison & Wells, 2003).

Virtual reality in the study of paranoia: rationale

When entering an immersive virtual environment "you know that the events you see, hear and feel are not real events in the physical meaning of the word, yet you find yourself thinking, feeling and behaving as if the events were happening" (Sanchez-Vives & Slater, 2005, p. 322). This *sense of presence* is defined as the psychological sense of being in the virtual environment rather than the physical place where the participant's body is actually located (Slater & Wilbur, 1997). Virtual reality (VR) has been used as a clinical and research tool because VR elicits realistic emotions and behaviour in an environment that is under full experimental control. Graded exposure in VR has been shown to be effective in the treatment of anxiety disorders; including acrophobia (Emmelkamp et al, 2002; Rothbaum, Hodges, Smith, Lee & Price, 1995), arachnophobia (Carlin, Hoffman & Weghorst, 1997; Garcia-Palacios, Hoffman, Carlin, Furness & Botella, 2002) and post-traumatic stress disorder (Difede & Hoffman, 2002). Other diverse therapeutic uses of VR include cognitive remediation (Moreira et al., 2004) and the assessment of community functioning in people with schizophrenia using a virtual supermarket (Greenwood et al., 2007).

Interpersonal processes have also been investigated using VR technology. Avatars are computer-generated people that provide a focus for social interaction in virtual environments (Slater, Steed, McCarthy & Maringelli, 1998). Participants have been found to perceive and respond to avatars as if they were social agents (Bailenson, Blascovich, Beall & Loomis, 2001; Garau, Slater, Pertaub & Razzaque, 2005; Pertaub, Slater & Barker, 2001). In the study by Garau et al. (2005), participants reported a higher sense of personal contact with avatars (co-presence) and their heart rate was increased if the computer characters were visually responsive to them, as opposed to them being static or simply moving. Similarly, in a study on fear of public speaking, participants who gave a presentation to a virtual audience that exhibited hostile or bored expressions during their talk, experienced higher levels of anxiety than participants whose presentation was observed by either a neutral or a positive audience of avatars (Pertaub et al., 2001; Slater, Pertaub, Baker & Clark, 2006).

In recent years virtual reality has been used to develop our understanding of persecutory ideation (Freeman et al., 2003; Freeman et al., 2005; Valmaggia et al., in press). The virtual environment presented to participants in these studies is a scenario in which the avatars are programmed to display neutral behaviour (Freeman et al., 2003; Freeman et al., 2005; Valmaggia et al., in press). Therefore participants' *appraisals* of the virtual social encounter (e.g. believing that an avatar has negative intentions) can be concluded to be unfounded.

The investigation of paranoid thoughts with this novel experimental design using VR technology allows testing hypotheses of cognitive models of persecutory delusions (Bentall, et al. 2001; Freeman et al., 2002; Morrison, 2001). First, people with persecutory delusions are hypothesised to interpret ambiguous or neutral events encountered in everyday life (e.g. someone smiling or glancing in

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the street) as potentially threatening (Freeman et al., 2002). Biases in such appraisals are influenced by pre-existing beliefs of oneself as vulnerable and others as hostile (Freeman et al., 2002) and beliefs that paranoia can be a useful survival/coping strategy (Morrison, 2001). Although there has been little research into the objective events that trigger search for meaning (i.e. if someone is paranoid, does it mean that there is no one out to get them?), research suggests that traumatic and stressful life events are related to the development of psychosis (Bebbington et al., 2004; Read, van Os, Morrison & Ross, 2005; Read, Agar, Argyle & Aderhold, 2003). These include interpersonal life events such as childhood abuse (Read et al., 2005), low parental care (Willinger, Heiden, Meszaros, Formann & Aschauer, 2002) and parental separation (Maughan, 1989), social disadvantage in the form of inner city living and lower socio-economic status (Lewis et al., 1992), as well as migration to an alien and potentially racially intolerant environment (Bhugra et al., 1997; Fearon et al., 2006). Paranoid ideation has been specifically linked to interpersonal traumatic events (Gracie et al., 2007), war-related trauma (Sautter et al., 1999) and experiences of humiliation, victimisation and powerlessness (Chisholm et al., 2006; Melo et al., 2006; Mirowski & Ross, 1984; Raune, Bebbington, Dunn & Kuipers, 2006). Given this evidence, it seems relevant to use VR to disentangle appraisals from real life paranoia-inducing events to investigate if cognitive factors associated with biases in appraising events rather than with adverse life events per se.

Another advantage of VR technology is that the actions of computer generated characters can be programmed to be neutral in their interactions. For instance, the participant's suspicious or unusual behaviour does not elicit hostile responses from avatars. Studying appraisals of interpersonal neutral behaviour that is not confounded by the behaviour of people with persecutory delusions is appealing in the light of research on safety behaviours (Freeman, Garety & Kuipers, 2001;

Freeman, et al., 2007). Safety behaviours are actions designed to minimise perceived threat which prevent disconfirmation of erroneous beliefs (Salkovskis, 1991) that have been found to be highly prevalent among people with persecutory delusions (Freeman et al., 2001; Freeman et al., 2007). Avoidance and active actions such as escaping the situation, help-seeking and aggression were amongst the safety behaviours reported in the Freeman et al. studies. Recent research looking at persecutory delusions from an experiential perspective has also highlighted that people with paranoia attempt to minimise perceived threat with isolation, being vigilant to threat, hostility and fight or flight responses, which can potentially elicit suspicious behaviour in others (Boyd & Gumley, 2007; Campbell & Morrison, 2007).

Persecutory ideation in virtual reality: findings from the paranoia continuum

Virtual reality research with non-clinical samples and people who are at risk of psychosis has shown that it is feasible to use this technology to investigate paranoia in the laboratory (Freeman et al., 2003; Freeman et al., 2005; Valmaggia et al., in press). People high on trait paranoia reported persecutory thoughts about the computer generated characters who had been programmed to behave neutrally (Freeman et al., 2005; Valmaggia et al., in press).Consistent with questionnaire research in non-clinical samples, studies studying persecutory ideation under controlled experimental conditions have also identified variables from a cognitive model of persecutory delusions that predict persecutory ideation in VR (Freeman et al., 2001). High persecutory ideation in VR was predicted by interpersonal sensitivity (Freeman et al., 2003; Freeman et al., 2005; Valmaggia et al., in press), executive dysfunction (Valmaggia et al., in press), sense of presence (Freeman et al., 2005; Valmaggia et al., in press) and hallucinatory

predisposition in a sample of healthy volunteers (Freeman et al., 2005) but not among people at risk of developing psychosis (Valmaggia et al., in press). Anxiety symptoms over the week prior entering the VR environment were also associated with increased paranoid ideation in VR (Freeman et al., 2003; Freeman et al., 2005; Valmaggia et al., in press) but state anxiety as assessed by standardised questionnaires at the time of entering the environment was not (Freeman et al., 2003). Reasoning biases (jumping to conclusion, need for closure) were not associated with virtual paranoid ideation (Freeman et al., 2005). In sum, there seems to be evidence that emotional processes hypothesised by a cognitive model of psychosis (Freeman et al., 2001) are related to unfounded persecutory ideation in non-psychotic samples. The next step involves using the same methodology to study paranoia with a clinical population experiencing persecutory delusions.

VR research on people with persecutory delusions: the current study

The main aim of the study is to investigate if it is feasible to use immersive virtual environments (VR) with people with psychosis who have persecutory delusions. This is the first study to use this technology with this population to investigate paranoia. We expect VR to be safe and acceptable to this group following data from a study with people at risk of developing psychosis in which there was no rise on levels of anxiety or intrusive thoughts following a VR experience (Valmaggia et al., in press).

The secondary aim of the study is to examine paranoid ideation in VR in people with persecutory delusions. The study will investigate if people with persecutory delusions have paranoid thoughts about neutral virtual reality characters. Further, it will be investigated whether they are more likely to make more severe paranoid interpretations about the avatars than non-clinical controls. The predictive value

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of interpersonal processes that have been highlighted in the literature on persecutory delusions will also be explored. Negative schemas about self and others have been linked to severity of persecutory ideation in both clinical and non-clinical samples (Fowler et al., 2006; Freeman et al., 2002; Smith et al., 2006). An interpersonal theory of the self proposes that persecutory delusions are likely to emerge from threats to self-construction in the form of beliefs about insecurity (fear of isolation and rejection) or alienation (fear of intrusion from others) (Trower & Chadwick, 1995). Paranoid beliefs and general attributions of negative intentions to others have also been associated with theory of mind (ToM) deficits (Craig et a., 2004; Harrington et al., 2006; Randall, Corcoran, Day & Bentall 2003), although these findings have not been consistently replicated (e.g. Pickup & Frith, 2001).

Lastly, a qualitative approach will be used in addition to quantitative analyses to further understand VR experiences. General feedback on the virtual reality exercise will be sought to assess acceptability of the technology. Participants will also be interviewed about how they develop intentional explanations in the VR context. Qualitative research has recently been used to investigate the phenomenology of persecutory delusions (Boyd & Gumley, 2007; Campbell & Morrison, 2007). The use of a qualitative approach to understanding an experience that is not naturalistic is unusual in this type of research (Willig, 2001). However, the virtual environment used in the study aims to be ecologically valid (i.e. travelling in the London underground) and the experimental control permitted by the technology bypasses a typical shortcoming of qualitative research (Willig, 2001) because participants' subjective experiences about interacting with others could be attributed to their appraisal of events.

Hypotheses

The hypotheses are:

<u>VR feasibility in people with persecutory delusions</u>

1) That it will be feasible (acceptable, safe and methodologically viable) to use VR with people with psychosis who have persecutory delusions. Safety is operationalised as no increase in anxiety or simulator sickness in the VR encounter.

<u>VR paranoia in people with persecutory delusions</u>

2) That people with persecutory delusions will experience paranoid thoughts about neutral VR characters and that the level of paranoid thoughts in VR will be higher in the group with persecutory delusions than in non-clinical participants.

<u>Predictors of intentionality</u>

3) That persecutory delusions will be associated with the following factors from multifactorial models:

   a. Negative schemas about oneself and other people

   b. Insecure and alienation threats to sense of self

   c. Biases in understanding other people's intentions

   d. Anomalous experiences

   e. Belief inflexibility

   f. Trait paranoia

4) Additionally, the predictive value of these factors will be explored in relation to paranoid ideation in VR in both groups.

<u>Phenomenology of persecutory appraisals in VR</u>

The question of how persecutory ideation in VR is subjectively experienced will be

explored using a semi-structured interview. Areas that will be covered include the content and the evidence behind persecutory appraisals and the behaviour of the participant in relation to the computer characters in the virtual environment.

METHOD

Participants

Clinical participants: persecutory delusions group

Twenty participants with early psychosis took part in the study. Recruitment sources were two specialist early intervention services in London. All participants were aged between 16 and 35 and had a diagnosis of schizophrenia, schizoaffective disorder or delusional disorder (ICD-10, F20-F29 World Health Organisation, 1992). They had a history of contact with mental health services of no longer than 3 years. Inclusion criteria were as follows: (a) A score of at least moderate severity (4) on the Suspiciousness item (P6) in the Positive scale of the PANSS (Kay et al., 1987) and (b) Current beliefs fulfilled Freeman & Garety's (2000) definition of persecutory delusion that "harm is occurring or is going to occur to oneself" and "the persecutor has the intention to cause harm". Exclusion criteria were: (a) inpatient status, (b) a primary diagnosis of substance misuse, (c) learning disabilities, (d) poor command of English, (e) a history of epilepsy or experience of dizziness/nausea as side effects of antipsychotic medication. Thirty-seven potential participants were identified using case notes and referrals from mental health professionals. They were approached to assess suitability and to request informed consent. Five people were not included in the study because they did not meet the criteria for persecutory delusions (Freeman & Garety, 2000) on interview and one person was excluded because he had a history of epilepsy. Ten people refused to take part in the study. Reasons for refusal were not sought,

in line with ethical approval. On available demographic data there were no differences between those consenting and refusing. Twenty-one people met the criteria for the study and gave informed consent. One of them was unable to complete the study because of physical health reasons.

Non-clinical participants

Twenty-one non-clinical participants were recruited from healthy volunteers' recruitment services at the Institute of Psychiatry and the University College London. Exclusion criteria were as follows: history of epilepsy, poor command of English, previous psychiatric history and positive screen for psychotic symptoms on the Psychosis Screening Questionnaire (Bebbington & Nayani, 1995).

The study had received approval from the relevant NHS research ethics committees.

Design and procedure

The design was cross-sectional. The study had two parts. In part I participants were invited to complete questionnaire measures (Pre-virtual reality assessment). Clinical participants completed the measures with the researcher in the clinical setting where they were receiving clinical care. Healthy volunteers completed the questionnaire measures at University College London. Pre-virtual reality assessment took approximately 30 minutes for the healthy volunteers group and approximately 1 hour for the group with persecutory delusions.

Part II of the study involved entering a virtual reality environment. The procedure closely followed the methods reported in Freeman et al. (2003, 2005). The virtual reality equipment was situated in the Department of Computer Science, University College London. Baseline levels of state anxiety and simulator sickness were

recorded before participants entered the virtual reality environment. Participants

were informed that if they were to become distressed or if they experience

dizziness during the four minutes in the VR, they should let the researcher know

and the exercise would be stopped immediately. There was a training task to help

participants to familiarise themselves with VR. Once the participant was

comfortable with the equipment, s/he entered the experimental virtual

environment.

The environment consisted of a virtual underground train carriage (see next

section for a detailed description). Participants boarded the virtual train and

disembarked after two stops. The train journey lasted 4 minutes.   The

instructions were "Please explore the environment, and try to form an impression

of what you think about the people in the train and what they think about you."

While on the train, the participant was able to move up and down the carriage.

After the virtual tube ride, participants were asked to complete again the

measures of state anxiety and simulator sickness. Additionally, they also

completed questionnaires and a brief semi-structured interview about the VR

experience.   Participants received a small payment to reimburse their time and

travel expenses. Part II took approximately 45 minutes. Lastly, participants were

contacted by telephone a week after they completed part II to ask about any

adverse reactions to the virtual reality experience.

Measures and materials

Pre-virtual reality assessment

Green et al. Paranoid Thoughts Scales (G-PTS; Green et al., in revision). The

G-PTS measures current ideas of reference (e.g. "People definitely laughed at me

behind my back") and persecution (e.g. "People have intended me harm") derived

from a definition of persecutory ideation (Freeman & Garety, 2000). This is a self-report measure that contains two subscales (G-PTS Reference and G-PTS Persecution) of 16 items each scored from 1 to 5 (1=Not at all, 5= Totally). The scales have good reliability and have been validated using clinical and non-clinical samples.

Picture Sequencing Task (Langdon, Coltheart, Ward & Catts, 2001). The short version of the non-verbal picture sequencing task was used to assess mentalisation. This task has been used to investigate theory of mind impairment in people with schizophrenia. Sixteen stories are typically presented in four-card picture sequences using a black and white cartoon style. There are four types of stories: false-belief, social-scripts, mechanical and capture (See Appendix 2 for an example of each story type). Cards are placed face down in front of the participant who is asked to turn the cards over and to place the four cards that represent the story in the correct order to show a logical sequence of events. Order of placement and time taken were recorded. Position scores for each individual sequence range from 0 to 6 and are averaged for the four stories in each story type. Similarly, time taken was averaged over the four examples of each story type whether order were correct or incorrect. For more details on scoring procedures, see Langton et al. (2001).

The Self and Other Scale (SOS; Dagnan, Trower & Gilbert, 2002). The SOS is 14-item self-report scale measuring the extent to which a person feels vulnerable to two types of threats to self construction. The first 7 items assess "Insecure self" vulnerabilities in which people express a failure to construct a sense of self because other people are absent, unreliable and rejecting (e.g. "I have to be close to someone to have a sense of who I am"). The remaining 7 items measure

"Engulfed self" which refers to fears of intrusion, control or possession from significant others and therefore a for distance to preserve a sense of self (E.g. "If I'm getting to much attention, it can feel like I'm being taken over"). Each item is scored on a 5-point scale (1= Strongly disagree, 5=Strongly agree).

The Brief Core Schema Scales (BCSS; Fowler et al., 2006). The BCSS is a self-report measure of schemata concerning self and others. The measure has 24 items concerning beliefs about self and other evaluation that are organized in four dimensions: negative-self, positive-self, negative-other, positive-other (e.g. "I'm vulnerable", "I am valuable", "Other people are harsh", "Other people are fair"). Each item is assessed on a five-point scale (0=No; 4= I believe it totally). The BCSS has good psychometric properties and has been validated with people with psychosis and with a student sample.

Trail Making Test (TMT; Reitan, 1958, 1992). The TMT is a widely used test of neuropsychological assessment. The test consists of two parts (A and B) that must be performed as quickly and accurately as possible. TMT-A requires participants to draw lines sequentially connecting in ascending order 25 encircled numbers randomly distributed in a sheet of paper. In TMT-B, the participant must alternate between numbers (1-13) and letters (A-L) while connecting them (E.g. 1-A-2-B, etc...). If an error occurs, this is pointed out by the researcher, and the participant is instructed to return to the point where the error originated. Total time (in seconds) to complete part A and part B are respectively recorded. Impaired performance in each part can result from motor slowing, visual scanning difficulties or frontal executive problems. Part B is more sensitive to executive dysfunction and cognitive flexibility (Lezak, 1995). Therefore, part A is used as a control condition and a derived score is calculated (B-A).

Hallucinatory predisposition and hallucinatory experiences were assessed with a different measure in each group. Healthy participants completed the *Launay Slade Hallucination Scale* (LSHS; Launay & Slade, 1981). This is a twelve-item self-report measure of hallucinatory predisposition in which participants answer Yes or No to each item. Higher scores indicate a greater predisposition to hallucinatory experiences. Clinical participants' hallucinatory experiences were assessed using the *Hallucinations subscale (HS) of the Psychotic Symptom Rating Scales* (AHS; PSYRATS; Haddock, McCarron, Tarrier & Faragher, 1999). The subscale has 11 items designed to assess the subjective characteristics of hallucinations: for frequency, duration, controllability, loudness, location; severity and intensity of distress; amount and degree of negative content; beliefs about the origin of voices; and disruption. The scales had good inter-rater reliability and good validity in people with early psychosis (Drake, Haddock, Tarrier, Bentall & Lewis, 2007). Each item is rated on a 4-point scale. Higher scores represent higher severity.

Persecutory delusions and general symptomatology in the clinical group were also assessed in detail using a semi-structured interview. The assessment included items from the delusions subscale of the Psychotic Symptom Rating Scale (PSYRATS; Haddock et al.,1999) on duration and frequency of preoccupation; intensity of distress; amount of distressing content; conviction and disruption. Two items on evidence and belief flexibility from the Maudsley Assessment of Delusions Schedule (MADS; Wessely et al, 1993) were also part of this assessment. General symptomatology in this group was assessed with the Positive and Negative Syndrome Scale (PANSS: Kay et al., 1987).

Wechsler Test of Adult Reading (WTAR; Ginsberg, 2003). The WTAR is an assessment tool for estimating premorbid intellectual functioning in individuals

aged 16 to 89. The task involves reading 50 non-phonetic words.

