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A paradigm for the study of paranoia in the general population: The Prisoner's Dilemma Game

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A growing body of research shows that paranoia is common in the general population. We report three studies that examined the Prisoner's Dilemma Game (PDG) as a paradigm for evaluation of non-clinical paranoia. The PDG captures three key qualities that are at the heart of paranoia—it is interpersonal, it concerns threat, and it concerns the perception of others' intentions towards the self. Study 1 ($n = 175$) found that state paranoia was positively associated with selection of the competitive PDG choice. Study 2 ($n = 111$) found that this association was significant only when participants believed they were playing the PDG against another person, and not when playing against a computer. This finding underscores the interpersonal nature of paranoia and the concomitant necessity of studying paranoia in interpersonal context. In Study 3 ($n = 152$), we assessed both trait and state paranoia, and differentiated between distrust- and greed-based competition. Both trait and state paranoia were positively associated with distrust-based competition (but not with greed-based competition). Crucially, we found that the association between trait paranoia and distrust-based competition was fully mediated by state paranoia. The PDG is a promising paradigm for the study of non-clinical paranoia.

Keywords: Non-clinical paranoia; Prisoner's Dilemma Game; Experimental methodology.

Recent research has suggested that "ordinary individuals, in their everyday behaviour, manifest characteristics—such as self-centred thought, suspiciousness, assumptions of ill will or hostility, and even notions of conspiratorial intent—that are reminiscent of paranoia" (Fenigstein & Vanable, 1992, p. 130). A growing number of survey studies shows that paranoia is indeed common in the general population (e.g., Ellett, Lopes, & Chadwick, 2003; Fenigstein & Vanable, 1992; Freeman et al., 2011). This finding is consistent with the idea that experiences such as clinical paranoia lie on continua functions with ordinary behaviour (Strauss, 1969).

In addition to these survey studies, two main experimental methods have also found evidence

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Study 1 formed part of the doctorate work of RA-C; Studies 2 and 3 part of the doctorate work of AS.
We thank BF for his help with development and validation of the SPS.

of state paranoia in non-clinical samples. The first paradigm was developed by Bodner and Mikulincer (1998) and subsequently used by Ellett and Chadwick (2007). It involves participants undertaking an experimental task with preset outcomes (no feedback, universal failure or personal failure) under conditions of high or low self-awareness. This method has offered empirical evidence that state paranoia can be triggered by the combination of high self-awareness plus either ambiguous feedback or explicit failure. This juxtaposes two elements long-associated with paranoia: First, focusing attention on the self increases paranoid cognitions, presumably because by directing attention towards the self one comes to think that others are doing the same (self-as-target bias; Fenigstein & Vanable, 1992). Ellett and Chadwick (2007) demonstrate empirically how heightened self-awareness is a key trigger for non-clinical paranoia. Second, possible (i.e., ambiguous feedback) or explicit failure elicits excessively external causal attributions in at least a proportion of people with clinical paranoia (Bentall, Corcoran, Howard, Blackwood, & Kinderman, 2001). Bentall and colleagues proposed that this self-serving attributional bias is actuated to protect vulnerable self-esteem in the face of threatened discrepancies between actual and ideal self. Consistent with this hypothesised self-protective function of paranoia, Ellett and Chadwick (2007) showed that a prior self-affirmation task reduced the experience of state paranoia under conditions of high self-awareness.

A second experimental paradigm for studying paranoia involves virtual-reality environments (e.g., Freeman, Pugh, Antley, Slater, Bebbington et al., 2008). A strength of this virtual reality research is that the environment is controlled. Thus, research using this methodology has demonstrated that state paranoia can be triggered in neutral environments—that is, in environments that lack an objective threat (Freeman et al., 2008). Virtual reality research can also explore participants' in-the-moment (rather than retrospective) attributions for events.

