

# Hypersensitivity to Contingent Behavior in Paranoia

## A New Virtual Reality Paradigm

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**Abstract:** Contingency in interpersonal relationships is associated with the development of secure attachment and trust, whereas paranoia arises from the overattribution of negative intentions. We used a new virtual reality paradigm to experimentally investigate the impact of contingent behavior on trust along the paranoia continuum. Sixty-one healthy participants were randomly allocated to have a social interaction with a pleasant virtual human (avatar) programmed to be highly responsive or not (high/low contingency). Perceived trustworthiness and trusting behavior were assessed alongside control variables attachment and anxiety. Higher paranoia and dismissive attachment were associated with larger interpersonal distances. Unexpectedly, extremely paranoid individuals experienced the highly contingent avatar as more trustworthy than their low contingency counterpart. Higher dismissive attachment was also associated with more subjective trust in both conditions. Extreme paranoia is associated with hypersensitivity to noncontingent behavior, which might explain experiences of mistrust when others are not highly responsive in everyday social situations.

**Key Words:** Attachment, trust, paranoia, contingency, social environment, virtual reality

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Contingency in interpersonal relationships plays an important role in early life, with parental responsiveness shown to be a predictor of secure attachment (Dunst and Kassow, 2008). In recent years, insecure attachment has been considered in pathways to persecutory delusions (Berry et al., 2006; MacBeth et al., 2008). The caregiver's accurate attribution of mental states facilitates the development of the infant's mentalizing capacity (Fonagy et al., 2007) but "overmentalizing" (Versmissen et al., 2008) can lead to paranoia via external attributions (Bentall et al., 2001). Accordingly, perceiving intentionality when there is none has been reported in people with persecutory delusions (Blakemore et al., 2003).

Paranoia has also been associated with safety behaviors, attempts to minimize perceived threat (Freeman et al., 2007). We propose that interpersonal boundaries are a type of safety behavior that can be conceptualized as self-regulatory (Mikulincer and Shaver, 2007), aiming to "deactivate" the attachment system and protect from interpersonal threat. Increased interpersonal boundaries are indeed reported in psychosis (Park et al., 2009) and are crucially associated with an external locus of control (Duke and Mullens, 1973). Accordingly, unfounded paranoia has been elicited in people with persecutory delusions, early psychosis, at-risk mental state, and high trait nonclinical paranoia in ambiguous virtual environments (Fornells-Ambrojo

et al., 2008; Freeman et al., 2010; Lysaker et al., 2010; Valmaggia et al., 2007).

We know that interactional synchrony influences trust (Kendon, 1970), but to date, no research has investigated the role of contingent behavior in people with paranoia. Virtual characters programmed to give contingent nonverbal feedback (e.g., nods) in response to participants' behavior elicit more rapport than noncontingent ones (Gratch et al., 2006). Mimicry also increases perceived likeability while it remains outside the perceiver's awareness (Bailenson et al., 2008). However, social anxiety reduces the impact of mimicry (Vrijssen et al., 2010).

This novel virtual reality (VR) study investigates interpersonal processes in paranoia by manipulating the contingency of virtual human (avatar) behavior. Perceptions of trustworthiness and interpersonal distance are evaluated. We hypothesize that a) the impact of contingent behavior on subjective trustworthiness and interpersonal distance will depend on trait paranoia. An interaction is predicted whereby higher contingent behavior results in higher trustworthiness and reduced interpersonal distance in individuals with low paranoia, whereas high trait paranoia participants will be immune to the contingency manipulation; and b) insecure attachment will be associated with lower levels of trust and larger interpersonal distance.

## METHOD

### Participants and Procedure

Healthy male volunteers 18 years or older were recruited from a London university. Exclusion criteria were a history of epilepsy or mental health problems, assessed with a question in the demographics section and a positive screen in the Psychosis Screening Questionnaire (Bebbington and Nayani, 1995). Ethical approval was obtained from the Division of Psychology and Language Sciences. Potential participants first completed a series of online screening questionnaires. Eligible participants were then invited by email to attend the Virtual Reality Lab at the Department of Computer Science. Written informed consent was obtained. Participants completed a series of post-VR measures and received £10.