Additional information. A number of demographic variables (age, ethnicity, occupational status) and details of antipsychotic medication for the clinical group were obtained during assessment and from clinical notes. For comparison purposes, quantities of antipsychotic medication were converted to Chlorpromazine and are reported as low (up to 200 mg), medium (201-400 mg) and high (more than 400 mg). Information on everyday use of the London underground was also obtained: "Do you normally use the tube?" Y/N; "Do you avoid using the tube?" Y/N; "Rate your fear and enjoyment of the tube on a scale of 1 to 10").

Virtual environment

Apparatus The virtual environment was displayed in an immersive projection system typically referred as 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 hand. Lightweight CrystalEyes LCD shutterglasses (StereoGraphics, California) delivered a stereo view of the virtual world that surrounded them on four sides. Participants moved around the virtual space with a combination of walking and whole body turning, and also by pressing a button in the joystick, which moved them forward in the virtual space in the direction in which they were pointing.

Environment The virtual environment was a tube train ride developed by the Department of Computer Science at University College London. The same environment was used in the study by Valmaggia et al.(in press). The environment

was modelled on the interior of a London Underground train carriage and was displayed in colour (Figure 1 in Appendix 3). The tube ride took the participant on the London Underground Central Line from "St. Paul's", stopping at "Chancery Lane", through to "Holborn", where the participant disembarked. Background noises associated with being in the London underground were played (E.g. background rumble of the moving train, "Mind the doors" announcement when the doors were closing).

Agents   The environment was designed so that the majority of the general population would find it a neutral experience. The carriage was populated by twenty computer-generated characters, known as "avatars". Both genders and a range of ethnicities were represented. All seats in the train carriage were taken. Eight of the 20 avatars had mobility. At the first stop, one avatar disembarked and another boarded. Avatars were programmed to exhibit only neutral behaviour. They could glance up and around the train carriage and occasionally they changed their facial expressions but they did not display any overtly hostile or friendly behaviour. 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.

Post virtual reality assessment

Spielberger State- Trait Inventory (STAI; Spielberger et al., 1983). Only the state scale was used in the current study. This scale has 20-item items that measure of state anxiety (e.g. "I feel nervous"). Each item is rated on a 4 point scale (1=Not at all, 5= Very much so). Higher scores indicate higher levels of anxiety. Participants completed the anxiety measure questionnaire before and after entering the virtual environment to monitor whether any distress was caused by the procedure.

*Simulator Sickness Questionnaire (*SSQ; Kennedy, Lane, Berbaum, & Lilienthal, 1993). Virtual Environments can sometimes cause different types of sickness or other transitory physical problems. Side effects can be prevented by minimising the amount of time users spend on the virtual environment. It is recommended that users begin a "practice round" for no more than 15 minutes, in order to allow adaptation to the virtual environment (Kennedy et al., 1993). Participants in the current study spent no longer than 8 minutes in the virtual environment, including training and the virtual tube journey. The SSQ was administered before exposure to the virtual reality environment to predict likelihood of symptoms, as well as after exposure to measure any noticeable side effects. The SSQ is a 16-item measure in which participants report the degree to which they experience each symptom on a scale of 0 to 3 scale (0= None, 3= Severe). Three types of symptoms are assessed: visuomotor dysfunctions (eyestrain, blurred vision, difficulty in focusing), mental disorientation (difficulty in concentrating, confusion, apathy), and nausea (including vomiting).

The *State Social Paranoia Scale* (SSPS: Freeman et al., in revision) is a 20-item self-report questionnaire that has been used to assess paranoid thoughts about virtual reality characters. There are 3 subscales. VR-persecution has 10 items assessing paranoid thinking (e.g. "Someone had it in for me", "Someone stared at me in order to upset me") that fulfil Freeman & Garety's (2000) definition of persecutory delusion i.e. contain both elements of threat towards the self and intentionality. The two remaining subscales serve as controls:
VR-Neutral has five items assessing neutral ideation about the virtual characters (E.g. "Everyone seemed unconcerned by my presence", "I wasn't really noticed by anybody") and VR-Positive includes five items measuring positive ideation about the avatars (E.g. "Someone was friendly towards me"). Each of the 20 items is

rated on a 5-point-scale (1= Do not agree, 5= Totally agree). Higher scores on a subscale indicate higher endorsement. The SSPS has very good internal reliability (α= 0.9), clear convergent validity as assessed by both independent interviewer ratings about and self-report measures on persecutory ideation, and shows divergent validity with measures of positive and neutral thinking.

VR semi-structured interview (Freeman et al., 2003). This is a 10 minute semi-structured interview conducted to assess participant experiences of the virtual tube environment. The focus was on interpersonal experiences with the computer generated characters. The interview includes questions about the content of thoughts involving intentionality and the evidence in which these thoughts are based. Participants are also asked about their own behaviour and about any interactions with the computer characters. The interviews were tape recorded.

Sense of presence questionnaire (Slater, Steed, McCarthy & Mringelli, 1998). Presence is the extent to which the participant experiences a sense of being in the virtual environment rather than in the place in which their actual body is located. There are three main constructs involved in assessing presence: the sense of "being there" in the actual virtual environment, a sense of having visited a "place" rather than just having seen images and the dominance of the virtual world over the real world where participants are located (e.g. the sense of being in the virtual tube rather than in the laboratory). This self-report questionnaire consists of 6 items, each rated on a scale of 1 to 7 with larger scores indicating a greater sense of presence.

Data analysis

Quantitative analyses

All analyses were conducted on SPSS for Windows (version 13) (SPSS, 2005). All significance test results are quoted as two-tailed probabilities. Chi-square tests were used for group comparisons on dichotomous variables. Normality assumptions were assessed using visual assessment of distribution of scores and the Kolmogorov-Smirnov test. Group comparisons were tested using t tests or the Mann-Whitney U, depending on whether parametric data assumptions were met or not. Spearman's correlation coefficients were used to explore hypothesised relationships between VR-persecution and predictors as the necessary assumptions for parametric tests were not met for these variables.

Qualitative analyses

Thematic analyses (Joffe & Yardley, 2004) were conducted on the interviews about the virtual reality experience. The tapes of the first 10 non-clinical and the first 10 clinical participants were transcribed. The transcripts were analysed one at a time by one of the researchers (M. F-A). The virtual reality interview covered two main domains: general views about virtual reality and intentionality appraisals. Themes about the virtual reality experience and in particular about the understanding of other people's 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, emerging themes were constantly compared and grouped intro superordinate themes. The software NVivo-7 (QSR International, 2006) was used to make notes about text, to create and organise emerging themes. The emerging

themes were then cross-checked to ensure that the analysis was grounded in the interviews. Planned credibility checks (Ellis, Fischer & 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 (E.H, 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

Demographic data

The demographic characteristics of the participants are displayed in Table 1. The majority of participants in each group were males and a substantial proportion of participants were from an ethnic minority (80% in the clinical and 67% in the non-clinical group). The healthy volunteers were older, were less likely to be unemployed and had a higher pre-morbid IQ as assessed by the Wechsler Test of Adult Reading (WTAR; Ginsberg, 2003) than clinical participants.

Due to the group differences in age and pre-morbid IQ, univariate analyses of co-variances (ANCOVAs), co-varying out age and IQ together, are carried out when assessing group differences in the following sections. For clarity of presentation, the results of the ANCOVA analyses are only reported where significant effects of covariates occurred and/or when a group effect became non-significant due to the introduction of covariates.

Table 1 *Demographic characteristics*

Characteristic	Persecutory delusions group (n=20)	Healthy volunteers (n=21)	Test	p
Gender (Males)				
Number (%)	17 (85%)	20 (96%)	$\chi^2(1)= 1.2$,	0.343 [a]
Age				
Mean (SD)	23 (2.9)	26 (4.6)	$t (39) = -2.2$	0.050 [b]
Ethnicity				
Black	7 (35%)	5 (24%)		
Asian	9 (45%)	9 (43%)	$\chi^2(2)= 1.1$	0.569
White	4 (20%)	7 (33%)		
Occupation				
Unemployed	12 (60%)	1 (5%)		
Employed	6 (30%)	9 (43%)	$\chi^2(2)= 16.1$	0.001*
Student	2 (10%)	11 (52%)		
Pre- morbid IQ[c]				
Mean (SD)	97.9 (10.6)	108.9 (5.8)	$t (36) = -2.1$	<0.001 [b]

[a] 2 cells (50.0%) had expected count less than 5, so an exact significance test was used (Fisher's exact test).
[b] Equality of variances not assumed corrected degrees of freedom 34.4.
[c] WTART was not administered to 2 clinical participants because in one case the participant had Dyslexia and in another English was not his first language.

Persecutory delusion group: symptom description

The mean duration of contact with services was just over a year (Mean = 12.8 months, SD = 9.2). Eighteen out of the 20 clinical participants were taking atypical antipsychotic medication (the remaining two had been prescribed medication but refused to take it) and when converted to Chlorpromazine equivalents, the levels were as follows: low (n=15) and medium (n=3). At time of assessment all participants were living in the community, but 9 out of the 20 had been previously admitted to hospital. The mean PANSS scores for Positive, Negative and General Psychopathology were 17.5 (SD= 3.0), 13.9 (SD=4.6) and

37.2 (SD=6.4) respectively. These mean PANSS scores are similar to the analogous scores in a sample of people first episode psychosis (Birchwood, Trower, Brunet, Gilbert, Iqbal & Jackson, 2007): PANSS scores for Positive, Negative and General Psychopathology were 14.1 (SD= 5.0), 15.6 (SD=5.3) and 33.3 (SD=7.5) but seem slightly lower than scores in a sample with acute psychosis (Tarrier, Gooding, Gregg, Johnson & Drake, 2007): PANSS- Positive: 23.5 (SD= 4.8), Negative:19.6 (SD=6.3) and General Psychopathology: 45.7 (SD=9.3)).

Table 2 shows examples of the content of the participants' persecutory delusions. Sixteen (80%) of the participants reported that the persecutor could include somebody they did not know. Nine (45%) believed that the persecution was only taking place outside their homes whereas 11 (55%) felt persecuted everywhere. The majority (17 people, 85%) felt that the persecution was undeserved. The preoccupation item of the PSYRATS delusions scale (Haddock, et al., 1999) revealed that 13 (65%) people thought about their beliefs on a daily basis, for at least one hour at a time in 7 cases (35%). In terms of conviction, 8 people (40%) reported 100% certainty, 8 people (40%) between 50-99% conviction and the remaining 4 participants (20%) in the clinical group reported 40% conviction. The majority of clinical participants (14 people, 70%) reported moderate to extremely severe levels of distress associated with their beliefs. However, only 5 people (25%) reported that their persecutory delusions caused moderate disruption in their lives, with the vast majority (15 people, 75%) reporting only minimal or no disruption to their lives (e.g. beliefs interfered with the person's ability to maintain daytime activities and social relationships but they were able to live independently). The scale total average score in the PSYRATS delusion scale was 13.7 (SD=3.7), which seems slightly lower than the equivalent value reported in a

Table 2 *Examples of content of persecutory delusions*

Content of persecutory delusion

"Spirits tell me to harm myself and other people. They upset me with rude and embarrassing comments." (Cp1 [a])

"People at work are trying to control me. They can read my thoughts and they want to confuse me and change my ideas (religious, political) to make me do things." (Cp3)

"People are doing experiments on me in hospitals and in the morgue. I'm in danger of being kidnapped." (Cp4)

"Old white men are after me because they want to take advantage (esp. sexual abuse)." (Cp6)

"People might try to set me up and damage my reputation (e.g. say to the newspapers I have schizophrenia)" (Cp7)

"People are trying to upset me and trick me into doing something bad." (Cp10)

"People in the street might try to attack me- hurt me seriously. They will come for me specifically." (Cp14)

[a] Cp: Clinical participant Id number

study by Startup, Freeman & Garety (2007) on an inpatient sample of people with persecutory delusions (Mean 17.8 (SD=4.5)).

The items from the MADS (Wessely et al, 1993) showed that 12 clinical participants (63%) acknowledged the possibility that they could be mistaken about their delusional beliefs, but only 5 (25%) of them were able to think of an alternative explanation for the evidence supporting their persecutory delusions. Alternative explanations suggested included "Sometimes I think, I just get paranoid, it's the way I am" and "It's all in my head".

Factors associated with persecutory delusions

Table 3 shows the mean values and standard deviations of the factors from multifactorial models of psychosis that were hypothesized to predict persecutory delusions (Hypothesis 3). The group with persecutory delusions significantly differed from non-clinical controls by endorsing more ideas of reference and persecution, negative schemas about themselves and others, as well as insecurity threats to their sense of self. Healthy participants performed significantly better on the measure of cognitive flexibility than the clinical group. False beliefs scores were significantly lower in the clinical than in non-clinical participants. However,

Table 3 *Group comparisons on paranoid ideation, schemas and reasoning*

Measure	Clinical group (n=20)	Healthy volunteers (n=21)	Test t (39)= (Unless specified)	P
GPTS				
Reference	39.6 (8.4)	27.0 (10.1)	4.2	<0.001**
Persecution	40.7 (14.8)	21.2 (9.5)	4.9	<0.001**
Theory of mind task				
False belief scores	4.0 (1.4)	4.9 (0.9)	-2.1	0.023*
Adj.false belief scores [a]	4.4 (0.2)	4.8 (0.2)	$F_{(1,35)}$= 1.7	0.240
Trail making (B-A)				
Seconds to complete	59.1 (34.7)	19.5 (10.0)	5.0	<0.001**
Self and other				
Insecurity	21.4 (5.8)	16.9 (5.3)	2.5	0.015*,[b]
Alienation	22.6 (4.4)	19.9 (4.9)	1.8	0.073
BCSQ				
Negative self-schema	5.8 (3.6)	1.1 (2.9)	4.5	<0.001**
Positive self-schema	10.2 (6.8)	13.7 (5.0)	-1.9	0.067
Negative other-schema	10.3 (5.9)	3.9 (5.9)	3.5	0.001**
Positive other-schema	11.6 (6.9)	9.6 (5.1)	0.5	0.609

[a] See text for details on ANCOVA analyses for Picture Sequencing Task.
[b] Between subject effect became non-significant when age and IQ were entered as covariates (see text)

when scores on the control stories of the theory or mind task (mechanical, social script and capture stories) were entered as covariates (see Langdon et al. (2006) for more details analyses of Picture Sequencing Task), the group variable became non-significant ($F_{(1,35)}$= 1.7, p=0.2) and the scores on the social script stories were the only significant predictor of theory of mind scores ($F_{(1,35)}$= 5.4, p=0.025).

When age and IQ were entered as covariate in ANCOVA analyses, group differences on beliefs about an insecurity threat in the SOS (Dagnan et al. 2002) became non-significant ($F_{(1,34)}$= 2.1, p=0.15).

Is it feasible to use virtual reality with people with persecutory delusions?

This section reports qualitative and quantitative data on the acceptability, sense of presence and safety of virtual reality.

Acceptability

Thematic analyses on the first 10 VR-interviews in each group were conducted to investigate general views about the virtual environment. The virtual reality experience was found to be acceptable to participants in both groups. When asked for feedback about entering the virtual environment (E.g. "How did you find the experience?), 9/10 (90%) people in the clinical group and 10/10 (100%) healthy volunteers spontaneously reported that they found the new experience interesting and that they enjoyed participating (see examples of Theme 1 in Table 4). No participants in either of the groups reported that the experience was unpleasant, but some participants (2 in the clinical and 1 in the control group) made suggestions for improving the virtual environment when asked if they had anything to add that had not been specifically discussed (see Theme 2 in Table 4).

Table 4   Themes and quotations for the "general views about VR" domain

Theme	Examples
1. Interesting/ new	"I haven't been in virtual reality before... and...pretty much... it was fun being in the virtual reality tube" (Hp[a].2)
	"Very interesting... I liked the concept of being.... It looks like you are actually in the tube" (Cp[b].1)
	"I was quite happy to try something new..." (Cp.5)
2. Suggestions for improving the virtual environment	"....it was pretty amazing... maybe more people standing up" (Hp.1)
	"...but ... you couldn't kick or punch..." (Cp.7)
	"I thought it could have been better... more... I don't know, more intense... more mixed up... just more action" (Cp.8)
3. Real but not real	"It really felt like you were on an actual tube station with people interacting with you in a way.... It just felt... the way they looked at you... but there were times when, you could tell, you weren't really there as well... it felt surreal, it's like you are there, but you are not really there... sort of thing" (Cp.6)
	"It was a lot more realistic than I thought it'd be.... A lot more detailed... the faces..." (Hp.1)
	"It's quite a strange sensation, I have not done anything like that... reminded me a little bit like being, like, in an IMAX cinema" (Hp.9)
	"It looks almost real, you know? The people... it takes you into the dimension of the real world... into the fantasy world... into the virtual... a computer world..." (Cp.2)
	"It was kind of weird... (Laughs) because you know they are not there.... But the time when I was there... I was about to put my arm and lean on one of the pools .... But then I thought it's not there (Laugh)" (Hp.4)

[a] Hp: Healthy volunteer; followed by the participant's Id number within the group
[b] Cp: Clinical participant; followed by the participant's Id number within the group

Sense of presence

The degree of immersion in the virtual environment was assessed by the Presence

Questionnaire (Slater et al., 1998). Fifteen (80%) people in the clinical group and

15 (71%) the healthy volunteers endorsed a score 6 or 7 on one of the

questionnaire items, indicating that they felt highly immersed in the virtual

experience (E.g. "The sense of being in the tube train was stronger than the sense

of being in the laboratory", "Felt that the virtual train was somewhere they

"visited" as opposed to "images they saw"). The were no significant group

differences in overall scores of sense of presence (Clinical group= 24.0, range 11-33, SD= 6.4), Healthy volunteers=23.8, range 14-32, SD= 4.5), t (39)= 0.1, p=0.92). None of the participants in either groups reported not to experience any sense of presence while in the virtual environment (i.e. total score of 6).

Qualitative analyses on general views about the VR experience revealed subjective reports from 9 (90%) of the clinical and 7(70%) healthy volunteers' transcripts that were consistent with the notion of sense of presence in VR, discussing the fact that the virtual tube was strange as it felt real and not real at the same time (see Theme 3 in Table 4).

Safety

To monitor occurrence of any emotional distress, state anxiety was measured with the STAI (Spielberger et al., 1983) before and after entering the VR environment (see Table 5). The results from a 2x2 ANOVA with group as the between-subjects factor and state anxiety before and after the virtual reality encounter as the within-subjects factor are as follows. The main effect of group was significant (F(1,38)= 10.4, p=0.003). Levels of pre and post state anxiety were significantly higher in the clinical group than in the control group. However, post-VR state anxiety was not significantly different from pre-VR state anxiety (Main effect of within-subjects variable: F(1,38)= 0.1, p=0.7)) and there was no indication of an interaction effect (F(1,38)=0.9, p=0.4) that would have indicated a different response to the VR between the two groups. In sum, there was no evidence of an increase in anxiety from entering the VR environment supporting the notion that it is safe to use this technology with both clinical and non-clinical groups.