The series of studies reported here assess the potential of a third experimental paradigm for studying and evaluating non-clinical paranoia: the Prisoner's Dilemma Game (PDG). The PDG, introduced in the 1950s (e.g., Dresher, 1961; Flood, 1952), is a social research paradigm used extensively in ethology, social psychology, political science, and experimental economics (e.g., Camerer, 2003; Poundstone, 1992), but not before to study paranoia. The PDG involves two players, who make a simple forced choice either to co-operate with or compete against each other (Figure 1). The dilemma faced by the players is that each can maximise outcomes by competing (selecting Y). Yet, paradoxically, when both players choose to compete, their outcomes are lower than the outcomes they can achieve by mutual co-operation (selecting X). The PDG thus models real-life situations in which one may be tempted to do something (e.g., hoard scarce resources) while realising that it would be a mistake if everyone acted in this way (Ridley, 1996). As in these real-life situations, trust (the expectation that the other player will select the co-operative X choice) is a sine qua non for establishing mutual co-operation in the PDG, and distrust (the expectation that the other player will select the competitive Y choice) precludes mutual co-operation and promotes competition (Pruitt & Kimmel, 1977). Within social psychology, the PDG has been used extensively to research

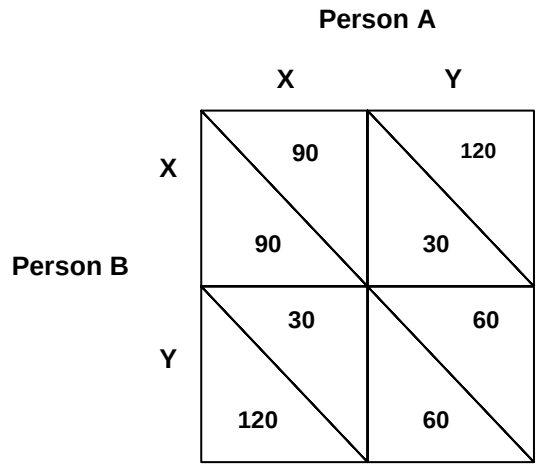

Figure 1. *Prisoner's Dilemma Game matrix. X = cooperation; Y = competition.*

perceptions of trust and distrust within both interpersonal and intergroup interactions (e.g., Cohen, Wildschut, & Insko, 2010).

It is surprising that the PDG has not been used before to study paranoia, given that it captures three key qualities that are at the heart of paranoia: (1) it is interpersonal, as it involves at least two players; (2) it concerns threat and perceptions of others' intentions towards oneself, both of which are key defining characteristics of paranoia (Freeman & Garety, 2000); and (3) the game is necessarily ambiguous (a player is not aware of their opponent's choice at the time of making their own choice), and ambiguity is a known trigger of non-clinical paranoia (Ellett & Chadwick, 2007). In addition, as Freeman and colleagues have duly noted with regard to non-clinical paranoia, "no other markers of this experience are currently available" (Freeman et al., 2008, p. 263). Thus, a further methodological benefit of the PDG is that it can provide a behavioural signature or marker of non-clinical paranoia—that is, the choice to co-operate or compete. This is a valuable assessment to place alongside the self-report questionnaires of paranoia that have been used in previous experimental research. A final benefit of the PDG paradigm is that it is inexpensive and can be easily implemented in different physical environments. The three studies reported in this paper used the PDG as a novel methodology to examine paranoid ideation in a non-clinical sample.

STUDY 1

In Study 1, we used the classic 2-choice PDG to address an initial question: Is there an association between paranoid cognition and behavioural choice in the PDG? The theoretical rationale for Study 1 was that choice to compete on the PDG would be associated with state paranoia—that is, participants experiencing paranoia regarding their opponents' intentions in the PDG would be more likely to compete, because they appraised their opponent as malevolent and competition provides the best defence against a malevolent other (Poundstone, 1992).

Method

Participants

Participants were 64 men and 111 women, aged 18 to 64 ($M_{age} = 29.6$ years, $SD = 9.5$) of whom 95 (54%) were in full-time employment, 8 (5%) were unemployed and 72 (41%) were undergraduate students at a British university. Participants were recruited in two ways: (1) through a student participant pool and (2) via the internet. We used mixed-sampling methods to ensure that the research was not restricted to an undergraduate population.