### VR Apparatus and Scenario

The VR environment was displayed in an immersive projection system. High-resolution images were projected in real-time onto three back-projected wall screens (3 m × 2.2 m) and a floor screen (3 m × 3 m). Stereo presentation was delivered via Lightweight CrystalEyes shutter-glasses. An inertial/ultrasonic head-tracking device was mounted on the glasses. Spatialized audio was delivered via four corner speakers. Intersense IS900 was used for 6 degrees of freedom head-tracking. The VR scenario represented a student flat and was designed to be non-anxiety provoking. The virtual tenant, "Mark," was a young man. The scenario had three stages. 1) The virtual tenant introduced himself to the participant and asked the participant his/her name. 2) Following the avatar's cue that he was ready, participants asked the virtual flatmate set questions. 3) When participants asked their fourth and last question (What is the best thing about this flat?), Mark walked toward the window and invited the participant to see the terrace. The scenario lasted 2½ minutes.

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## Contingency Manipulation

Some of the virtual flatmate's nonverbal responses were programmed to have contingent/noncontingent relationship to participant's head movements. In the high-contingency (HC) condition, the virtual flatmate tilted his head every time the participant moved the head from side to side, with a 1.5-second delay. When participants moved their head in any other way, the virtual flatmate swayed side to side. In addition, the researcher triggered avatar nodding each time the participant spoke. In the low-contingency (LC) condition, avatar responses were programmed to occur, but with a 20-second delay.

## VR Procedure

Participants were divided into two groups based on a median split in paranoia scores and they were randomly allocated to the HC/LC condition by permuted blocks method. Participants were informed that the study aimed to understand how people respond to virtual environments. They were instructed to enter the scenario and to interview the virtual tenant by asking him four preset questions in order (e.g., Q1: What do you like about flat sharing?). They were given a prompt sheet.

## Measures

The pre-VR measures were a) the Paranoia Scale (PS) (Fenigstein and Venable, 1992), b) the Trait Anxiety Inventory (STAI) (Spielberger, 1983), and c) the Relationship Questionnaire (RQ) (Bartholomew and Horowitz, 1991). VR measures included d) interpersonal distance, a behavioral measure of trusting behaviour assessed by the mean distance kept by the participant from the virtual tenant during the last scene. The distance was automatically recorded (in meters) using horizontal Pythagorean distance. Baseline distance used as control was measured in the same way from the start of the scenario. Post-VR measures were e) subjective avatar trustworthiness, assessed by asking participants to rate how trustworthy the virtual tenant had come across to them on a 7-point Likert scale, and f) the Sense of Presence Questionnaire (Slater et al., 1998).

## Statistical Analyses

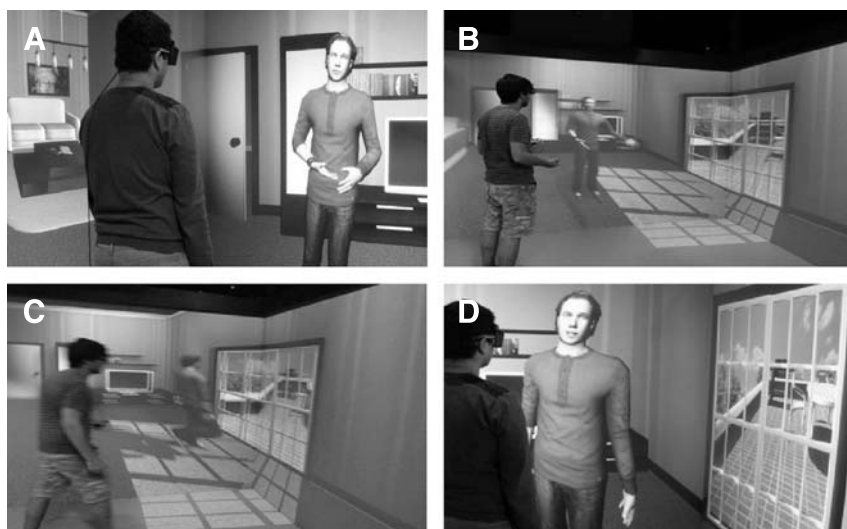
Data were analyzed using SPSS for Windows (v.21). Hierarchical regression analyses were conducted to predict the two dependent