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Table 5 *Assessment of adverse reactions pre and post the VR exercise: anxiety STAI-state (Spielberger et al., 1983) and motion sickness questionnaire (SSQ; Kennedy et al., 1993)*

Measure [range]	Clinical group (n=20)	Non-clinical group (n=21)
Pre-VR anxiety [20-100]	38.1 (8.6)	29.5 (8.9)
Post-VR anxiety [20-100]	37.9 (10.1)	27.8 (7.8)
Pre-simulator sickness [0-48]	5.6 (7.7)	2.2 (2.9)
Post-simulator sickness [0-48]	4.8 (5.7)	1.9 (2.5)

Table 5 shows that scores on the simulator sickness questionnaire (SSQ; Kennedy et al., 1993) were low for both groups in both points in time. Scores on the SSQ (Kennedy et al., 1993) were not normally distributed so non-parametric analyses were conducted. The clinical group reported significantly higher levels of post- VR simulator sickness than healthy volunteers (U=135.0, p=0.04) but the baseline levels did not significantly differ between the groups (U=165.1, p=0.2). Wilcoxon matched-paired tests were used to explore if symptoms of simulation sickness had changed post-VR in relation to baseline levels. This was not the case for either the persecutory (z= -0.9, n-Ties=16, p= 0.4) or the non-clinical group (z= -0.7, n-Ties=12, p= 0.5). State anxiety and simulator sickness symptoms were significantly correlated pre (*rho*= 0.5, p=0.03) and post (*rho*= 0.6, p=0.02) the VR exercise.

At one-week telephone follow up, 8(40%) of the clinical and 3(14%) of the non-clinical participants reported having thought about the experience (e.g. comments by a clinical participant "Yes, it was very good, I thought it was like pictures, but stood out more", "Yes, it was a good idea, but I would have like to interact a bit more", "I talked to a friend about it"). However, the VR exercise was not associated with

adverse consequences during the week following the experience. None of these participants reported intrusive thoughts, unpleasant emotions or changed their behaviour in any way as a result of entering a virtual reality environment.

In sum, virtual reality was found to be acceptable, elicited a sense of presence and was safe. These data support the main hypothesis of the study (Hypothesis 1) suggesting that it is feasible to extend the use virtual reality to people with psychosis who have persecutory delusions.

Persecutory ideation in VR: group differences

Table 6 shows the mean scores on the type of appraisals participants made about the virtual environment as assessed by the *State Social Paranoia Scale* (SSPS: Freeman et al., in revision). Taking into account the possible range of each of the subscales, positive (e.g. "someone was friendly towards me") and neutral items (e.g. "I wasn't really noticed by anybody") were generally more highly endorsed than items describing paranoid ideation.

Thirteen (65%) people with persecutory delusions and 12 (57%) healthy volunteers respectively endorsed at least one persecutory item (e.g. "Someone stared at me in order to upset me"). This relative proportion of endorsement of paranoid items by each group was not significantly different (χ^2(1)= 0.3, p=0.6). Table 6 shows analyses of group comparisons on the actual scores assessing virtual reality appraisals. VR-persecution was positively skewed and therefore non-parametric analyses were conducted. The mean level of paranoid ideation in the virtual environment was not significantly different between the group with persecutory delusions and healthy volunteers. Therefore Hypothesis 2 received only partially support: some people with persecutory delusions experienced paranoid thoughts in

Table 6 *Persecutory, positive and neutral ideation in the virtual environment (State Social Paranoia Scale)*

Measure SPSS	Clinical group (n=20)	Non-clinical group (n=21)	Test	p
VR-persecution [10-50]	14.2 (5.1)	13.5 (4.6)	U= 185	0.5
VR-positive [5-25]	11.3 (4.6)	13.7 (3.3)	t (39)= -1.9	0.07
VR-neutral [5-25]	13.7 (5.1)	14.9 (7.0)	t (39)= 0.4	0.5

VR but the rate of endorsement or the severity of paranoid ideation in VR was not higher than in the non-clinical group.

The groups also did not differ on the average number of neutral items (e.g. "I wasn't really noticed by anybody"). There was a non-significant trend for healthy volunteers to endorse more positive appraisals (e.g. "Someone was friendly towards me", "I felt safe in their company") than clinical participants.

Factors associated with VR persecution

Table 7 shows non-parametric correlations between hypothesised predictors and persecutory ideation in virtual reality as assessed by the *State Social Paranoia Scale (Freeman et al., in press)*. Predictors of paranoid ideation were different in each group. Paranoid appraisals in VR in the group of healthy participants were significantly associated with higher predisposition to hallucinations (*rho*= 0.7 p<0.001) (Hypothesis 4.d), more negative schemas about others (*rho*= 0.8 p<0.001) (Hypothesis 4.a), higher alienation threat to self which refers to fear of intrusion (*rho*= 0.4 p=0.050) (Hypothesis 4.b) and lower IQ (*rho*= -0.6 p<0.040).

In the group with persecutory delusions, paranoid ideation in the virtual tube was significantly associated with scores on trait persecution (*rho*= 0.6 p=0.004)

(Hypothesis 4.f). None of the other variables from the cognitive model of persecutory delusions (e.g. schemas, theory or mind, belief inflexibility...) were significantly associated with VR-persecution (i.e. Hypothesis 4.a to 4.e).

Table 7 *Spearman's correlations (rho) between predictors and VR-Persecution*

Measure	VR-persecution	
	Persecutory delusions (n=20)	Healthy volunteers (n=21)
Green Paranoid Thoughts Scale:		
Reference	0.3	0.3
Persecution	**0.6***	0.2
Anomalous experiences:		
Launay Slade Hallucinations	-	**0.7****
PSYRATS- Hallucinations subscale	0.2	-
Picture Sequencing Task (score)		
Theory of mind	-0.2	- 0.1
Trail making		
B-A	-0.1	0.2
Self and other		
Insecurity	0.3	-0.0
Alienation	-0.1	**0.4***
Brief core schema questionnaire		
Negative self-schema	-0.1	0.1
Positive self-schema	0.1	-0.1
Negative other-schema	0.1	**0.8*****
Positive other-schema	0.1	0.0
WTAR- Premorbid IQ	-0.3	**-0.5***
Sense of presence	0.2	-0.1

$p < 0.05$, ** $p < 0.01$, ***$p<0.001$

A-posteriori analyses were carried out to investigate if the content of persecutory delusions and social behaviour in the clinical group were associated with VR-paranoia. Clinical participants who believed that the persecutor in their delusional beliefs was unknown to them were no more likely to report paranoid ideation in

the virtual environment than those who knew their alleged persecutors or whose persecutors were of a spiritual nature (U= 29.5, $n_{unkown}=16$, $n=4_{known/spiritual}$, p=0.8). Similarly, a higher general apprehension of the London underground in everyday life was not related to higher VR-persecution scores (rho= 0.3, p=0.9) but everyday social behaviour as assessed by the PANSS (Kay et al., 1987) was related to persecutory ideation in virtual reality. "Passive/apathetic social withdrawal" (Item n4, PANSS-Negative Scale) that captures diminished interest and initiative in social interactions due to passivity, apathy or avolition, was positively associated with VR-persecution (rho= 0.5, p=0.039) but "Active social avoidance" (Item g16, PANSS-General Psychopathology Scale) was not (rho= 0.3, p=0.2).

Persecutory ideation in VR: Thematic analyses

The thematic analyses of the transcripts yielded 10 themes that were grouped in 3 main categories: (a) evidence in favour of paranoid appraisals, (b) evidence against paranoid appraisals and (c) behaviour of participants in the virtual environment. Table 8 shows verbatim excerpts from interviews with participants in each group and the numbers of participants who mentioned each theme.

Participants provided 4 main types of evidence in support of paranoid beliefs in the virtual environment: *mood/impression* evidence refers to descriptions of negative emotions and negative initial perceptions of avatars (Theme1); *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 general beliefs about threat in daily interactions to interpret the virtual scenario (Theme 4).

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The evidence against paranoid interpretations included 3 main themes: *social scripts* about tube etiquette were used by participant 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 comparing 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 behaviour: *exploration* of the environment without a particular goal (Theme 10) and *avoidance* of avatars that were 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 ability to take into account the computer characters' point of view when interacting with them in the virtual tube (Theme 5). This is consistent with data from the quantitative analyses reported in the current study showing that the sample with persecutory delusions did not have a specific impairment on the theory of mind task (i.e. false belief) as assessed by *Picture Sequencing Task* (Langdon & Coltheart, 2001).

Category	Themes	Persecutory group (10 interviews analysed)	Healthy volunteers (10 interviews analysed)
a) Evidence for paranoid appraisals	1. *Mood/ impression*	"Frightening... I cannot describe it... just felt weird." (Cp1) "Funny, scary, there were dead people" (Cp9)	"I think that he stared back at me... and that gave me an unpleasant feeling... "
		Cp1, Cp3, Cp5, Cp6 & Cp9 (5)	Hp2 (1)
	2. *Actions of the avatar*	"That was irritating... they turned their head like that... you know... I thought like... they don't want to look at me or something like that..." (Cp2) "When I looked at them, they looked at me and then they looked away." (Cp7) "They were coming close to me " (Cp9)	"I don't know, what the purpose would be of looking away, but because he had a frown... when he looked away... there was something that was telling me ... that he didn't want any conversation with me or...interaction as such."(Hp6) "A guy that came up in my face" (Hp10)
		Cp2, Cp6, Cp7, Cp9 & Cp10 (5)	Hp2, Hp6, Hp7 & Hp10 (4)
	3. *Avatar's negative evaluations of me*	"He just didn't like me, the sight of me." (Cp6)	"He (the avatar) just thought ... I was going to try and rob him or something"
		Cp1, Cp6 (2)	Hp4 (1)
	4. *Comparison with everyday paranoid ideas*	"And sometimes I feel threatened, well I used to, not so much now... 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) "... you don't have to sit next to people... if you are sitting down on a seat... there is always an uncomfortable bit... I don't like making eye contact with people...might be staring at you... so I feel very self conscious.... When you are sitting down, there might be more than one person in front of you..." (Cp6)	"...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) "You are standing on a particular spot and you can see there is a bunch of people... and you do get those looks..." (Hp7)
		Cp3, Cp6, Cp7 & Cp10 (4)	Hp4, Hp7 (2)

Category	Themes	Persecutory group (10 interviews analysed)	Healthy volunteers (10 interviews analysed)
b) Evidence against paranoid appraisals	5. *Tube social scripts inform explanations from the avatars' point of view*	"I was looking and walking up and down the train.... And I was looking at people... so I think they would have found that a bit irritating...because I had not business there... it was like I'm invading their space... there is so little space in the tube." (Cp2) "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)	"I think because I was walking up and down... if this was a real tube train... people would be thinking what is this guy doing? But I thought people seemed pretty neutral, really..." (Hp1) "they were looking at someone that was walking pass, as it normally happens on the tube ...it's quite a closed space" (Hp9)
		Cp1, Cp2, Cp4, Cp6 & Cp7 (5)	Hp1, Hp3, Hp8, Hp9 & Hp10 (5)
	6. *Disconfirmation after active hypothesis testing*	"I was trying to cause a reaction... Looking at people's faces for too long... yeah..." (Cp8) "I did that <touches his belly>.... to see if they could see me do that... but they cannot see" (Cp7) "... 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)	"...so I just moved back, to see his reaction, and then...he never did anything so I let go." (Hp10) "I was just walking around and sometimes staring at people... to see, you know, if they would stare back at me... you know... but nothing of that sort happened..." (Hp2)
		Cp5,Cp7 & Cp8 (3)	Hp1, Hp2, Hp5, Hp6, Hp7 & Hp10 (6)
	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... it's something that I just do... I don't want to give wrong impressions, you know... " (Cp2) "These are the reasons why I like a computer... because you press a button and you know the computer will do this thing... if the computer doesn't do it properly, it's because I didn't do something well... compared to a person, you know, who might have some ideas, you know... really, he's Black, he is White...you know... (Cp5)	-
		Cp2, Cp5 (2)	(0)

Category	Themes	Persecutory group (10 interviews analysed)	Healthy volunteers (10 interviews analysed)
b) Evidence against paranoid appraisals (Cont.)	8. *Friendly interactions*	"There was this guy and this woman, and the guy looked at me and he smiled at me, and it was like, his girlfriend or his friend, a woman next to him, and they both seemed friendly.... And on the other side... there was this Black woman, and she sort of smiled at me, with friendly look on her face..." (Cp6) "Everybody seemed pretty friendly and people were minding they own business." (Cp2)	"... going through the aisle they kind of look towards you, and I think the first that came into my mind is "she thinks I'm cute", so... you know... then she looked away, and then I looked away..." (Hp8) " A few people were very pleasant... there were a few people smiling... they were genuine smiles..." (Hp7)
		Cp2, Cp3, Cp4 & Cp6 (4)	Hp1, Hp6, Hp7, Hp8 & Hp9 (5)
	9. *Neutral behaviour*	"I didn't feel that there was any interaction" (Cp5)	"I thought people seemed pretty neutral" (Hp1) "I felt like they didn't notice me really" (Hp5)
		Cp2, CP4, Cp5, Cp10	Hp1, Hp2, Hp5, Hp9, Hp10
c) Behaviour	10. *Exploring the environment, looking at avatars generally*	"I was just looking around, looking at people, just observing them..." (Cp1) "look at each individual, how they looked like... the only think I noticed was, there was a woman who got off in the first stop... and there was someone, you know, another person standing beside... which wasn't there... so... I was observing the passengers" (Cp4)	"I was just looking around to see what is going on..." (Hp4) "... I just tried to look at different people, look at their facial expressions... their body language..." (Hp7)
		Cp1, Cp2, Cp3, Cp4, Cp6, Cp10 (6)	Hp3, Hp4, Hp6, Hp7 & Hp10 (5)
	10. *Avoiding others*	"He was too close to me, so I don't like people getting that close to me.... You need to have your own space, don't you? (Cp6) "I moved every way, just walked up and down, moved away from them." (Cp9)	"He just seemed unsteady...I just moved to the other side of the train" (Hp3) "And he stood right in my face... so I stepped back..." (Hp10)
		Cp3, Cp6 & Cp9 (3)	Hp3 & Hp10 (2)

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

The data displayed on Table 8 also 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 contrary, active hypothesis testing (Theme 6) was less frequently used by clinical group members.

Six out of 10 clinical participants (Cp1, Cp3, Cp6, Cp7, Cp9 and Cp10)[1] 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 et al., in press.). 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 8), 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 et al., in press.) had entertained the possibility of evidence in favour of persecutory ideas (e.g. see Themes 1 & 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 8 for details).

DISCUSSION

Virtual reality (VR) has previously been used to study paranoid ideation in non-clinical individuals and in individuals at high risk of psychosis. This is the first study to use the technology with people with persecutory delusions. The main aim

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[1] So, participants Cp2, Cp4, Cp5, Cp8 from the clinical group and Hp1, Hp3, Hp5, Hp8, Hp9 from the non-clinical group did not endorse any persecutory items on the SSCS.

of the study was to investigate the feasibility of using VR with people with persecutory delusions. The data showed that this technology was acceptable and safe. There were no adverse reactions, levels of anxiety were not raised, and participants did not experience intrusive thoughts. A sense of presence was achieved in the VE by people with persecutory delusions. Overall, VR was found to be a methodologically viable research and clinical tool for people with persecutory delusions.

Before discussing the findings on paranoia in VR, a summary of the data on factors associated with the group with persecutory delusions is presented. The limitations of the current research are discussed in each section but general cautions are introduced here. The study was cross-sectional and therefore it is not possible to draw causal inferences from the data. Demographic differences were found between the groups on age and IQ. Statistical analyses were used to adjust for these demographic differences statistically. Moreover, the absence of a clinical control group prevents excluding that reported differences could be related to general factors associated with mental illness or psychosis in general, rather than with persecutory delusions specifically. Sample sizes were also small and therefore the generalisability of the findings is compromised. Multiple analyses were conducted, which increased the risk of Type I errors (finding an effect that is not really there).

Negative schemas and reasoning biases in persecutory delusions

The group with persecutory delusions experienced higher levels of ideas of reference and persecution in their everyday lives. Ideas of reference, which involve perceiving that events, including the behaviour of others, as somehow related to the self, have been argued to be a source of evidence for persecutory

delusions by cognitive models of persecutory delusions (Fenigstein & Vanable, 1992; Freeman et al., 2002; Freeman 2007; Hemsley, 1987; Maher, 1974).

Negative beliefs about oneself (e.g. bad, vulnerable) and others (e.g. hostile, harsh) were also found to be higher in the clinical group, providing support for direct associations between negative schemata and paranoia (Freeman et al., 2002; Morrison, Frame & Larkin, 2003). This thematic correspondence between conscious beliefs and persecutory ideation is inconsistent with the notion that paranoia serves to defend against low self-worth (Bentall et al., 1991; 1994).

Trower & Chadwick's (1995) theory of two types of paranoia received mixed support from the data. The vast majority (85%) of people with persecutory delusions in this group with early psychosis believed that they did not deserve to be persecuted. This high rate of "poor me" paranoia is consistent with previous reports (Fornells-Ambrojo & Garety, 2005). As predicted by Trower & Chadwick (1996) the group with predominantly "poor me" persecutory delusions reported a fear of rejection by others as assessed by the insecurity scale in the SOS (Dagnan et al., 2003) but this finding became non-significant when demographic variables (age, pre-morbid IQ) were taken into account.

Reasoning biases that have previously been reported in people with delusions include data gathering biases characterised by "jumping to conclusions" (Dudley & Over, 2003; Garety & Freeman, 1999; Garety et al., 2005), "all or nothing thinking" (Teasdale et al., 2001) and belief inflexibility (Garety et al., 2005). Accordingly, the group with persecutory delusions in the current study performed worse on a measure of cognitive flexibility than healthy participants. These differences were not accounted for by the lower IQ in the clinical group.

People with persecutory delusions did not show a specific impairment on "theory of mind" abilities, a finding that builds on the picture of mixed findings in the literature (Drury, Robinson & Birchwood, 1998; Pickup & Frith, 2001; Walston et al., 2000). Indeed, thematic analyses conducted in the present study revealed that some people in the clinical group took into account the beliefs and wishes of other people when assessing their actions (e.g. aware that someone might be frowning because they are late for work).

Overall, the group with persecutory delusion performed in a manner consistent with existing literature on paranoia.

Paranoid thoughts in VR: a similar experience for both groups?

Persecutory appraisals were elicited by VR in both groups, but, contrary to hypothesis, people with persecutory delusions did not show higher levels of paranoid thoughts in VR in relation to healthy volunteers. Similarly, qualitative analyses of a very short (4 min) interaction with neutral avatars revealed an overall similar pattern of evidence in favour of paranoid ideation in VR (e.g. actions of avatars, comparison with everyday paranoid beliefs and a few negative evaluations) in both groups.

Two group differences in the type of evidence used in VR appraisals were suggested by the qualitative analyses. The group with persecution provided more affective evidence in favour of their paranoid thoughts in VR, which is coherent with current thinking about psychosis in which affective processes are proposed to be at the core of psychotic symptoms (Bentall et al., 2001; 1994; 1991; Birchwood, 2003; Freeman et al., 2002; Garety et al., 2001). Similarly, people

with persecutory delusions were 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 next two sections focus on discussing tentative explanations for the unexpected finding that people with persecutory delusions did not show a bias towards more paranoid appraisal about neutral characters in VR.

Are non-clinical participants too paranoid in VR?

The virtual environment used in the current study was designed to be neutral. Avatars were programmed to show ambiguous movements that were not threatening (e.g. turning the head right and left). Accordingly, the data from the *State Social Paranoia Scale* (SSPS: Freeman et al., in revision) showed that positive and neutral appraisals were the predominant response to the virtual tube experience for participants in the current study.