Measure

State Paranoia Scale (SPS). This is a 4-item scale assessing state paranoia vis-à-vis another person, which was developed for the present programme of research. Participants rate how they perceive the other person by marking responses on a 7-point scale anchored with two opposing statements. The four paranoia items are: (1) "Is friendly towards me" vs. "Is hostile towards me"; (2) "Wants to please me" vs. "Wants to upset me"; (3) "Wants to help me" vs. "Wants to harm me"; and (4) "Respects me" vs. "Has it in for me". Like the Freeman et al. (2007) state paranoia measure, all SPS items contain both elements of threat and intention, such that clear persecutory thinking was assessed. Items were scored so that high ratings indicate higher levels of state paranoia (possible range = 4–28). We administered the SPS to 162 undergraduate students in a pilot study (131 female, 31 male, $M_{age} = 20.7$ years, $SD = 4.49$). A factor analysis revealed a single factor that explained 75% of the total variance. All four SPS items loaded highly on this factor (factor loadings $> .6$). The SPS showed good internal consistency (Cronbach's alpha = .92). In a further pilot study ($n = 286$, 163 female, $M_{age} = 30.4$ years, $SD = 10.7$), we found a significant correlation between the SPS and the Paranoia Scale (Fenigstein & Vanable, 1992), a validated measure

of trait paranoia ($r = .415$, $p = .0005$). These findings attest to the construct validity of the SPS.

Procedure

PDG procedures were modelled on extensive prior research (e.g., Cohen et al., 2010). Participants were given no specific representation or information about their opponent, nor were they given any guidance on game strategy (e.g., to try and maximise ones' earnings). In all information provided to participants, the two choices on the PDG were labelled simply as "X" and "Y" (it is only in writing about the research that we have adopted the nomenclature of "co-operate vs. compete" from Insko, Kirchner, Pinter, Efaw, & Wildschut, 2005). Participants were provided with detailed instructions on the PDG matrix including a review of the possible combinations of choices and their subsequent outcomes (see Figure 1). Participants then were required to pass an exercise assessing their understanding of the outcomes of various combinations of choices. Participants were informed that they would be playing between 1 and 6 rounds of the PDG. This was done to ensure that participants did not know that, in fact, there was to be only a single trial. When participants know that only a single trial is involved this can strongly increase competition, thereby producing restriction of range (Pruitt & Kimmel, 1977). After participants selected their PDG choice on the first (and only) trial, we administered the SPS to assess state paranoia (Cronbach's alpha = .82). Crucially, the state paranoia measure was completed before participants were informed of the other player's choice. After completing the state paranoia measure, participants were told the study involved only a single trial. All participants were then debriefed fully and awarded the maximum pay-off each.

Results and discussion

Overall, 114 (65%) chose to co-operate and 61 (35%) to compete on the PDG. Mean score on the SPS was 13.17 ($SD = 3.2$) for those who co-operated and 14.84 ($SD = 3.46$) for those who competed. Because PDG choice is a dichotomous variable, we calculated the point-biserial correlation coefficient between state paranoia and competition (r_{PB}). As predicted, this correlation was positive and significant, $r_{PB} = .20$, $p = .002$. Study 1 thus supported the main hypothesis that behavioural choice on PDG would be associated with state paranoia, offering encouragement that the PDG might provide a means to evaluate state paranoia in non-clinical samples.

STUDY 2

We propose that the PDG is ideally suited to the evaluation of paranoia because it is an interpersonal task in which choices are based on inferences about the other player's malevolent (vs. benevolent) intentions vis-à-vis the self. Our basic assumption, then, was that paranoia is inherently interpersonal and, accordingly, should be assessed in interpersonal context. In Study 2, we tested this idea by varying whether participants interacted in the PDG with another person or with a computer. We hypothesised a significant positive association between state paranoia and competition when individuals play the PDG against another person (i.e., when the task is interpersonal), but not when they are playing against a computer (i.e., when the task is impersonal).

Method

Participants

Participants were 36 men and 74 women, aged 18 to 65 ($M_{age} = 27.8$ years, $SD = 9.4$) of whom 68 (62%) were in full-time employment, 4 (4%) were unemployed and 38 (34%) were undergraduate students.

Procedure and measure

The procedure and measure used in Study 2 were the same as Study 1, with the important exception that participants were randomly assigned to play the PDG either against another person (as in Study 1) or against the computer. As in Study 1, participants only completed a single PDG trial and did not actually interact with an opponent.