variables: trustworthiness and interpersonal distance. In step 1, individual key predictor variables (paranoia, contingency condition) and control variables (anxiety, avatar movement, attachment) were included using the Enter Method. When mean interpersonal distance from the virtual tenant was the dependent variable, mean baseline distance was also entered as a covariate in step 1. In step 2, the interaction term (paranoia  $\times$  contingency condition) was added also using forward selection method. Step 1 was included to investigate the main effects of paranoia and the contingency condition on the dependent variables because the inclusion of the interaction term in step 2 prevents interpretation of coefficients for these variables as they reflect conditional relationships (Jaccard et al., 1990). Regression residual plots confirmed approximation to a normal distribution. The Johnson-Neymann technique was used to follow up significant interactions.

## RESULTS

A total of 281 potential participants accessed the online pre-VR survey, 93 of which did not complete the survey, and 46 were excluded because of a history of mental illness. Of the 142 contacted to participate, 54 did not reply and 25 were not available to meet within the study timeframe. Of the 63 participants who took part in the study, 2 were excluded because of unexpected technical faults during the running of the virtual scenario. Sixty-one men participated. Their mean (SD) age was 25.3 (7.3) years, 47 (77%) were from a white ethnic background, and 55 (90%) had student status. The mean (SD) paranoia score (PS; Fenigstein and Venable, 1992) was 35.57 (10.96) (range, 22–63), and trait anxiety (STAI) (Spielberger, 1983) had a mean (SD) of 38.08 (8.91). PS and STAI were significantly correlated (Pearson's  $r = 0.48$ ,  $p < 0.001$ ). About half of the sample ( $n = 30$ , 49%) had a secure attachment as indicated by the RQ (Bartholomew and Horowitz, 1991). Mean (SD) continuous scores for individual attachment categories were as follows: secure, 4.87 (1.56); insecure fearful, 3.16 (1.82); insecure preoccupied, 2.72 (1.85); and insecure dismissive, 3.84 (1.26). Paranoia was significantly associated with secure (Pearson's  $r = -0.28$ ,  $p = 0.029$ ), insecure fearful (Pearson's  $r = 0.38$ ,  $p = 0.002$ ), and insecure preoccupied (Pearson's  $r = 0.38$ ,  $p = 0.052$ ) but not with dismissive attachment (Pearson's  $r = 0.12$ ,  $p = 0.354$ ).

Interpersonal distance between the participant and the avatar at the last stage of the virtual interaction (Fig. 1D) had a mean (SD) of 1.43 (0.26) m (range, 0.93–2.20 m), which compares to a mean baseline



**FIGURE 1.** Virtual reality images of interaction with virtual tenant: sequence of events. (A) Initial greeting (stages 1 and 2). (B) Virtual tenant invites participant to look at the terrace, "Come and have a look!" (stage 3). (C) Virtual tenant and participant walk toward the window (stage 3). (D) Virtual tenant and participant have moved across the room to look at the terrace (stage 3).

distance (Fig. 1A) of 2.02 (0.26) m (range, 1.37–2.60 m). These values are in line with implicit rules about social distance (Hall, 1966). Participants reported a mean (SD) level of subjective avatar trustworthiness of 4.87 (1.07) (range, 2–7). Subjective trust and interpersonal distance were not significantly associated (Pearson's  $r = -0.03, p = 0.833$ ). The HC ( $n = 30$ ) and LC ( $n = 31$ ) groups did not differ on subjective trust ( $t = 0.76, df = 58, p = 0.452$ ) or interpersonal distance,  $F(1, 58)$  [covarying for baseline distance] = 0.67,  $p = 0.417$ ). The mean total number of contingent avatar movements significantly differed between the HC (mean [SD] = 23.1 [7.3]) and LC (mean [SD], 7.0 [1.1]) conditions ( $t = 11.86, df = 59, p < 0.001$ ). Participants felt as if they were in the virtual flat, as shown by a mean (SD) sense of presence (Slater et al., 1998) score of 25.47 (6.52) (range, 11–38).