There was however a high proportion of healthy volunteers (57%) who endorsed at least one paranoid thought about the computer- generated characters. This level of paranoia is similar to that reported in previous VR studies (Freeman et al., 2003; 2005) and is 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 et al., 2006). Moreover, paranoid ideation in VR was predicted in the non-clinical group by predisposition to hallucinations and negative beliefs about others, which replicate previous findings and support models of paranoia (Freeman et al., 2003; 2005).

There are three main methodological issues that need to be explored further

before conclusions on the lack of group differences on paranoid ideation in VR can

be drawn. Firstly, the current study did not assess paranoid thoughts as a

dimensional experience. 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 &

Orbacj, 1999; Peters, Joseph, Day & Garety, 2004). Secondly, the instructions in

the current study prompted participants to form an impression of the computer-

generated characters before they entered the VE. It is possible that, had this

specific instruction not been given, non-clinical participants might have been less

likely than people with persecutory delusion to spontaneously focus on

understanding the intentions of others.

Lastly, the current study did not include an additional virtual environment as a

control condition. Manipulations on the visual reponsivity 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 (the tracker device in their 3D glasses) 80% of the time. Thus, 80%

of avatar movement was contingent to 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). Participants who tested hypotheses

about the reaction of the avatars to their movements (e.g. by moving closer and

further away from them) realised that there was no substantial evidence in favour

of intentional (i.e. contingent) behaviour. However, the high probability of looking towards the head tracker (80% on mobile avatars) might have resulted in a slightly high "perception of contingencies" in the environment in people who did not actively test this hypothesis while in the VE. Further research should include different versions of environments that control for different probabilities of behaviour of avatars in relation to the participant.

People with persecutory delusions: No biases in appraising a neutral VE?

Sixty-five percent of the people with persecutory delusions endorsed paranoid thoughts about avatars. The severity of trait paranoia in this group was significantly associated with higher paranoia in VR.

The rationale for using an experimentally controlled environment to investigate paranoia was 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 can be concluded to be unfounded. Under these circumstances, the current study found that people with persecutory delusions report similar levels of paranoia to non-clinical participants. In addition to the methodological issues discussed in the previous section, tentative explanations for this striking finding are discussed next with the aim of highlighting areas for further research.

Although people with persecutory delusions were more likely to rely on their emotions when discussing evidence supporting paranoid ideation in VR (e.g. "frightening, I cannot describe it..."), they were also able to provide a variety of other types of evidence in favour of and against paranoid interpretations of the virtual environment. The virtual environment (as intended) did not increase levels

of arousal. 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. This information should be taken into account when interpreting the findings since there is evidence that emotional arousal can exacerbate reasoning biases in people with psychosis (Dudley, John, Young & Over, 1997; McGuire et al., 2001).

Similarly, it is not possible to reject the hypothesis that the virtual environment depicted in the current study was genuinely less threatening than the real environment in which people with psychosis live. Life events involving experiences of humiliation, victimisation and powerlessness have been associated with paranoia (Chisholm et al., 2006; Melo et al., 2006; Mirowski & Ross, 1984; Raune, et al., 2006). The theme that VR is safer 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).

The role of interpersonal behaviour also needs to be investigated further as it is not possible to conclude from the current study if people with persecutory delusions who did not endorse any paranoid items in VR are typically more likely to behave in a manner that raises suspicions in other people in the real world. 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 bus that appears threatening to them) with the perverse

consequence of eliciting concerned looks which could be taken as confirming evidence for original threat belief. This they were not able to do in the current controlled virtual environment.

The current study did not include a formal assessment of safety behaviours (Freeman et al., 2001) but data from the general assessment of psychopathology revealed that "passive/ apathetic" social withdrawal, which captures diminished interest and initiative in social interactions due to passivity, apathy or avolition, was related to increased paranoid ideation in the VE, whereas active avoidance of others was not. It is not clear how to interpret this data. Research has shown that social withdrawal appearing to be the result of negative symptomatology (apathy, avolition) is in fact associated with underlying dysfunctional beliefs in the interpersonal domain (e.g. "People will probably think less of me if I make a mistake) (Rector, Beck & Stolar, 2005). Further research will be needed to establish if social withdrawal is related to underlying dysfunctional beliefs and/or if people with persecutory delusions are more likely to experience paranoid thinking in neutral situations partly because of their diminished exposure to typical behaviour from people.

An alternative explanation relates to sampling issues. People with persecutory delusions in the current study were living in the community and they were engaged with community services. They were a self-selected sample who agreed to take part in research. Their general psychopathology and the severity of their persecutory delusions was slightly lower as assessed by the PSYRATS (Haddock et al., 1999) than in inpatient samples, which are typically employed in paranoia research. However, all fulfilled the criteria of persecutory delusions (Freeman & 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 and emotional disturbance (e.g. people in hospital) would have been more likely to endorse paranoid thinking than the current sample.

Implications

The safety of a new technology (VR) was investigated in people with persecutory delusions using quantitative and qualitative methods. VR has the potential to be incorporated into cognitive behavioural interventions as has occurred with anxiety disorders (Carlin et al., 1997; Difede & Hoffman, 2002; Emmelkamp et al., 2002; Garcia-Palacios et al., 2002; Rothbaum et al.,1995).

However, more needs to be learnt about the specific environmental factors that trigger paranoid thinking. The inclusion of a control group in the current study enable to recognise that people with persecutory delusions report similar levels of paranoid ideation in a neutral virtual environment than people from the general population. Further research needs to assess paranoid thinking in VR using different experimental conditions such as virtual environments with different rates of contingent behaviour in avatars or environments in which avatars are overtly friendly in their demeanour. The current study also tentatively suggests that environmental factors and the interpersonal behaviour of people with persecutory delusions warrants further attention.

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PART 3: CRITICAL APPRAISAL

THE JOYS AND PERILS OF WORKING WITH A NEW TECHNOLOGY

I am entering data from the empirical paper on the SPSS database and have BBC

Radio 4 on. The presenter announces the topic of discussion: virtual reality (VR)

is becoming so popular that major brands, such as Nike and Levi's jeans are

advertising their goods in the virtual world. Second life (www.secondlife.com), an

online virtual world that has over 7 million "residents" who, as well as hang out,

can buy and sell anything from land to invented hairstyles, is booming. There are

people out there that certainly seem keen to engage with a technology that

allows the user to interact with computer-simulated environments. The prospect

of 'pioneering' the use of VR in people with persecutory delusions seemed

exciting when I first heard about the VR studies on paranoid ideation in non-

clinical individuals (Freeman et al., 2003; 2005).

The other main reason that attracted me to VR is the huge potential of this

technology for psychological research and interventions. Behavioural experiments

and exposure are among the most powerful techniques of Cognitive Behaviour

Therapy (CBT) (Bennett-Levy, Butler, Fennell, Hackmann, Mueller & Wesbrook

(2004). Bennett-Levy et al. (2004) point out that a range of theories of cognitive

science propose that experiential information is encoded in memory differently

than verbal information possibly due to the fact that it is multi-sensory and can

elicit high emotional arousal. Immersive virtual environments such as the one used

in the current thesis elicit a sense of presence, of "being" in the virtual

environment rather than the physical place where the participant's body is

located. I tried the virtual tube environment myself when developing the

proposal. It was fascinating to experience that, in spite of having read the

literature in this area and knowing what to expect, I found myself perceiving the avatars as if they were real people.

VR has been shown to be effective treatment in a range of anxiety disorders. For instance, a recent randomised control trial (RCT) with people with panic disorder and agoraphobia showed that CBT using exposure in VR was as effective as CBT using imagery exposure in relation to a waiting list control group (Vincelli et al., 2003). The VR-assisted CBT required on average a smaller number of sessions than CBT involving imagery exposure. However, this is a still an area in development. In a recent review of the literature on virtual reality in mental health, Gregg and Tarrier (2007) concluded that there was a need for more RCTs to assess the effectiveness of VR as an intervention tool as the vast majority of the more than 50 studies included in their review were case studies.

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Using a new technology with people with persecutory delusions: concerns

The main aim of the empirical paper was to assess the feasibility of using VR with people with persecutory delusions. A previous study with people who were at risk of developing psychosis had shown preliminary evidence that this was likely to be the case, since VR did not raise levels of distress or cause adverse experiences over the week subsequent to testing in this similar group (Valmaggia et al., in press). VR had also been used in people with schizophrenia to assess cognitive functioning (Greenwood, 2007; Ku et al. 2007).

A range of safety measures were planned. Anxiety and simulator motion-sickness were to be measured. As in previous studies, participants would be told that if they experienced any dizziness or felt uncomfortable at any point they could let me know and the VR immersion would be interrupted immediately. Only people

who were in the community would be eligible for the study, excluding people with persecutory delusions who were in hospital and likely to be more distressed.

Then the date for review by the allocated Research Ethics Committee arrived, in the early summer of 2006. I attended the meeting. Well, I intended to attend the meeting. I was not invited inside the meeting room to clarify any questions about the project. Instead, the Chair came out of the room and took me aside. He mentioned that the member who was the expert on mental health matters, a psychiatrist, was not able to attend, but instead he had faxed his opinion about my application. The Chair said that he could barely read the handwriting in the fax... but attempted to decipher a few of the comments as he wanted to give me some feedback ... I was read three remarks made by the absent member: *"I would not put any of my patients forward to such research"*, *"The principal investigator and the facilities are fine"* and *"I would unequivocally refuse ethical approval"*. The Chair mentioned that the committee would back the expert's view on the matter. A formal letter of refusal followed with this following comment:

"Virtual reality is untested for the kind of psychotic disorders proposed in the application. Despite the applicant's six years experience of research in psychosis, these are vulnerable patients and the Committee are very concerned about the risks of relapsing paranoid psychosis, which could also endanger the public."

I had not foreseen a refusal for ethical approval. I have experienced Ethics Committees before and believe that they are essential in ensuring that research is conducted safely and respectfully and that research proposals meet quality standards. As someone training to be a clinical psychologist it was particularly upsetting to hear the suggestion that I was planning to conduct research that was likely to endanger patients and the general public. My supervisors were very

supportive at this stage. We followed Central Office for Research Ethics Committees (COREC) procedures and submitted a new application for ethical review to a different Research Ethics Committee. The new application addressed the concerns raised by the first committee's and included details of the reasons for the initial rejection.

I attended the meeting with the second Research Ethics Committee and this time was given the opportunity to answer concerns from members. A range of interesting and valid concerns were raised. I remembered being asked by a lay member about the ecological validity of research in the virtual world and about the apparently contradicting notion of sense of presence (i.e. so do you know it is not real or not?). In terms of safety, the members' main concern was for my own safety, as I was to accompany clinical participants to the virtual reality facilities at University College London (UCL). No specific concerns about the safety of VR in psychosis were discussed as research on the use of VR with people with schizophrenia in general and with people with attenuated symptoms of psychosis to investigate paranoia were seen as evidence that the current study was just a step forward, not a major leap forward, in the application of VR technology. The letter by the second Committee read:

"The members of the Committee present gave a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation."

Finally, I was able to start recruitment. However, I must admit that the fear of doing something unethical stayed with me for a while. Well, only until I started testing participants in the clinical group. The typical participant in the current study was in his early twenties and male. The majority knew more about computer animation than me, due to their knowledge of computer games. In fact, two had

tried virtual reality before. Both clinical and non-clinical participants embraced the prospect of entering the virtual environment more enthusiastically than filling in questionnaires. People who took part in the research gave positive feedback and I grew confident about the use of this technology. It is also, however, important to note that ten people refused to take part in the study. Reasons for refusal were not sought in line with ethical procedures. Potential participants were approached and given an information sheet which included detailed information on the VR technology (including a picture of the virtual tube). Potential participants had an opportunity to ask questions and were able to decide if they wished to take part in the study or not. Ten people decided that they preferred not to take part in the study and twenty-one that they wished to do so.

The use of new technologies to engage and reach client groups that are typically less likely to access psychological interventions is not exclusive to VR. For instance, Carlbring et al. 2007) propose that internet-based CBT could be offered to people with social phobia who would otherwise refuse, out of embarrassm ent of shame, to engage with services. Their recent RCT on the treatment of social phobia found that participants in the internet-based CBT condition showed greater improvements on measures of general and social anxiety, avoidance and depression in relation to a waiting list control group. The benefits were maintained at one year follow-up (Carlbring, et al. 2007).

One of the cornerstones of successful psychological interventions is a good therapeutic relationship or 'engagement'. However, people with psychosis have been identified as posing an engagement challenge, partly because of the negative symptoms of the disorder (e.g. social withdrawal, anhedonia), partly because of positive symptoms (e.g. feeling suspicious of others, not experiencing

distress associated with grandiose delusions) and also because of lack of insight into their difficulties (Fowler, Garety & Kuipers, 1995). Service users with psychosis also point that psychiatric services tend to be disempowering and stigmatizing (Thornhill, Clare and May, 2004). During this last year I have been on a placement with an early intervention service in psychosis and I have been thinking that a new technology such as VR has the potential to be a good engagement tool. A group intervention dedicated to learning about different ways of interacting with others using VR might be more appealing for a 22-year-old male that attending a "social skills" group.

Designing a virtual environment to investigate paranoia

This project was possible because of the collaboration with the Virtual Environments and Computer Graphics group at the Department of Computing Science at UCL. After an initial meeting with the then head of department, Professor Mel Slater, I had planned to work with one of their Master's students to design a new environment for the current study. The plan was to design a 'virtual street' with interacting avatars. The participant was to be instructed to walk to the end of the street. There was a plan to program one of the avatars to interact with the participant more overtly (e.g. a newspaper seller would talk to the participant when approached by him). Unfortunately, there were no Master students who cho se that particular subject and I had to use one of the existing virtual environments i.e. the virtual tube or the library. I choose the first one because the virtual library seemed less relevant for people with psychosis, whose education tend to be disrupted by the onset of illness (Isohanni et al., 2001). Although disappointing at first, on hindsight it has been useful to use the same environment as previous studies investigating paranoia. I was able to compare the

scores on appraisals about the virtual environment with previous studies to check that the non-clinical group was performing as expected.

What I did not consider when deciding to use an existing virtual environment was that the notion of "neutrality" is built on a complex set of design decisions in the programming of avatar movements. None of this would have probably worried me had I not been surprised by the lack of group differences on paranoid appraisals in the virtual environment. If I had to start all over again (or plan the next study!), I would simplify things. To investigate why people become paranoid in non-threatening (neutral) situations, more needs to be understood about what is meant by 'neutrality'. To start with, it might be useful to use different environments to control for different rates of contingent behaviour in avatars and to test people from the general population.

MY UNDERSTANDING OF PARANOIA AFTER THE VIRTUAL REALITY PROJECT: MORE QUESTIONS THAN ANSWERS

I started testing people with persecutory delusions and then moved to recruiting the non-clinical controls with the aim of matching them as much as possible on demographics such as ethnicity and age. While conducting these initial interviews with the clinical group I was reassured that they were responding to the environment as anticipated. Most of them reported some paranoid ideation. Then the interviews with the healthy volunteers started. And they also have some fascinating stories to tell me about the avatars- which often included elements of paranoid ideation. It was quite astonishing to listen to the array of different narratives reported about the *same* environment. I had read about the importance

of our own subjective experience of the 'objective' world. This research has given me experiential evidence of it!

The lack of significant differences between the groups in the empirical study also suggests that biased appraisals of ambiguous interpersonal encounters might be less crucial in maintaining persecutory delusions than I had previously thought. After the initial surprise, I finally embraced the thrill of not disconfirming the null hypothesis. I have learnt more and done more thinking about the topic than if the results had been as expected. Three main reflections have influenced the way I think about persecutory delusions.

Firstly, while writing the literature review, I realised that dysfunctional beliefs have attracted a disproportionate amount of research interest in the study of persecutory delusions. Interpersonal behaviour and life events pose a greater challenge for measurement. However, the effectiveness of behavioural techniques has increasingly been acknowledged within CBT interventions. Interpersonal behaviour is influenced by the actions of each individual involved in the interaction. We don't know if group differences would have emerged if avatars in the virtual environment had responded to the participants' actions as people in the real world would. But we know that it is possible to design virtual environments that could be used to test this hypothesis.

Secondly, the virtual environment used in the current study did not aim to induce high levels of arousal in the participants. However, affective disturbance is proposed to be at the core of psychosis (Bentall et al., 2001; Birchwood, 2003; Freeman et al., 2001; Garety et al., 2001) and stress-vulnerability models argue that psychotic experiences are triggered by a combination of adverse (stressful)

life events and an inner vulnerability (Nuechterlein & Dawson, 1984). More needs to be known about the interaction between reasoning biases in psychosis and affective processes in people with persecutory delusions.

Lastly, I have grown to view the lack of significant differences between people with persecutory delusions and non-clinical participants as an indication that this clinical group had more resources than I had anticipated. Most of the literature on persecutory delusions and my previous research experience involved samples of people at the most severe end of the spectrum i.e. in hospital with extreme levels of paranoia. Although it is important to understand the processes in the acute phase of psychosis, longitudinal research at present is scarce. The preoccupation with "deficits" and factors involved in the aetiology of paranoia has obscured the search for strengths or factors that promote resilience.

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LIST OF APPENDICES

APPENDIX 1   ETHICAL APPROVAL MATERIALS

Ethical approval letter

Front sheet for clinical participant

Front sheet for non-clinical participant

Information sheet for clinical participant

Information sheet for non-clinical participant

Consent form for clinical participant

Consent form for non-clinical participant

APPENDIX 2   PRE-VIRTUAL REALITY MEASURES

Green et al. Paranoid Thoughts Scales (G-PTS; Green et al., in revision)

Picture Sequencing Task (Langdon & Coltheart, 2001): answer sheet

Picture Sequencing Task (Langdon & Coltheart, 2001): stories

Launay Slade Hallucination Scale (LSHS; Launay & Slade, 1981)

Psychotic Symptom Rating Scales (AHS; PSYRATS; Haddock et al., 1999)

Assessment of persecutory delusions

PANSS scoring sheet (Kay et al., 1987)

The Self and Other Scale (SOS; Dagnan, Trower & Gilbert, 2002)

The Brief Core Schema Scales (BCSS; Fowler et al., 2006)

Trail Making Test (TMT; Reitan, 1958, 1992)

APPENDIX 2   PICTURE OF THE VIRTUAL ENVIRONMENT

Figure 1 Virtual tube train

APPENDIX 3   POST VIRTUAL REALITY ASSESSMENT

Simulator Sickness Questionnaire (SSQ; et al. 1993)

State Social Paranoia Scale (SSPS: Freeman et al., in revision)

VR semi-structure interview (Freeman et al., 2003)

Sense of presence questionnaire (Slater et al., 1998).

Intrusions monitoring interview (1 week follow up)

APPENDIX 4   EXAMPLES OF TWO CODED TRANSCRIPTS

Case 1 Clinical participant

Case 2 Non-clinical volunteer

The Joint South London and Maudsley and The Institute of Psychiatry NHS Research Ethics Committee

Telephone:

3 August 2006

Miss Miriam Fornells-Ambrojo
Trainee Clinical Psychologist
University College London
Sub-Department of Clinical Health Psychology
University College London

Dear Miss Fornells-Ambrojo

Full title of study: **A virtual reality and questionnaire study of everyday worries**
REC reference number: **06/Q0706/92**

The Research Ethics Committee reviewed the above application at the meeting held on 18 August 2006.

Ethical opinion

The members of the Committee present gave a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation.

Ethical review of research sites

The favourable opinion applies to the research sites listed on the attached form. Confirmation of approval for other sites listed in the application will be issued as soon as local assessors have confirmed they have no objection.

Conditions of approval

The favourable opinion is given provided that you comply with the conditions set out in the attached document. You are advised to study the conditions carefully.

Approved documents

The documents reviewed and approved at the meeting were:

Document	Version	Date
Application	1	28 July 2006
Investigator CV		16 June 2006

Protocol	2	28 July 2006
Covering Letter		28 July 2006
Letter from Sponsor: UCL		25 May 2006
Peer Review: UCL Doctorate in Clinical Psychology Research Proposal Review Form		10 November 2005
Compensation Arrangements: UCL Indemnity Statement		16 June 2006
Questionnaire: PSQ		
Questionnaire: LSHS		
Questionnaire: PDA	1	16 June 2006
Questionnaire: Use and beliefs about the underground		
Questionnaire: Demographic	1	16 June 2006
Questionnaire: Suggested items for scales		
Questionnaire: Self and Other Scale		
Questionnaire: Symptom Score		
Questionnaire: Post Virtual Reality		
Questionnaire: Self Evaluation		
Advertisement	1	16 June 2006
Participant Information Sheet: Clinical Participants	1	28 July 2006
Participant Information Sheet: Healthy Participants	1	28 July 2006
Participant Consent Form: Healthy Participants	1	16 June 2006
Participant Consent Form: Clinical Participants	1	16 June 2006
Participant Consent Form: Audio Tape	1	16 June 2006
Participant Consent Form: Post Virtual Reality	1	28 July 2006
Virtual reality semi structured interview	1	16 June 2006
Scale for assessment of positive symptoms		
Scale for assessment of negative symptoms		
Scale for assessment of positive symptoms		
Letter of rejection from South East MREC		20 July 2006
Educational Supervisor CV - Daniel Freeman		
Picture Sequencing Task		
Educational Supervisor CV - Chris Barker		16 June 2006
UCL Dept of Psychology Risk Assessment form		
Scale for assessment of negative symptoms		

Research governance approval

The study should not commence at any NHS site until the local Principal Investigator has obtained final research governance approval from the R&D Department for the relevant NHS care organisation.

Membership of the Committee

The members of the Ethics Committee who were present at the meeting are listed on the attached sheet.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

| 06/Q0706/92 | Please quote this number on all correspondence |

With the Committee's best wishes for the success of this project

Yours sincerely

Chair

Email:

Enclosures: List of names and professions of members who were present at the meeting and those who submitted written comments

Standard approval conditions

Site approval form (SF1)

Copy to:

University College London
Room G652, Medical School Admin Corridor
Royal Free and University College Medical School

R&D Department for SLAM NHS Trust

The Joint South London and Maudsley and The Institute of Psychiatry NHS Research Ethics Committee

Attendance at Committee meeting on 18 August 2006

Committee Members:

Name	Profession	Present?	Notes
	Consultant Psychiatrist	Yes	
	Lay member	Yes	
	Professor of Psychiatry	No	
	Consultant Psychiatrist	No	
	Professor of Psychiatry	Yes	
	Senior Lecturer in Military Epidemiology	No	
	Lay member	Yes	
	Lay member	Yes	
	Senior Research Fellow in Basic Biomedical Science	Yes	
	Senior Lecturer in Statistics	No	
	Consultant Psychologist, Mental Health of Older Adults	No	
	Professor of Child Psychiatry	No	
	Lay member	No	
	Chief Pharmacist	No	
	Lecturer in Clinical Neuroscience	No	
	Social Work Representative	Yes	
	Consultant Neuroradiologist	Yes	
	Senior Lecturer in Clinical Psychology	No	
	Psychologist	Yes	

Also in attendance:

Name	Position (or reason for attending)
	REC Co-ordinator

The Joint South London and Maudsley and The Institute of Psychiatry NHS Research Ethics Committee

30 November 2006

Miss Miriam Fornells-Ambrojo
Trainee Clinical Psychologist
Sub-Department of Clinical Health Psychology
University College London

Dear Miss Fornells-Ambrojo

Full title of study: **A virtual reality and questionnaire study of everyday worries**
REC reference number: 06/Q0706/92

The REC gave a favourable ethical opinion to this study on 18 August 2006.

Further notification(s) have been received from local site assessor(s) following site-specific assessment. On behalf of the Committee, I am pleased to confirm the extension of the favourable opinion to the new site(s). I attach an updated version of the site approval form, listing all sites with a favourable ethical opinion to conduct the research.

Research governance approval

The Chief Investigator or sponsor should inform the local Principal Investigator at each site of the favourable opinion by sending a copy of this letter and the attached form. The research should not commence at any NHS site until research governance approval from the relevant NHS care organisation has been confirmed.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

06/Q0706/92	Please quote this number on all correspondence

Yours sincerely

Committee Co-ordinator

Email:

Enclosure: *Site approval form*

The Joint South London and Maudsley and The Institute of Psychiatry NHS Research Ethics Committee

LIST OF SITES WITH A FAVOURABLE ETHICAL OPINION

For all studies requiring site-specific assessment, this form is issued by the main REC to the Chief Investigator and sponsor with the favourable opinion letter and following subsequent notifications from site assessors. For issue 2 onwards, all sites with a favourable opinion are listed, adding the new sites approved.

REC reference number:	06/Q0706/92	Issue number:	2	Date of issue:	30 November 2006

Chief Investigator:	Miss Miriam Fornells-Ambrojo

Full title of study:	A virtual reality and questionnaire study of everyday worries

This study was given a favourable ethical opinion by The Joint South London and Maudsley and The Institute of Psychiatry NHS Research Ethics Committee on 18 August 2006. The favourable opinion is extended to each of the sites listed below. The research may commence at each NHS site when management approval from the relevant NHS care organisation has been confirmed.

Principal Investigator	Post	Research site	Site assessor	Date of favourable opinion for this site	Notes [1]
Miss Miriam Fornells-Ambrojo	Trainee Clinical Psychologist	South London and Maudsley NHS Trust	The Joint South London and Maudsley and The Institute of Psychiatry NHS REC	23/08/2006	
Dr Miriam Fornells-Ambrojo	Trainee Clinical Psychologist	Central North West London Mental Health NHS Trust	St Mary's REC	30/11/2006	

Approved by the Chair on behalf of the REC:

………………………………………… (Signature of Chair/Co-ordinator)
(delete as applicable)

………………………………………… (Name)

[1] *The notes column may be used by the main REC to record the early closure or withdrawal of a site (where notified by the Chief Investigator or sponsor), the suspension of termination of the favourable opinion for an individual site, or any other relevant development. The date should be recorded.*

FRONT SHEET- Clinical Participant

ID MRP:

Stage	Form:	Date given/ completed:
Consent	1. Information sheet-cp	
	2. Consent form to take part in the research-cp	
Stage 1	3. Demographics-cp	
	4. Use of tube	
	5. GTPS	
	6. PANSS	
	7. Assessment of persecutory delusions	
	8. Picture sequencing task	
	9. Self & Other questionnaire	
	10. Brief core schema scales	
	11. Trail making test	
	12. WASI	
Prepare stage 2	13. Consent-audio	
	14. Appointment card for stage 2	
Stage 2	15. Tape recorder & Tape number:	
	16. STAI-pre	
	17. SSQ-pre	
	18. VR tube task	
	19. VR interview	
	20. VR questionnaire (Post VR Questionnaire 1)	
	21. Sense of presence (Post VR Questionnaire 2)	
	22. STAI-post	
	23. SSQ-post	
	24. Thanks, want feedback and consent 1 week follow up phone call	
	25. Receipt	
	26. Post- VR interview	

FRONT SHEET- Healthy volunteer

ID MRP:

Stage	Form:	Date given/ completed:
Consent	1. Information sheet-cp	
	2. Consent form to take part in the research-cp	
Stage 1	3. Demographics-cp	
	4. Use of tube	
	5. GTPS	
	6. LSHS	
	7. PSQ	
	8. Picture sequencing task	
	9. Self & Other questionnaire	
	10. Brief core schema scales	
	11. Trail making test	
	12. WASI	
Prepare stage 2	13. Consent-audio	
	14. Appointment card for stage 2 (& optional map)	
Stage 2	15. Tape recorder & Tape number:	
	16. STAI-pre	
	17. SSQ-pre	
	18. VR tube task	
	19. VR interview	
	20. VR questionnaire(Post VR Questionnaire 1)	
	21. Sense of presence (Post VR Questionnaire 2)	
	22. STAI-post	
	23. SSQ-post	
	24. Thanks, want feedback and consent 1 week follow up phone call	
	25. Receipt of payment £15	
	26. Post- VR interview	

SUB-DEPARTMENT OF CLINICAL HEALTH PSYCHOLOGY
UCL PSYCHOLOGY
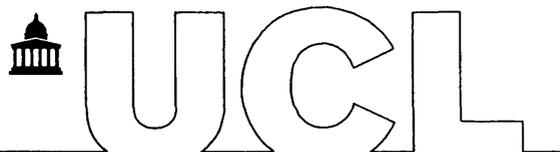
PARTICIPANT INFORMATION SHEET

Title of Project: **A virtual reality and questionnaire study of everyday worries**

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

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

You have been invited to take part in the study because you have expressed worries about other people or fears of being harmed. We hope to have twenty participants who are attending mental health services take part in the study.

Do I have to take part?

No. It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep, and be asked to sign a consent form. You are still free to withdraw at any time, and without giving a reason. A decision not to take part or to withdraw at any time will not affect your medical care.

What will happen if I decide to take part?

Participation in the project has two parts:

Part I   Questionnaires

We invite people to complete some questionnaires which ask about everyday worries about other people, sensory experiences, general wellbeing, thinking style and understanding of causes of everyday events. There are no right or wrong answers. Completion of the questionnaire will take approximately 1 hour and 15 minutes. The questionnaires will be completed with the researcher at a time that is convenient for you at your local NHS community team or at the Sub-Department of Clinical Health Psychology.

Part II   Virtual reality

After Part I has been completed, you will be invited to come to the Department of Computer Science at University College London where the virtual reality equipment is located. This second part of the study will take approximately 1 hour. The main thing you will do will be to explore a virtual environment representing a London tube train.

- Instruction in the use of virtual reality will then be given before you start.
- Once you are familiar with the use of virtual reality, you will be asked to explore a virtual environment. This involves wearing glasses that produce three-dimensional images. The virtual environment is modelled on a London underground train (please see figure 1). You will be asked to go on a virtual journey on the tube train, which will take 4 minutes. This involves staying on board of the train carriage for two stops. You will be asked to form an impression of their environment and the people in the carriage.
- You will be asked to complete questionnaires on anxiety and motion sickness before and after the virtual reality exercise. This is to monitor that the virtual reality exercise is carried out safely. We will also be with you at all times to ensure that you feel comfortable during the exercise.
- You will be asked about your experience of the virtual environment, using written questionnaires and a brief interview.

Figure 1 Virtual reality tube image

Are there any disadvantages of taking part?

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

There has been some research that suggests that people using virtual reality might experience some disturbances in vision afterwards. No long term studies are known to us, but the studies which have been carried out do testing after about 30 minutes, and find the effect is still sometimes there. It is advised that participants do not drive a car, motorcycle, or use any piece of complicated machinery in the four hours

immediately following being in virtual reality. There have been various reported side effects of using virtual reality equipment, such as 'flashbacks'. With any type of video equipment there is a possibility that an epileptic episode may be generated. This, for example, has been reported for computer video games. If you have had epilepsy please tell us. We would not want you to take part in the study in this case.

What if there is a problem?

If you have a concern about any aspect of the study, you should ask to speak with the researchers who will do their best to answer you questions (Num:). If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. In the event that something goes wrong and you are harmed during the research study, UCL has arrangements in place for non-negligent harm. If you are harmed due to somebody's negligence, then you may have grounds for legal action.

Will my taking part in the study be kept confidential?

All the information obtained will be kept confidential and you will not be identified.

What will happen to the results of the research study?

The results of the research will be analysed in order to complete a doctorate in clinical psychology and the findings will be published a scientific journal. Participants will not be identified in any report or publication. Please inform Miriam Fornells-Ambrojo if you would like a copy of the study's findings.

Who is organising the study?

The research is being organised and funded by UCL.

Who has reviewed the study?

The study has been reviewed and given favourable ethical opinion by the Joint South London and Maudsley and the Institute of Psychiatry NHS Research Ethics Committee (ref. 06/Q0706/92).

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

Research team members: Miriam Fornells-Ambrojo[a] Trainee Clinical Psychologist
Dr Chris Barker[a], Senior lecturer in Clinical Psychology
Dr Daniel Freeman[b], Senior lecturer in Clinical Psychology
Prof Mel Slater[c], Professor of virtual environments
Dr David Swapp[c] Immersive Virtual Reality Laboratory Manager
Based at:
[a] Sub-Department of Clinical Health Psychology, University College London,
[b] Department of Psychology, Institute of Psychiatry, King's College London,
[c] Department of Computer Science, University College London,

SUB-DEPARTMENT OF CLINICAL HEALTH PSYCHOLOGY
UCL PSYCHOLOGY

PARTICIPANT INFORMATION SHEET- Healthy volunteers

Title of Project: A virtual reality and questionnaire study of everyday worries

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

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

You have been invited to take part in the study as a healthy volunteer. In total, twenty healthy volunteers will take part in the study.

Do I have to take part?

No. It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep, and be asked to sign a consent form. You are still free to withdraw at any time, and without giving a reason.

What will happen if I decide to take part?

Participation in the project has two parts:

Part I   Questionnaires

We invite people to complete some questionnaires which ask about everyday worries about other people, sensory experiences, general wellbeing, thinking style and understanding of causes of everyday events. There are no right or wrong answers. Completion of the questionnaires will take approximately 40 minutes. The questionnaires will be completed with the researcher at a time that is convenient for you at the Sub-Department of Clinical Health Psychology.

Part II Virtual reality

After part I has been completed, you will be invited to come to the Department of Computer Science at University College London where the virtual reality equipment is located. This second part of the study will take approximately 1 hour. The main thing you will do will be to explore a virtual environment representing a London tube train.

- Instruction in the use of virtual reality will be given before you start.
- Once you are familiar with the use of virtual reality, you will be asked to explore a virtual environment. This involves wearing glasses that make three dimensional images. The virtual environment is modelled on a London underground train (please see figure 1). You will be asked to go on a virtual journey on the tube train, which will take 4 minutes. This involves staying on board of the train carriage for two stops. You will be asked to form an impression of the environment and the people in the carriage.
- You will be asked to complete questionnaires on anxiety and motion sickness before and after the virtual reality exercise. This is to monitor that the virtual reality exercise is carried out safely. We will also be with you at all times to ensure that you feel comfortable during the exercise
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Figure 1 Virtual reality tube image

Are there any disadvantages of taking part?

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

There has been some research that suggests that people using virtual reality might experience some disturbances in vision afterwards. No long term studies are known to us, but the studies which have been carried out do testing after about 30 minutes, and find the effect is still sometimes there. It is advised that participants do not drive a car, motorcycle, or use any piece of complicated machinery in the four hours immediately following being in virtual reality. There have been various reported side effects of using virtual

reality equipment, such as 'flashbacks'. With any type of video equipment there is a possibility that an epileptic episode may be generated. This, for example, has been reported for computer video games. If you have had epilepsy, please tell us. We would not want you to take part in the study in this case.

What if there is a problem?

In the event that something goes wrong and you are harmed during the research study, UCL has arrangements in place for non-negligent harm. If you are harmed due to somebody's negligence, then you may have grounds for legal action. Regardless of this, if you have a concern about any aspect of the study, you should ask to speak with the researchers who will do their best to answer you questions (Num:

). If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure.

Will my taking part in the study be kept confidential?

All the information obtained will be kept confidential and you will not be identified.

What will happen to the results of the research study?

The results of the research will be analysed in order to complete a doctorate in clinical psychology and the findings will be published in a scientific journal. You will not be identified in any report or publication. Please inform Miriam Fornells-Ambrojo if you would like a copy of the study's findings.

Who is organising the study?

The research is being organised and funded by UCL.

Who has reviewed the study?

The study has been reviewed and given favourable ethical opinion by the Joint South London and Maudsley and the Institute of Psychiatry NHS Research Ethics Committee (ref. 06/Q0706/92).

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

Centre Number:
Participant Identification Number for this trial:

CONSENT FORM

Title of Project: A virtual reality and questionnaire study of everyday worries

Name of Researcher: Miriam Fornells-Ambrojo

Please initial box

1. I confirm that I have read and understand the information sheet dated 28/07/06 (version 1) for the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.

3. I understand that information relating to myself will be kept confidential

4. I understand that relevant sections of any of my medical notes and data collected during the study, may be looked at by responsible individuals from the research team, from regulatory authorities or from the NHS trust, where it is relevant to my taking part in this research. I give permission to these individuals to have access to my records.

5. I agree to take part in the above study.

Name of Participant   Date   Signature

Name of Person taking consent   Date   Signature
(if different from researcher)

Researcher   Date   Signature

1 for participant; 1 for researcher; 1 to be kept with hospital notes

M. Fornells-Ambrojo A virtual reality and questionnaire study of everyday worries (Clinical Participant Version 1 16.6.06)

SUB-DEPARTMENT OF CLINICAL HEALTH PSYCHOLOGY
UCL PSYCHOLOGY

Centre Number:
Participant Identification Number for this trial:

CONSENT FORM - Healthy volunteers

Title of Project: A virtual reality and questionnaire study of everyday worries

Name of Researcher: Miriam Fornells-Ambrojo

Please initial box

1. I confirm that I have read and understand the information sheet dated 28/07/06 (version 1) for the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.

3. I understand that information relating to myself will be kept confidential

4. I agree to take part in the above study.

Name of Participant	Date	Signature

Name of Person taking consent (if different from researcher)	Date	Signature

Researcher	Date	Signature

1 for participant; 1 for researcher

GPTS

Please read each of the statements carefully.
They refer to thoughts and feelings you may have had **about others over the last month.**
Think about the **last month** and indicate the extent of these feelings from **1 (Not at all)** to **5 (Totally). Please complete both Part A and Part B.**

(N.B. **Please do not rate items according to any experiences you may have had under the influence of drugs.**)

Part A.

	Not at all		Somewhat		Totally
1. I spent time thinking about friends gossiping about me	1	2	3	4	5
2. I often heard people referring to me	1	2	3	4	5
3. I have been upset by friends and colleagues judging me critically	1	2	3	4	5
4. People definitely laughed at me behind my back	1	2	3	4	5
5. I have been thinking a lot about people avoiding me	1	2	3	4	5
6. People have been dropping hints for me	1	2	3	4	5
7. I believed that certain people were not what they seemed	1	2	3	4	5
8. People talking about me behind my back upset me	1	2	3	4	5
9. I was convinced that people were singling me out	1	2	3	4	5
10. I was certain that people have followed me	1	2	3	4	5
11. Certain people were hostile towards me personally	1	2	3	4	5
12. People have been checking up on me	1	2	3	4	5
13. I was stressed out by people watching me	1	2	3	4	5
14. I was frustrated by people laughing at me	1	2	3	4	5
15. I was worried by people's undue interest in me	1	2	3	4	5
16. It was hard to stop thinking about people talking about me behind my back	1	2	3	4	5

Part B.