**Predictors of Trusting Behavior and Subjective Trustworthiness**

Table 1 shows the results of a multiple regression predicting interpersonal distance from the virtual tenant. A greater distance from the avatar (less trusting behavior) was predicted by higher paranoia and dismissive attachment (dismissive attachment was entered in step 1 out of the four attachment categories because of its association with the dependent variables: Dismissive attachment was found to be the only attachment type that was either significantly associated with subjective trust,  $r = 0.31, p = 0.016$ , or approached significance for interpersonal distance,  $r = 0.23, p = 0.083$ ), as well as by greater distance at the start of the conversation and less avatar movements.

Greater trustworthiness was predicted by higher levels of dismissive attachment and by the interaction between paranoia and contingency (see Table 1, step 2). The Johnson-Neymann technique was used to

characterize the interaction. The conditional effect of contingency condition on trust transitioned to significance at a paranoia score of 49.89 ( $b = -1.24, SE = 0.15, t = -2.01, p = 0.05, 95\%$  confidence interval,  $-2.49$  to  $0.00$ ) at the 90th percentile of the distribution in the sample ( $n = 8$ ), with the relation between trust and contingency condition being significant at paranoia scores above this point. In sum, individuals with high trait paranoia reported significantly higher levels of trust toward a highly responsive avatar (HC) than to an avatar that was less responsive (LC).

**DISCUSSION**

**Self-Regulatory Attachment Behavior**

A novel VR paradigm was used to investigate the impact of interpersonal contingency on trust. Trusting behavior, operationalized as interpersonal distance, was predicted by higher paranoia, dismissive attachment, baseline interpersonal distance, and avatar movement but not by the degree of avatar contingent behavior. This is in line with evidence from experience data sampling in people with high paranoia who reported social threat irrespective of degree of familiarity (Collip et al., 2011) and failure to adjust behavior in response to evidence of another agent's trustworthy behavior in economic exchange paradigms (Fett et al., 2012).

High subjective trust was not reflected behaviorally in closer proximity with the avatar. Dismissive attachment was also associated with both higher subjective trust and larger interpersonal distances. Why would individuals who are experiencing another as trustworthy behave in a way that might signal mistrust? Anomalous trust behavior with discrepancies between observed trusting behavior in the presence

**TABLE 1.** Multiple Regressions Predicting Interpersonal Distance and Avatar Trustworthiness

Dependent Variable	Interpersonal Distance (at Window in Meters)					Avatar Trustworthiness				
	B	SE (B)	$\beta$	t	p	B	SE (B)	$\beta$	t	p
<b>Step 1</b>										
Baseline distance	0.31	0.11	0.32	2.81	0.007**	–	–	–	–	–
Avatar movement	–0.02	0.01	–0.66	–3.15	0.003**	–0.02	0.03	–0.33	–0.53	0.583
Trait anxiety	0.00	0.00	0.11	0.81	0.419	–0.02	0.02	0.15	–0.96	0.343
Dismissive attachment	0.04	0.02	0.26	2.27	0.027*	0.20	0.09	0.30	2.24	0.029*
Paranoia	0.01	0.00	0.33	2.55	0.014*	0.01	0.01	0.07	0.48	0.633
Contingency	–0.19	0.11	–0.37	–1.72	0.091	–0.20	0.52	–0.09	–0.38	0.708
$F(6, 54) = 4.89, p < 0.001^{***}, \text{adj } R^2 = 0.28$					$F(5, 54) = 1.47, p = 0.215, \text{adj } R^2 = 0.038$					
<b>Step 2</b>										
Avatar movement	–0.02	0.03	–0.20	–0.86	0.392					
Trait anxiety	–0.02	0.02	0.14	–0.99	0.325					
Dismissive attachment	0.23	0.08	0.35	2.72	0.009**					
Paranoia	0.03	0.02	0.35	2.04	0.047 <sup>a</sup>					
Contingency	–0.29	0.49	–0.14	–0.59	0.560 <sup>a</sup>					
Paranoia × contingency	–0.07	0.24	–0.44	–2.75	0.008**					
$F(6, 53) = 2.63, p = 0.026^*, \text{adj } R^2 = 0.142, \Delta R^2 = 0.110$										

Note: Step 1 predictors (method: enter): baseline distance in meters (for interpersonal distance regression only), avatar movements, Trait Anxiety Inventory (STAI; Spielberger, 1983), dismissive attachment assessed by the RQ (Bartholomew and Horowitz, 1991), and PS (Fenigstein and Vanable, 1992). Contingency condition variable coding is as follows: HC = 0; LC = 1. Step 2 predictor (method: forward selection): paranoia × contingency interaction.