	Not at all		Somewhat		Totally
1. Certain individuals have had it in for me	1	2	3	4	5
2. I have definitely been persecuted	1	2	3	4	5
3. People have intended me harm	1	2	3	4	5
4. People wanted me to feel threatened, so they stared at me	1	2	3	4	5
5. I was sure certain people did things in order to annoy me	1	2	3	4	5
6. I was convinced there was a conspiracy against me	1	2	3	4	5
7. I was sure someone wanted to hurt me	1	2	3	4	5
8. I was distressed by people wanting to harm me in some way	1	2	3	4	5
9. I was preoccupied with thoughts of people trying to upset me deliberately	1	2	3	4	5
10. I couldn't stop thinking about people wanting to confuse me	1	2	3	4	5
11. I was distressed by being persecuted	1	2	3	4	5
12. I was annoyed because others wanted to deliberately upset me	1	2	3	4	5
13. The thought that people were persecuting me played on my mind	1	2	3	4	5
14. It was difficult to stop thinking about people wanting to make me feel bad	1	2	3	4	5
15. People have been hostile towards me on purpose	1	2	3	4	5
16. I was angry that someone wanted to hurt me	1	2	3	4	5

Picture Sequencing Task

Sub ID: _____

Story	Layout order	Time taken	Subject order (colour id → no. id)	Correct order	Score	Story
Prac 1						Prac 1
Prac 2						Prac 2
3	OGYB			BYGO		3
9	YGBO			BYGO		9
17	OBYG			GYOB		17
12	GYOB			GYBO		12
18	YBOG			BGOY		18
10	YOBG			GYBO		10
5	YGBO			YOBG		5
14	OYBG			YBOG		14
8	YBOG			GBYO		8
15	BGYO			YOGB		15
7	GOYB			OBYG		7
11	BGYO			YBGO		11
4	BGOY			OBYG		4
13	GBOY			OBYG or OBGY		13
16	GYOB			BOYG		16
6	GYBO			OYGB		6

Picture Sequencing Task
Example of Social Script story
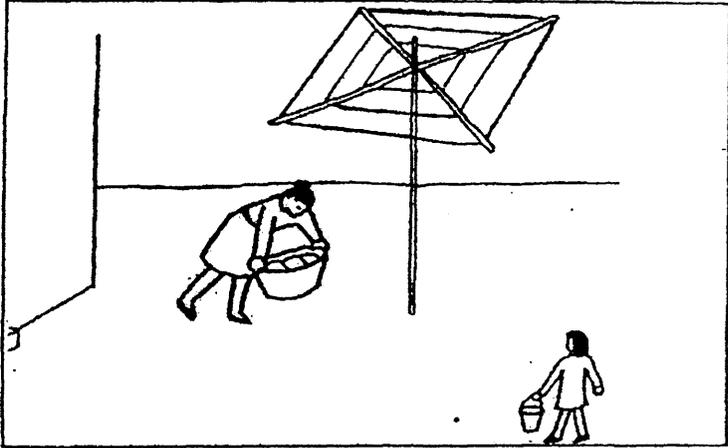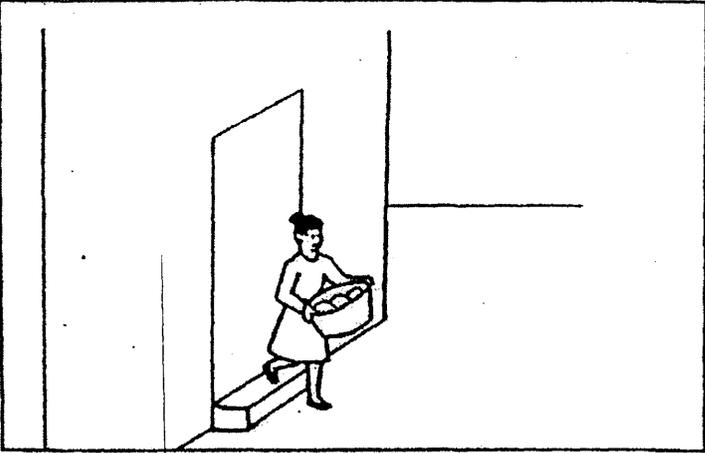
Picture Sequencing Task
Example of Mechanical story

SPLASH
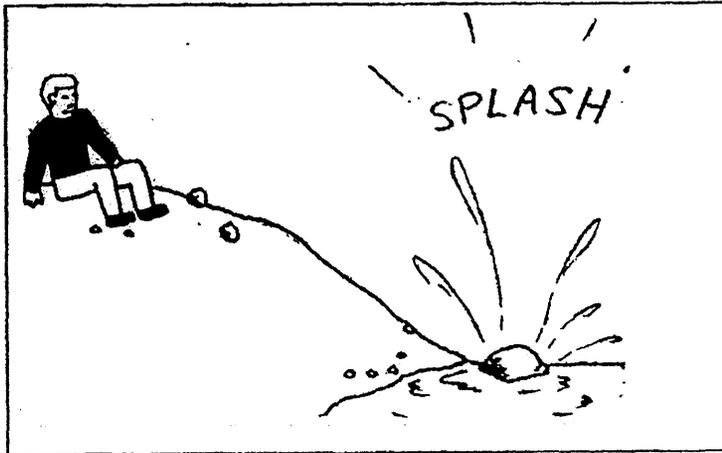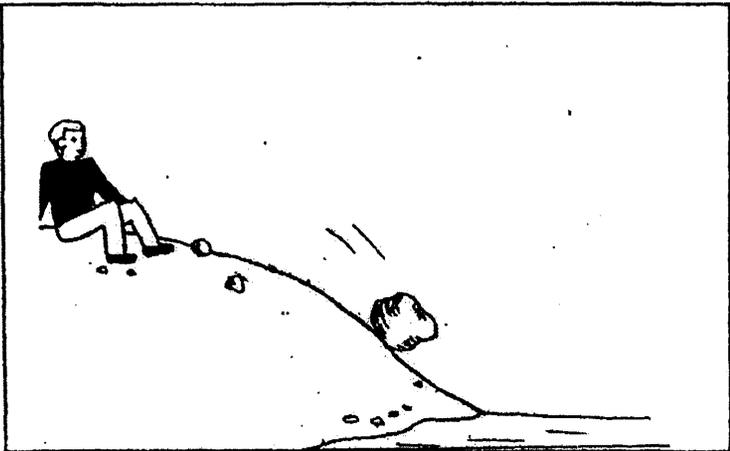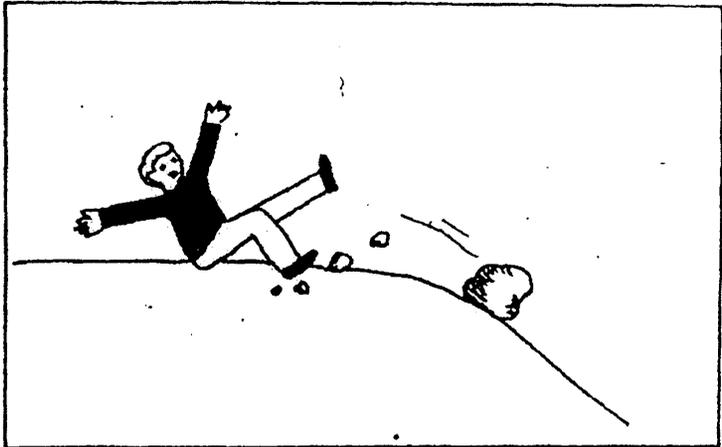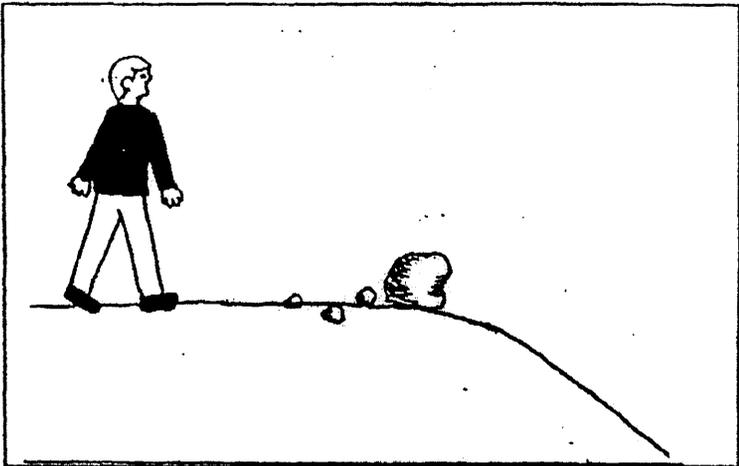
Picture Sequencing Task
Example of False Belief story
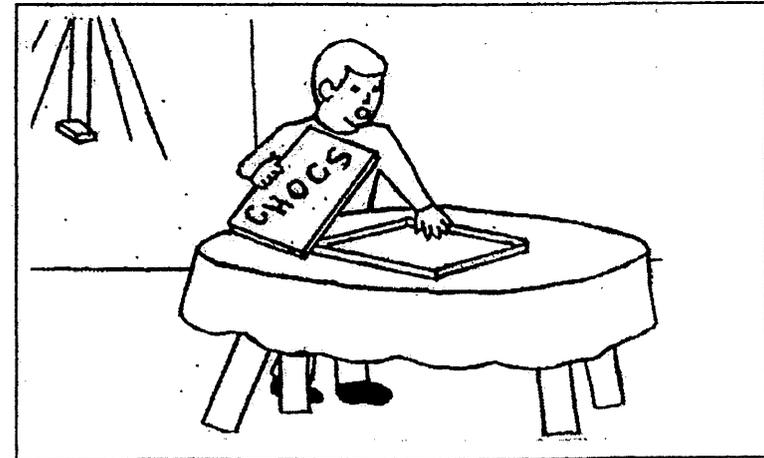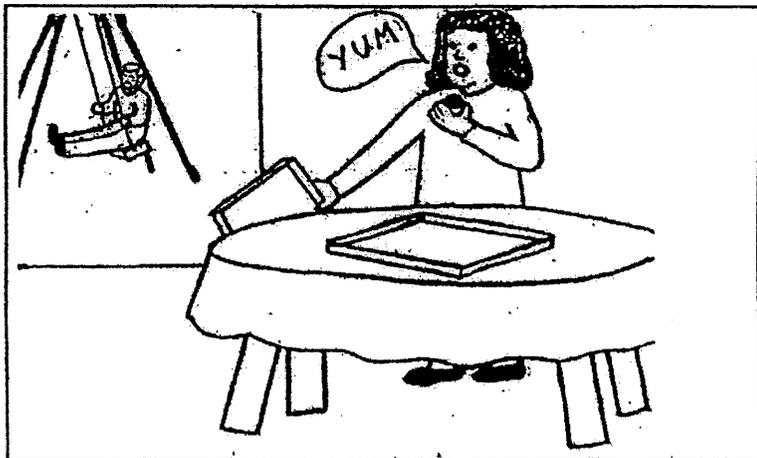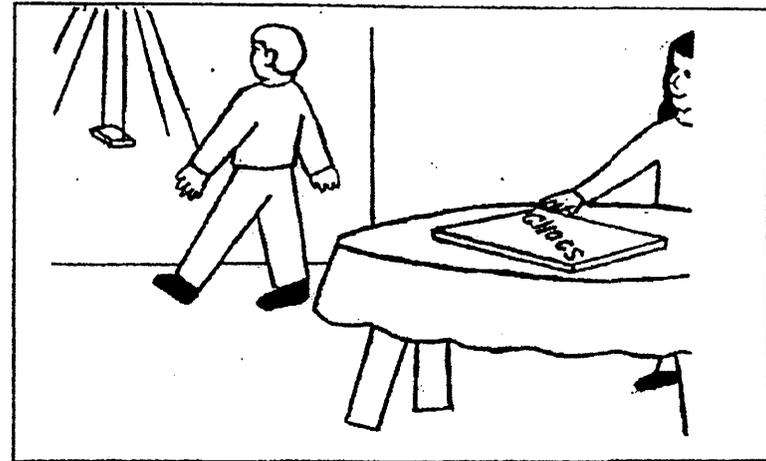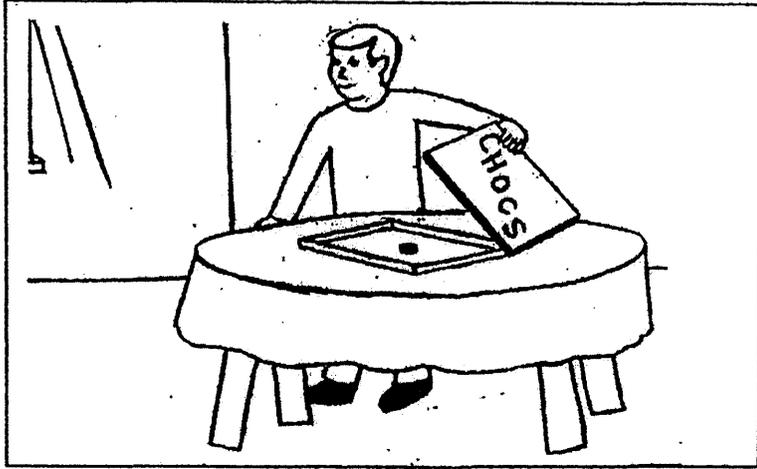
Picture Sequencing Task
Example of Capture story
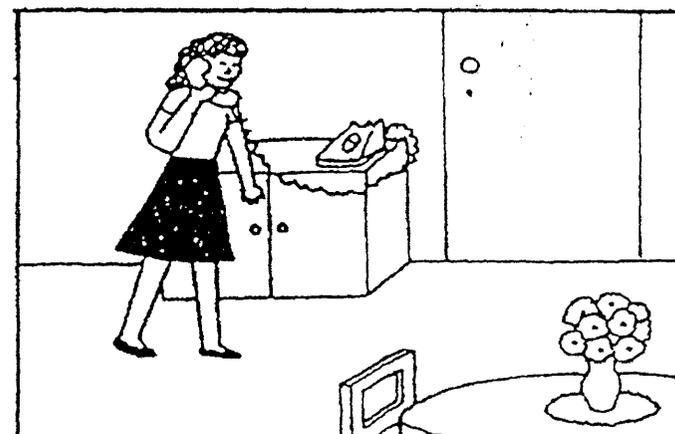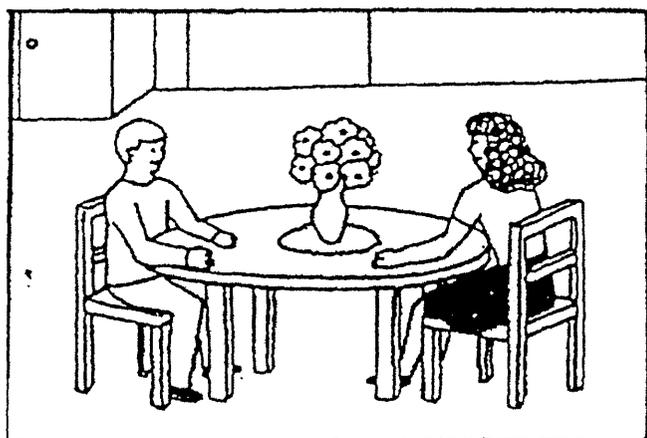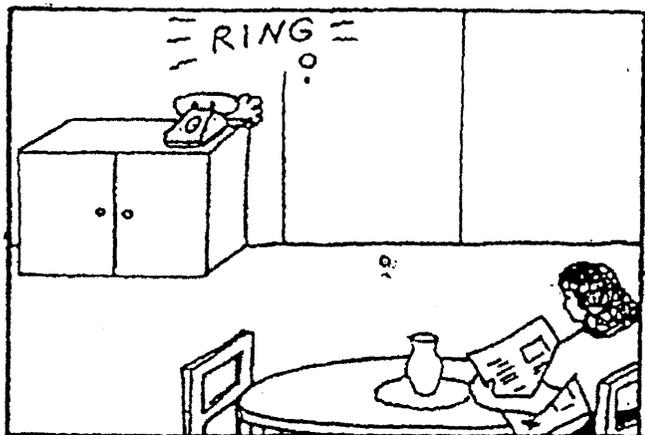
LSHS

Please circle **YES or NO** in response to the following statements:

1. In the past I have heard the voice of God speaking to me   **YES**   **NO**

2. Sometimes a passing thought will seem so real that it frightens me   **YES**   **NO**

3. No matter how hard I try to concentrate on my work, unrelated
   thoughts always creep into my mind   **YES**   **NO**

4. In the past I have had the experience on hearing a persons voice and
   then found out no-one was there   **YES**   **NO**

5. In my daydreams I can hear the sound of a tune almost as clearly
   as if I was actually listening to it   **YES**   **NO**

6. The people in my daydreams seem so true to life that I sometimes
   think they are   **YES**   **NO**

7. I often hear a voice speaking my thoughts aloud   **YES**   **NO**

8. On occasions I have seen a person's face in front of me when no-one
   was in fact there   **YES**   **NO**

9. I have heard the voice of the devil   **YES**   **NO**

10. Sometimes my thoughts seem as real as actual events   **YES**   **NO**

11. I have been troubled by hearing voices in my head   **YES**   **NO**

12. The sounds I hear in my daydreams are usually clear and distinct   **YES**   **NO**

to delusions; whether conviction alone is a key predictor of preoccupation; or whether distress is dependent upon either preoccupation and conviction (i.e. does distress reduce as an index of disconfirmation in behavioural experiments, via reductions in belief conviction?). In outcome studies, it may be useful to have a global dimensional symptom score plus a detailed measure of the specific target symptom in the way that the scales were used in this study. As already pointed out though, this may have some limitations in clinical practice when trying to put together a detailed picture of an individual's psychotic experiences. For this reason, further evaluation of the scales in terms of their use in rating individual hallucinations or individual beliefs when there are more than one of these reported is warranted. Nevertheless, the PSYRATS are likely to be of benefit to the clinician in the initial assessment and formulation of these symptoms and provide a reliable means of monitoring dimensional change over treatment (whether this is biochemical or psychological) and open a way forward to the possibility of bringing about significant clinical improvements in patients presenting for a variety of treatments.

APPENDIX 1
PSYCHOTIC SYMPTOM RATING SCALES

A Auditory hallucinations

1 Frequency
0 Voices not present or present less than once a week
1 Voices occur for at least once a week
2 Voices occur at least once a day
3 Voices occur at least once an hour
4 Voices occur continuously or almost continuously i.e. stop for only a few seconds or minutes

2 Duration
0 Voices not present
1 Voices last for a few seconds, fleeting voices
2 Voices last for several minutes
3 Voices last for at least one hour
4 Voices last for hours at a time

3 Location
0 No voices present
1 Voices sound like they are inside head only
2 Voices outside the head, but close to ears or head. Voices inside the head may also be present

3 Voices sound like they are inside or close to ears and outside head away from ears
4 Voices sound like they are from outside the head only

4 Loudness
0 Voices not present
1 Quieter than own voice, whispers.
2 About same loudness as own voice
3 Louder than own voice
4 Extremely loud, shouting

5 Beliefs re-origin of voices
0 Voices not present
1 Believes voices to be solely internally generated and related to self
2 Holds < 50 % conviction that voices originate from external causes
3 Holds ⩾ 50 % conviction (but < 100 %) that voices originate from external causes
4 Believes voices are solely due to external causes (100 % conviction)

6 Amount of negative content of voices
0 No unpleasant content
1 Occasional unpleasant content (< 10 %)
2 Minority of voice content is unpleasant or negative (< 50 %)
3 Majority of voice content is unpleasant or negative (⩾ 50 %)
4 All of voice content is unpleasant or negative

7 Degree of negative content
0 Not unpleasant or negative
1 Some degree of negative content, but not personal comments relating to self or family e.g. swear words or comments not directed to self, e.g. 'the milkman's ugly'
2 Personal verbal abuse, comments on behaviour e.g. 'shouldn't do that or say that'
3 Personal verbal abuse relating to self-concept e.g. 'you're lazy, ugly, mad, perverted'
4 Personal threats to self e.g. threats to harm self or family, extreme instructions or commands to harm self or others

8 Amount of distress
0 Voices not distressing at all
1 Voices occasionally distressing, majority not distressing (< 10 %)
2 Minority of voices distressing (< 50 %)
3 Majority of voices distressing, minority not distressing (⩾ 50 %)
4 Voices always distressing

9 Intensity of distress
0 Voices not distressing at all
1 Voices slightly distressing
2 Voices are distressing to a moderate degree

3   Voices are very distressing, although subject could feel worse
4   Voices are extremely distressing, feel the worst he/she could possibly feel

10 Disruption to life caused by voices
0   No disruption to life, able to maintain social and family relationships (if present)
1   Voices causes minimal amount of disruption to life e.g. interferes with concentration although able to maintain daytime activity and social and family relationships and be able to maintain independent living without support
2   Voices cause moderate amount of disruption to life causing some disturbance to daytime activity and/or family or social activities. The patient is not in hospital although may live in supported accommodation or receive additional help with daily living skills
3   Voices cause severe disruption to life so that hospitalisation is usually necessary. The patient is able to maintain some daily activities, self-care and relationships while in hospital. The patient may also be in supported accommodation but experiencing severe disruption of life in terms of activities, daily living skills and/or relationships
4   Voices cause complete disruption of daily life requiring hospitalization. The patient is unable to maintain any daily activities and social relationships. Self-care is also severely disrupted.

11 Controllability of voices
0   Subject believes they can have control over the voices and can always bring on or dismiss them at will
1   Subject believes they can have some control over the voices on the majority of occasions
2   Subject believes they can have some control over their voices approximately half of the time
3   Subject believes they can have some control over their voices but only occasionally. The majority of the time the subject experiences voices which are uncontrollable
4   Subject has no control over when the voices occur and cannot dismiss or bring them on at all

B   Delusions

1   Amount of preoccupation with delusions
0   No delusions, or delusions which the subject thinks about less than once a week
1   Subject thinks about beliefs at least once a week
2   Subject thinks about beliefs at least once a day
3   Subject thinks about beliefs at least once an hour
4   Subject thinks about delusions continuously or almost continuously

2   Duration of preoccupation with delusions
0   No delusions

1   Thoughts about beliefs last for a few seconds, fleeting thoughts
2   Thoughts about delusions last for several minutes
3   Thoughts about delusions last for at least 1 hour
4   Thoughts about delusions usually last for hours at a time

3   Conviction
0   No conviction at all
1   Very little conviction in reality of beliefs, < 10%
2   Some doubts relating to conviction in beliefs, between 10–49%
3   Conviction in belief is very strong, between 50–99%
4   Conviction is 100%

4   Amount of distress
0   Beliefs never cause distress
1   Beliefs cause distress on the minority of occasions
2   Beliefs cause distress on < 50% of occasions
3   Beliefs cause distress on the majority of occasions when they occur between 50–99% of time
4   Beliefs always cause distress when they occur

5   Intensity of distress
0   No distress
1   Beliefs cause slight distress
2   Beliefs cause moderate distress
3   Beliefs cause marked distress
4   Beliefs cause extreme distress, could not be worse

6   Disruption to life caused by beliefs
0   No disruption to life, able to maintain independent living with no problems in daily living skills. Able to maintain social and family relationships (if present)
1   Beliefs cause minimal amount of disruption to life, e.g. interferes with concentration although able to maintain daytime activity and social and family relationships and be able to maintain independent living without support
2   Beliefs cause moderate amount of disruption to life causing some disturbance to daytime activity and/or family or social activities. The patient is not in hospital although may live in supported accommodation or receive additional help with daily living skills
3   Beliefs cause severe disruption to life so that hospitalisation is usually necessary. The patient is able to maintain some daily activities, self-care and relationships while in hospital. The patient may be also be in supported accommodation but experiencing severe disruption of life in terms of activities, daily living skills and/or relationships
4   Beliefs cause complete disruption of daily life requiring hospitalization. The patient is unable to maintain any daily activities and social relationships. Self-care is also severely disrupted

Id:

Today's date:

Belief content:

- Intentionality?   Y   N
- Current or future threat to self?   Y   N

- **Persecutor:**

Known person/people   Unknown person/people   Spiritual   Both   Unknown

- **Power**

1	2	3	4	5
Completely powerless	Quite powerless		Quite powerful	Completely powerful

How powerful is the persecutor?

How powerful are you?

- **Pervasiveness** of persecution:

Home only   Outside only   Both

Details:

PSYRATS items

Amount of preoccupation	0	1	2	3	4
Duration of preoccupation	0	1	2	3	4
Conviction	0	1	2	3	4
Amount of distress	0	1	2	3	4
Intensity of distress	0	1	2	3	4
Disruption to life	0	1	2	3	4

Details (e.g. isolation, changes in activity, lose temper...):

Deservedness of persecution

Answer:

Rating:

1	2	3	4	5
Totally undeserved	Somewhat undeserved	Unsure	Somewhat deserved	Totally deserved

Id:

Today's date:

Length belief:

MADS items

Evidence

- Evidence in favour of the belief (e.g. observable event, abnormal experience, mood) :

- Evidence against the belief:

Belief flexibility

- When you think about it is it possible that you are mistaken about X?   Y   Maybe   N

ANSS   Id: Date:

	Absent	Minimal	Mild	Moderate	Moderate-severe	Severe	Extreme
e symptom subscale items							
usions	1	2	3	4	5	6	7
nceptual disorganization	1	2	3	4	5	6	7
lucinatory behavior	1	2	3	4	5	6	7
citement	1	2	3	4	5	6	7
andiosity	1	2	3	4	5	6	7
spiciousness/persecution	1	2	3	4	5	6	7
stility	1	2	3	4	5	6	7
ve symptom subscale items							
nted affect	1	2	3	4	5	6	7
otional withdrawal	1	2	3	4	5	6	7
or rapport	1	2	3	4	5	6	7
ssive/apathetic social withdrawal	1	2	3	4	5	6	7
ficulty in abstract thinking	1	2	3	4	5	6	7
ck of spontaneity and flow of conversation	1	2	3	4	5	6	7
reotyped thinking	1	2	3	4	5	6	7
al psychopathology symptoms							
matic concern	1	2	3	4	5	6	7
xiety	1	2	3	4	5	6	7
ilt feelings	1	2	3	4	5	6	7
nsion	1	2	3	4	5	6	7
nnerisms and posturing	1	2	3	4	5	6	7
pression	1	2	3	4	5	6	7
tor retardation	1	2	3	4	5	6	7
cooperativeness	1	2	3	4	5	6	7
usual thought content	1	2	3	4	5	6	7
isorientation	1	2	3	4	5	6	7
oor attention	1	2	3	4	5	6	7
ack of judgment and insight	1	2	3	4	5	6	7
isturbance of volition	1	2	3	4	5	6	7
oor impulse control	1	2	3	4	5	6	7
reoccupation	1	2	3	4	5	6	7
ctive social avoidance	1	2	3	4	5	6	7

Date:
Id:

The Self and Other Scale

Please rate each item by placing a cross in the most appropriate box.

	Strongly agree 5	Agree 4	Unsure 3	Disagree 2	Strongl disagre 1
. Having a secure relationship helps me feel I exist.					
. When I am alone I feel the need to contact someone.					
. I have to be close to someone to have a sense of who I am.					
. I am nothing without certain special other people.					
. Sometimes when I am alone I have a strange feeling that I'm not real.					
. If I'm not getting the right attention it's like I'm not there.					
. Special people are vital to my sense of being a person.					
. I dread being under someone else's control.					
. I have to get away from other people in order to have a sense of who I am.					
0. If I'm getting too much attention it can feel like I'm being taken over.					
1. I'd hate certain people to know the real me.					
2. Often I wish people would give me space to be myself.					
3. Sometimes I only feel like me when I am on my own.					
4. I can feel suffocated if I am too close to someone.					

THE BRIEF CORE SCHEMA SCALES: BELIEFS ABOUT SELF AND OTHERS

This questionnaire lists beliefs that people can hold about themselves and other people. Please indicate whether you hold each belief (NO or YES). If you hold the belief then please indicate how strongly you hold it by circling a number (1-4). Try to judge the beliefs on how you have generally, over time, viewed yourself and others. Do not spend too long on each belief. There are no right or wrong answers and the first response to each belief is often the most accurate.

			Believe it slightly	Believe it moderately	Believe it very much	I believe it totally
MYSELF						
I am unloved	NO	YES→	1	2	3	4
I am worthless	NO	YES→	1	2	3	4
I am weak	NO	YES→	1	2	3	4
I am vulnerable	NO	YES→	1	2	3	4
I am bad	NO	YES→	1	2	3	4
I am a failure	NO	YES→	1	2	3	4
I am respected	NO	YES→	1	2	3	4
I am valuable	NO	YES→	1	2	3	4
I am talented	NO	YES→	1	2	3	4
I am successful	NO	YES→	1	2	3	4
I am good	NO	YES→	1	2	3	4
I am interesting	NO	YES→	1	2	3	4
OTHER PEOPLE						
Other people are hostile	NO	YES→	1	2	3	4
Other people are harsh	NO	YES→	1	2	3	4
Other people are unforgiving	NO	YES→	1	2	3	4
Other people are bad	NO	YES→	1	2	3	4
Other people are devious	NO	YES→	1	2	3	4
Other people are nasty	NO	YES→	1	2	3	4
Other people are fair	NO	YES→	1	2	3	4
Other people are good	NO	YES→	1	2	3	4
Other people are trustworthy	NO	YES→	1	2	3	4
Other people are accepting	NO	YES→	1	2	3	4
Other people are supportive	NO	YES→	1	2	3	4
Other people are truthful	NO	YES→	1	2	3	4

Trail Making (Part A) – *SAMPLE*

End

2

7   8   Begin   3

1   4

6   5

10 HP
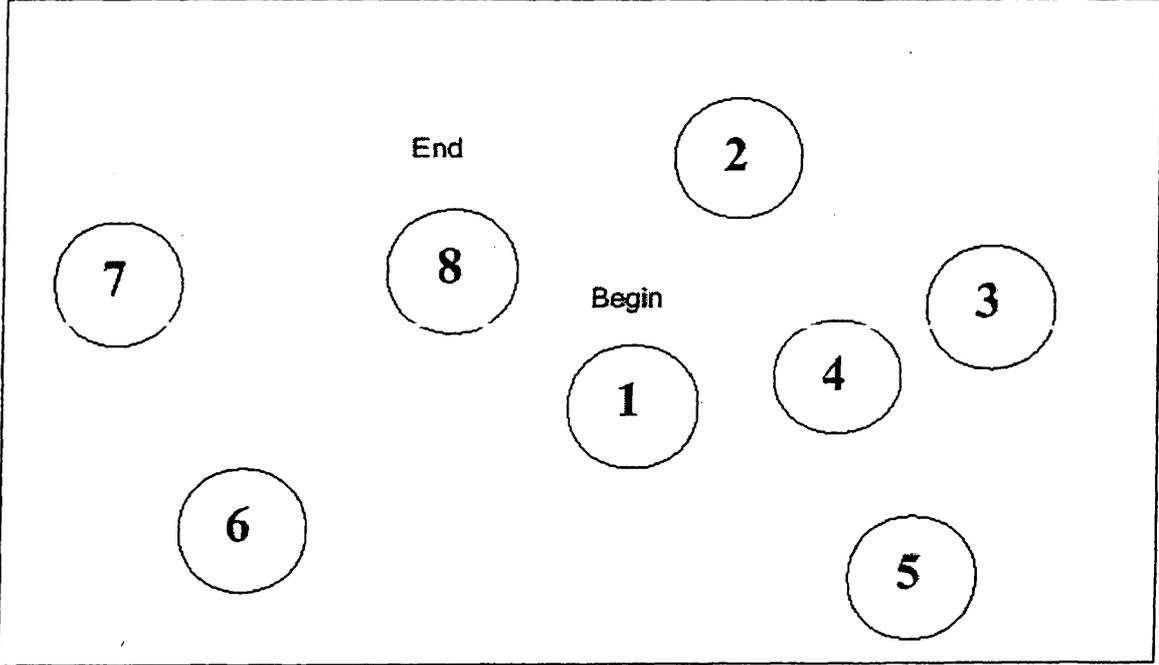
Trail Making (Part A)

Patient's Name: _____   Date: _____
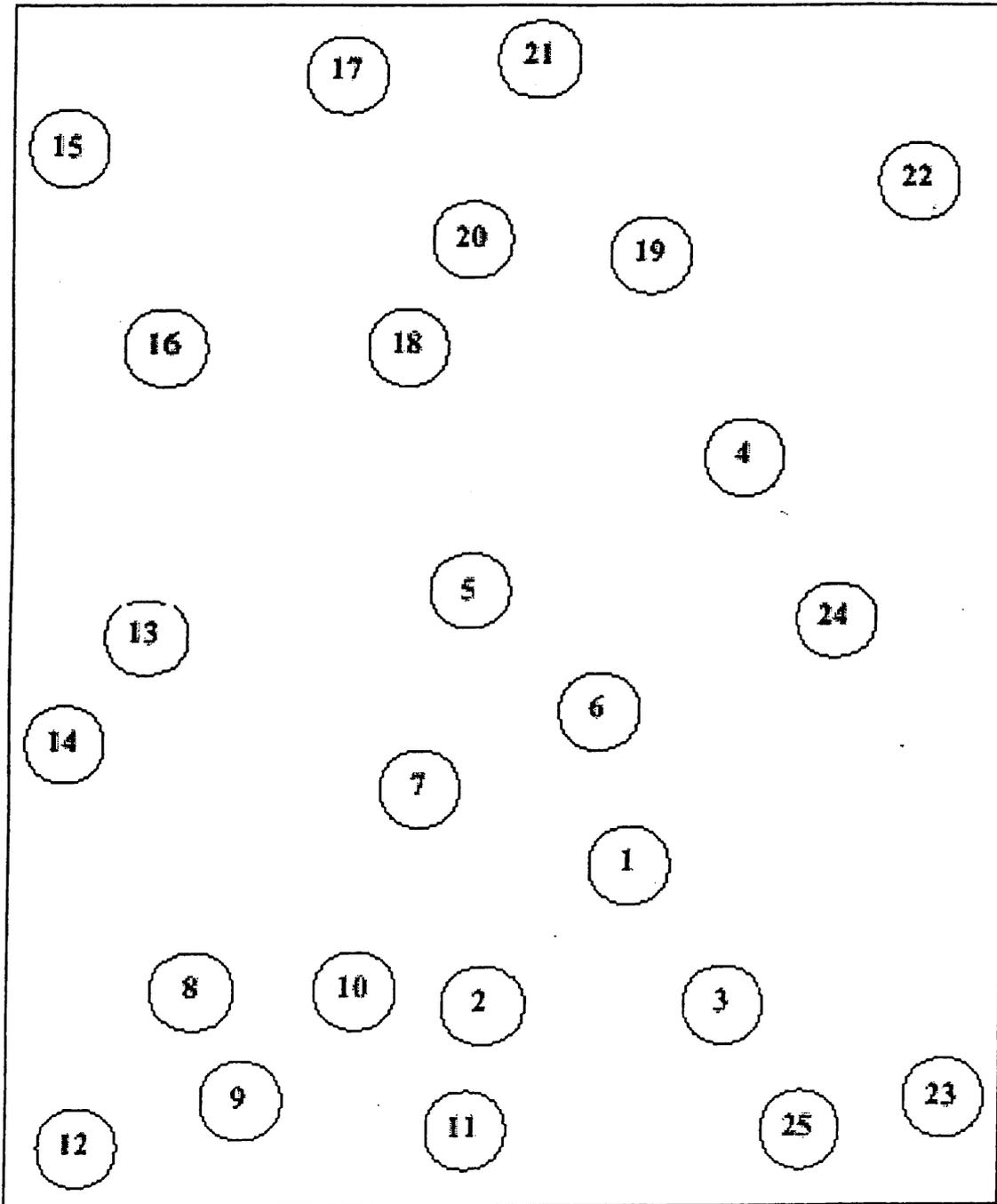
Trail Making (Part B) – *SAMPLE*
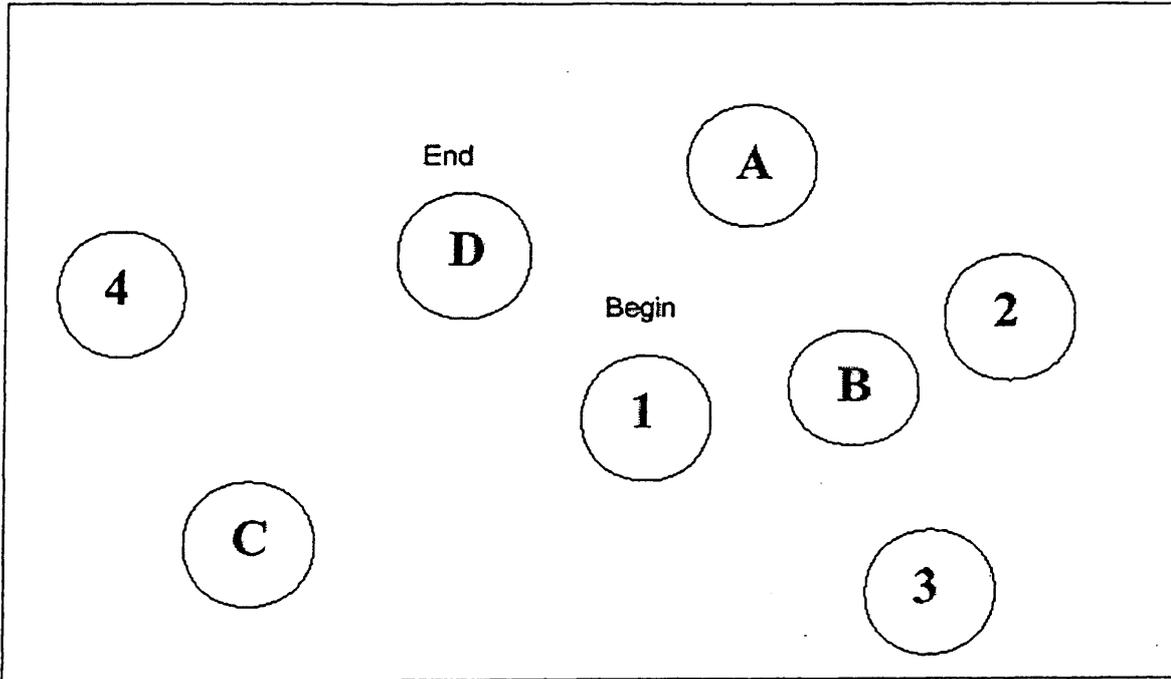
Trail Making (Part B)