<sup>a</sup>Values for paranoia and contingency entered in step 2 regression analyses are not interpretable because of the presence of the interaction term paranoia × contingency in the equation. For DV = interpersonal distance, the interaction term paranoia × contingency condition was entered in step 2 using forward selection but was not kept in as it did not significantly contribute to the model ( $\beta = 0.062, t = 0.423; p = 0.674$ ) and would have resulted in a negligible increase in total variance explained ( $\Delta R^2 = 0.002$ ).

\* $p < 0.05$ .

\*\* $p < 0.01$ .

\*\*\* $p < 0.001$ .

of subjective trust can be rooted in insecure attachment (Fonagy et al., 2007). Indeed, children with externalizing behavior, who, like individuals with paranoia (Combs et al., 2007), have been found to have a hostile attribution style (de Castro et al., 2005), are trusting of others but seem less trustworthy. Experiencing another as trustworthy in the context of a history of disrupted attachments can be threatening and give rise to overarousal (Horowitz et al., 1964). Distancing is therefore conceptualized as a “deactivating strategy,” a self-regulatory attachment behavior (Mikulincer and Shaver, 2007).

### Hypersensitivity to Contingency in Extreme Paranoia?

Tasks used to investigate intentionality in paranoia (Blakemore et al., 2003) have been criticized for their third-person perspective (Chan and Chen, 2011) and questionable generalizability (Montag et al., 2011). In contrast, the current paradigm manipulated used a first-person perspective. Under these circumstances, people with extreme nonclinical paranoia, against our predictions, showed a heightened perceptiveness to contingent behavior instead of overattributing intentionality. Heightened sensitivity to threat could emerge from adverse childhood experiences (MacBeth et al., 2008). Indeed, attachment-disrupting events, such as being brought up in an institution, have been implicated in paranoia (Bentall et al., 2014), and in at risk of psychosis populations, interpersonal sensitivity, an excessive awareness of the behavior of others, has been associated with paranoia (Masillo et al., 2012; Valmaggia et al., 2007). The current study suggests that particularly high levels of interpersonal contingency might be necessary for highly paranoid individuals to develop trust, and therefore, the absence of high responsiveness from others is experienced as a sign of mistrust. As argued in the interpersonal theory of poor me paranoia of Trower and Chadwick (1995), threats to the self can arise from the lack of objectifying other and the defense involves transforming indifference into persecution.

### Research and Clinical Implications

The findings should be interpreted with caution given the small sample size, with only eight participants in the 90th percentile of high paranoia showing sensitivity to the contingency manipulation. However, data in the current study replicate continuum research with extreme subclinical paranoia, such as (Combs and Penn, 2004) reports that those on the 85th percentile of paranoia, with paranoia scores of PS 53 or higher ( $n = 29$ ), prefer larger interpersonal distances than do people with low paranoia in an in vivo social task. Further research should focus on the role of paranoid belief characteristics such as intentionality to cause harm, which differ between those at the top and those at the bottom of the paranoia hierarchy (Freeman et al., 2005) as well as investigating contingency manipulations in more ambiguous scenarios that increase anxiety (Lysaker et al., 2010). The current findings also need to be replicated with clinical and nonclinical populations, including women. The analog nature of the study is also a limitation, and further work could use naturalistic designs to capture the richness of real-life social encounters. However, the use of VR allowed us to control for confounds and focus on the aspects under investigation. Moreover, participants reported a sense of presence, a subjective feeling of “being” in the virtual scenario, and their interpersonal behavior followed proxemics rules (Hall, 1966), supporting the validity to the paradigm.

Paranoia about the therapist has been linked to lack of progress in cognitive therapy for psychosis (Lawlor et al., 2014). The current study suggests that when working clinically with individuals with high trait paranoia, awareness of potential interpersonal sensitivity and therapist's own contingent behavior may be particularly important, as careful attention to the client and contingent responsiveness might be crucial for the development of a trusting therapeutic relationship.

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### DISCLOSURES

The authors declare no conflicts of interest.

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