Patient's Name: _____   Date: _____
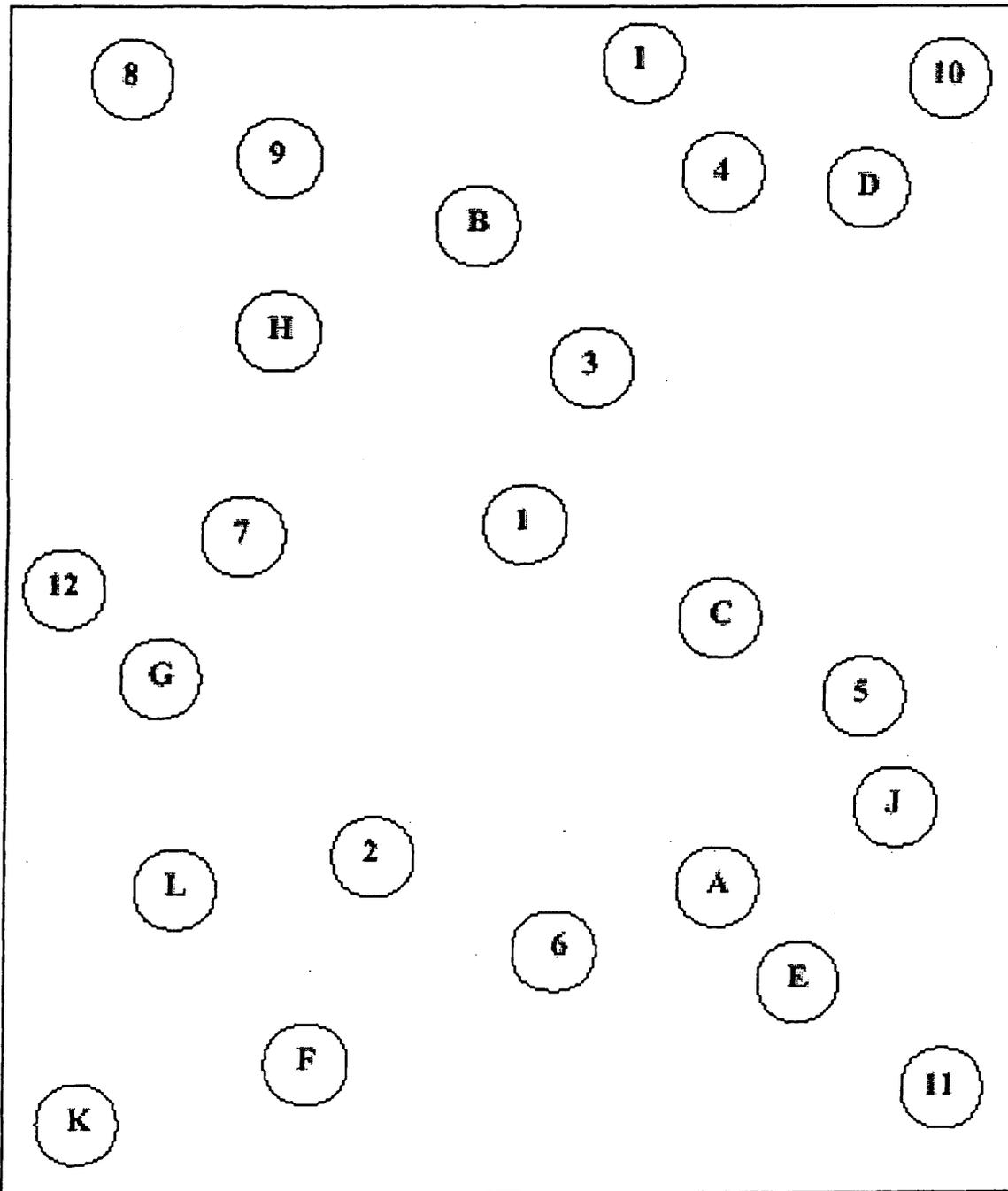
Figure 1 Virtual reality tube image

SSQ-baseline

Instructions: Please report the degree to which you are experiencing each of the following symptoms
at the moment:

	None	Mild	Moderate	Severe
General discomfort	0	1	2	3
Fatigue	0	1	2	3
Headache	0	1	2	3
Eye strain	0	1	2	3
Difficulty focusing	0	1	2	3
Increased salivation	0	1	2	3
Dry mouth	0	1	2	3
Sweating	0	1	2	3
Nausea	0	1	2	3
Difficulty concentrating	0	1	2	3
Fullness of head	0	1	2	3
Blurred vision	0	1	2	3
Dizzy (eyes open)	0	1	2	3
Dizzy (eyes closed)	0	1	2	3
Vertigo	0	1	2	3
Stomach awareness	0	1	2	3
Wind	0	1	2	3

Post VR Questionnaire 1

We are interested in your views of the other people who were on the tube. Please circle **how much you agree or disagree** with following statements based upon your thoughts when you were on the tube.

	Do not agree	Agree a little	Agree Moderately	Agree very much	Totally Agree
1. Someone was hostile towards me	1	2	3	4	5
2. No-one had any particular feelings about me	1	2	3	4	5
3. Someone had bad intentions towards me	1	2	3	4	5
4. Someone was friendly towards me	1	2	3	4	5
5. Someone was trying to make me distressed	1	2	3	4	5
6. I felt very safe in their company	1	2	3	4	5
7. Someone stared at me in order to upset me	1	2	3	4	5
8. Everyone was trustworthy	1	2	3	4	5
9. Someone wanted me to feel threatened	1	2	3	4	5
10. I wasn't really noticed by anybody	1	2	3	4	5
11. Someone had kind intentions toward me	1	2	3	4	5
12. Someone would have harmed me in some way if they could	1	2	3	4	5
13. Someone had it in for me	1	2	3	4	5
14. Everyone was neutral towards me	1	2	3	4	5
15. Someone was trying to intimidate me	1	2	3	4	5
16. Everyone was pleasant	1	2	3	4	5
17. Someone was trying to isolate me	1	2	3	4	5
18. No-one had any intentions towards me	1	2	3	4	5
19. Everyone seemed unconcerned by my presence	1	2	3	4	5
20. Someone was trying to irritate me	1	2	3	4	5

PARTICIPANT NO: DATE:...............................

Centre Number:
Participant Identification Number for this trial:

CONSENT FORM- AUDIO TAPE

Title of Project: A virtual reality and questionnaire study of everyday worries

Name of Researcher: Miriam Fornells-Ambrojo

Please initial box

1. I consent to have the interview about the virtual reality experience audio taped as part of the "virtual reality and questionnaire study of everyday worries" study

2. I understand that anything I say will be kept entirely confidential to the research team and that no identifying names will be used in reports in the study

3. I understand that the tapes will be destroyed no later than eight years after the end of the study.

Name of Participant   Date   Signature

Name of Person taking consent   Date   Signature
(if different from researcher)

Researcher   Date   Signature

1 for participant; 1 for researcher

Participant num:

      Today's date:

Virtual reality semi-structure interview

Virtual reality interview

GENERAL

- What did you think about your virtual reality experience?

- Was it what you expected?

- What thoughts ran through your mind whilst you were in the Virtual tube?

- How was it like being in the VE?

- How was it like to interact with people in VE? How would have been like without other people?

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INTENTIONALITY

- What did you think of the people in the VE?

- What did you think of the behaviour of people in the VE? What were they doing?

- Do you think people in the VE had intentions towards you?

- How did you feel towards them?

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EVIDENCE

- What made you think that (i.e. what evidence did you base your thoughts on)?

- Can you think of an alternative explanation for that piece of evidence?

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Participant num:
    Today's date:
Virtual reality semi-structure interview

BEHAVIOUR

- How did you behave in VE? Was that different to how you would normally behave?

- Motivation: Behaviour as a reaction to beliefs about others, with other purposes?

- Environmental triggers of own behaviour

EMOTIONS

- How are you feeling now? Did you feel emotional or aroused in any way whilst you were in the VE?

- How did the people in the VE made you feel?

VIRTUAL REALITY EXPERIENCE

- How do you think the virtual tube compared to your experience of being on a real street?

- Presence   Were there any times when you felt totally immersed in the VE? Times were the opposite happened?

- Co-presence   How real did the people in the virtual street felt?

<u>Post VR questionnaire 2</u>
The following questions relate to your recent virtual reality experience. Please read each question and answer as you are instructed in each one.

1. Please rate the extent to which you were aware of background sounds in the real laboratory (outside the virtual reality experience):

Not at all aware of background sounds	1	2	3	4	5	6	7	Very much aware of background sounds

2. How dizzy, sick or nauseous did you feel as a result of the experience, if at all?

Not at all	1	2	3	4	5	6	7	Very much

3. Please rate the sense of actually being in the tube train:

Abnormal experience	1	2	3	4	5	6	7	Normal experience of being in a tube train

4. To what extend were there times during the experience when the virtual tube train became "reality" for you, and you almost forgot about the "real world" of the laboratory in which the whole experience was actually taking place?

At no time	1	2	3	4	5	6	7	Almost all the time

5. When you think back about your experience, do you think of the virtual tube train more as "images that you saw", or more as "somewhere that you visited"?

Images that I saw	1	2	3	4	5	6	7	Somewhere that I visited

6. During the experience, which was strongest on the whole, your sense of being in the virtual tube train, or being in the real world of the laboratory?

Laboratory	1	2	3	4	5	6	7	Virtual tube train

7. Have you experienced "virtual reality" before?   NO   YES

If YES: how many times?..............

8. Consider your memory of being in the tube train. How similar is the memory of the virtual reality experience to other memories of "real places" in terms of: visual quality, size, colour and how realistic and vivid it seems in your imagination?

Not at all similar	1	2	3	4	5	6	7	Very similar

9. To what extend do you use a computer in your daily activities?

Not at all	1	2	3	4	5	6	7	Very much

10. During the experience, did you think to yourself that you were actually "just standing in a room wearing equipment" or did the virtual tube "overwhelmed" you? The virtual tube train overwhelmed me....

Not at all	1	2	3	4	5	6	7	All of the time

Participant ID: Date:
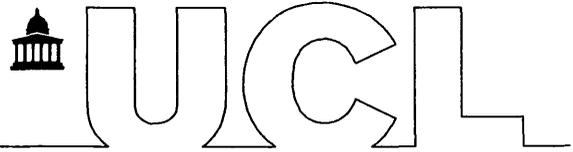
Centre Number:
Participant Identification Number for this trial:

CONSENT FORM- post virtual reality

Title of Project: A virtual reality and questionnaire study of everyday worries

Name of Researcher: Miriam Fornells-Ambrojo

Please initial box

1. I consent to being contacted by telephone one week from today's date. ☐

Preferred contact time: 9 am-5 pm ☐ After 5 pm ☐

Contact number of the above time: ....

2. I would like to receive feedback from the study ☐

Address to send the feedback: ....

....

Name of Participant	Date	Signature

Name of Person taking consent (if different from researcher)	Date	Signature

Researcher	Date	Signature

1 for participant; 1 for researcher

PARTICIPANT NO: DATE:

What we are after is simply if they had any intrusions, descriptions of what they are like and the affective response.

1) Were you reminded about or did you have thoughts about the VR environment, over the last week?
   [ ] YES   [ ] NO

If YES describe (examples) prompt:
1.a) Could you describe what these thoughts were like?

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+--------------------------------------------------------------------+
|                                                                    |
|                                                                    |
|                                                                    |
|                                                                    |
|                                                                    |
|                                                                    |
|                                                                    |
+--------------------------------------------------------------------+
```

1.b) How often did these thoughts occur?

[ ] once in the past week	[ ] more than once a day but less than once every hour
[ ] more than once but not everyday	[ ] once every hour
[ ] once a day	[ ] continuously

2) Did you think about the VR when you didn't want to ?   [ ] YES   [ ] NO
if YES ask:
2.a) How disruptive were these thoughts? 0-100 _____--
2.b) How did that make you feel (0-100)

```
+--------------------------------------------------------------------+
|   -    Anxious          ......                                     |
|   -    Angry            ......                                     |
|   -    Sad              ......                                     |
|   -    Happy            ......                                     |
|   -    Other, name and rate from 0-100                             |
+--------------------------------------------------------------------+
```

3) Have you done anything different because of the experiment? [ ] YES   [ ] NO

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+--------------------------------------------------------------------+
|                                                                    |
|                                                                    |
|                                                                    |
|                                                                    |
|                                                                    |
+--------------------------------------------------------------------+
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4) Have you avoided going anywhere (e.g. using the Tube) because of the VR? [ ] YES [ ] NO

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+--------------------------------------------------------------------+
|                                                                    |
|                                                                    |
|                                                                    |
|                                                                    |
+--------------------------------------------------------------------+
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Other comments:

```
+--------------------------------------------------------------------+
|                                                                    |
|                                                                    |
|                                                                    |
+--------------------------------------------------------------------+
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21

I: So, you were saying to me that...if you had asked anything to anybody in the tube...

R: I was looking and walking up and down the platform, I mean up and down the train.... And I was looking at people... so I think they would have found that a bit irritating... because I had not business there... it was like I'm invading their space... there is so little space in the underground...(THEME: SOCIAL SCRIPTS REAL TUBE) so that's all

I: So, who did you find the experience?

R: I found it quite strange; it's the first time I've been in a virtual reality, quite strange, you know... I'm not back in the real world... yeah.... yeah... what was the question?

I: How did you find it?

R: It was a good experience, it was fun......(THEME: NEW, INTERESTING, ENJOYED)

I: What thought were running through your head when you were in there?

R: I was thinking... it looks almost real, you know? The people... it takes you into the dimension of the real world... into the fantasy world... into the virtual... a computer world... yeah... it was quite interesting (THEME: SENSE OF PRESENCE)

I: So, you were having these thoughts about it being quite interesting and quite real...

R: Just like begin into a different world, a different world to the world we live in...

I: And what about the people there, what did you think of them?

R: The people seemed peaceful, you know, they mind their own business, (THEME: NEUTRAL) like they were just getting on with what they were doing, waiting for their stop... yeah... people were nice, people seemed friendly in there (THEME: FRIENDLY)... there was no hostile behaviour on the train...you know, nobody was shouting... mhm... what else...yeah...you know... that was it...

I: Okay... Did you feel as if somebody was doing something with intentions towards you?

R: Ah...intentions... there was only...intentions towards me... no, I don't think so, no

I: You were saying " the only..."

R: There were only two things that I think... er... that was irritating... when I was standing and they turned their head like that... you know... I though like... they don't want to look at me or something like that...(THEME: ACTIONS OF AVATAR PERCEIVED NEGATIVELY) but that was the only thing... and maybe as I was going through... there was a lady that seemed to be obstructing(THEME: ACTIONS OF AVATAR PERCEIVED NEGATIVELY)) ... there was still space... in the compute simulation is hard to move around ... yeah... apart from that... everybody seemed pretty friendly and people were minding they own business (THEMES: FRIENDLY & NEUTRAL) If there was a bunch of teenagers (THEME:REAL WORLD EXPERIENCES POTENTIALLY MORE THREATENING), I would have felt different... but people that were there were normal

I: I have asked you if you thought they had any intentions towards you... but how did you feel about them?

R: I thought some people were normal dressed.... Some people looked attractive... I know it's a computer simulation... but I thought that somebody tried... er... looked attractive ...

what else... I thought it was interesting... I would have liked to know where they were going, which stations...

I: Yes, that is okay, I'm interested in what you thought... so that is okay... if that's it, it's good. And what were you trying to do... the way you were acting... ?

R: I was just trying to look at everybody, I was just trying to see everybody, their features, see everybody, and see what their behaviour was, you know... see what their facial expression were like... and that is it... I was thinking... just looking around...sightseeing (THEME: GENERALLY EXPLORING THE ENVIRONMENT)

I: Sightseeing, and you were looking at everybody

R: Yes, everybody, every individual in the carriage

I: And how did you feel when you were in there... did you have any emotions at all?

R: Mhm... er... can I compare it to a real life experience?

I: Yes

R: I don't think that in a real train I could do that... I'd like to say that now... yeah... so what was the question?

I: How were you feeling?

R: I felt quite relaxed, I felt really relaxed... like it was easy.... Relaxed... what else...

I: Yes, that is enough... if this is how it was for you. Mhm... going back to what you said... comparing this tube to the real tube... how similar or dissimilar were they?

R: Er.... Quite similar, but there is a difference, one was in the real world and one wasn't... and it's different, one, one you do it with real people, therefore you are dealing with real feelings, and also... you are feeling real feelings too... so ... that is a big difference.... Also in the real world people are much more unpredictable... so , there is a difference, there was a safety in the virtual reality place...(THEME:REAL WORLD EXPERIENCES POTENTIALLY MORE THREATENING)

I: Yes...

R: So, 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... it's something that I just do... I don't want to give wrong impressions, you know... ...(THEME:REAL WORLD EXPERIENCES POTENTIALLY MORE THREATENING) because sometimes if you don't really look happy, that reflects in the way you... you tend to withdraw... you know... other than just, you know

I: Thanks so much. Is there anything you want to mention in terms of the people, the way they looked, or anything else... or you think we have covered everything?

R: Mhm... no not really.... I know it was summer, it must have been spring time or summer

I: Yes, okay... you noticed that!

R: Because of the dress code, isn't it... some people were in shorts...

I: Yes. Well, thank you so much I am just going to stop the tape.

I: It's recording now... so you want to tell me how was the experience in the virtual reality?

R: I didn't feel that my presence in the tube made any difference to anyone there... and it was just like being in the normal tube...without being noticed (THEME: NEUTRAL) add to analyses)...it was like being present (THEME: SENSE OR PRESENCE, REAL BUT NOT REAL) in the tube I haven't been in virtual reality before... and...pretty much it was fun being in the virtual reality tube (THEME: INTERESTING, ENJOYED)

I: What thought were running through your mind when you were in there? What were you thinking?

R: A few times I was trying to make out if someone was actually trying... you know... look at me... or is my presence being watched... but I didn't feel anything, I felt completely normal...(THEME: HYPOTHESIS TESTING) just trying to see more about how the virtual reality thing works...

I: And how was it to interact with the characters in there...

R: It was pretty normal, it didn't make any difference to me at all... and it didn't make any difference to them...(THEME: NEUTRAL)

I: And in terms of what you were trying to do... you said you were trying to see if you presence made any difference... and you realised it didn't... so what kind of things were you trying to do?

R: I was just walking around and sometimes staring at people... to see, you know, if they would stare back at me... you know... but nothing of that sort happened... (THEME: HYPOTHESIS TESTING)

I: Was there anything in the virtual reality that made you react in a certain way?

I: Mhmm

R: I was looking at this lady... and there was this gentleman sitting besides her...

I: Sorry?

R: A man sitting besides her... and ... when I was starting at her...I think that he stared back at me... and that gave me an unpleasant feeling... (THEME: IMPRESSION/AFFECT)

I: So, it felt like he was staring back at you because you were staring at her?

R: At the girl

I: Yes, you stared at the girl, and the man sitting next to her, stared at you and that made you feel unpleasant... so what did you think he was trying to do?

R: Maybe the girl told him, you know, that guy is staring at me... and the guy check me out... that I was staring at her...that is it...

I: Did you have any feeling when you were in there? Did you experience any emotions?

R: It was fun. (THEME: INTERESTING, ENJOYED)

I: And would you say it was similar to a real tube?

R: Similar in how people behave in the tube.... Minding their own business...(THEME: NEUTRAL

I: Anything I haven't asked you about the experience that you would like to add?

R: No

I: Okay, thank you.