Results and discussion

Overall, 61 (56%) participants chose to co-operate and 49 (44%) chose to compete. Mean score on the SPS was 14.20 ($SD = 2.6$) for those who co-operated and 14.86 ($SD = 3.0$) for those who competed. Replicating Study 1 findings, we found a significant positive correlation between state paranoia and competition when the opponent was another person, $r_{PB} = .28$, $p = .02$. When the opponent was a computer, however, the correlation between state paranoia and competition was not significant, $r_{PB} = -.15$, $p = .31$. We compared the Fisher z-transformed correlations and found that they differed significantly, $z = 2.20$, $p = .014$.[1] This is the first empirical evidence that paranoia is inherently interpersonal (compared to impersonal). It reinforces the idea that paranoia should be assessed in interpersonal context and demonstrates the promise of the PDG paradigm for advancing theory on paranoia.

STUDY 3

Studies 1 and 2 demonstrated that state paranoia is positively associated with competition in the PDG when the context is specifically interpersonal. To establish firmly the PDG as a paradigm for evaluating non-clinical paranoia, however, we had to address three limitations in Studies 1 and 2. We did so in Study 3.

The first limitation that Study 3 sought to address concerns participants' motives for choosing to compete. Within the 2-choice PDG, a player might choose to compete either because of greed (i.e., predicting that an opponent will co-operate, and responding exploitatively to this possibility) or distrust (i.e., predicting that an opponent will compete, and responding defensively to this possibility; Poundstone, 1992). It is important to differentiate between these two possibilities because non-clinical paranoia should be reflected in distrust-based (but not greed-based) competition, because only distrust-based competition flows from the perception that the other player possesses malevolent intentions vis-à-vis the self. Study 3 therefore separated the motives of distrust and greed by including a validated self-report measure of choice reasons (Insko et al., 2005). We used this measure to distinguish between participants who selected the competitive choice based primarily on greed (relative to distrust) and those who selected the competitive choice based primarily on distrust (relative to greed).

The second limitation we sought to address concerns the role of trait paranoia. To establish the PDG as an experimental paradigm for assessing non-clinical paranoia, it is crucial to show that trait paranoia (and not only state paranoia) is associated with distrust-based competition in the PDG. In Study 3, participants also completed a validated measure of trait paranoia, the Paranoia Scale (Fenigstein & Vanable, 1992), prior to making their PDG choice. We predicted that trait paranoia would be positively associated with distrust-based (but not greed-based) competition.

The third issue under investigation in Study 3 concerned the timing of the state paranoia assessment. In Studies 1 and 2, state paranoia was assessed after the PDG choice. This raises the legitimate question of whether state paranoia is merely a post hoc rationalisation of having chosen to compete. To address this, Study 3 participants completed the SPS prior to making their choice on the PDG. We tested the hypothesis that state paranoia would be positively associated with distrust-based (but not greed-based) competition. Furthermore, we examined whether state paranoia mediates the postulated link between trait paranoia and distrust-based (but not greed-based) competition. That is, is trait paranoia positively associated with distrust-based competition

[1] A potential criticism of the study is that the SPS does not capture the sense of mistrust and suspicion that people might feel when playing the PDG against a computer. If this were the case, we would expect a floor effect in participants' scores on the SPS in the computer condition. However, there was a normal distribution of scores on the SPS among participants playing against the computer ($M = 15.08$, $SD = 2.49$) and with similar range of scores (9–20) as those playing another person (range = 7–23).

because it predisposes individuals to experience state paranoia in the interpersonal PDG context?

Method

Participants

Participants were 64 men and 88 women, aged 18 to 63 ($M_{age} = 33.1$ years, $SD = 14.1$) of whom 94 (62%) were in full-time employment, 11 (7%) were unemployed and 47 (31%) were undergraduate students.

Procedure and measure

The procedure and measure used in Study 3 were the same as in Study 1, with three minor alterations:

1. Participants first completed the Paranoia Scale (Fenigstein & Vanable, 1992), a 20-item trait measure of non-clinical paranoia;
2. Participants then completed the SPS; and
3. Finally, participants completed the PDG task and the self-report measure of choice reasons.

The self-report measure comprises 10 items assessing various reasons for choice on the PDG. Each item is rated on a 7-point scale (1 = *Not at all*, 7 = *Very much*). For the purposes of this study, we were interested in the two items that measure distrust ("I wanted to defend myself against the actions of the other person" and "I did not trust the other person") and the two items that measure greed ("I wanted to earn more than the other person" and "I wanted to maximise the difference between both persons in my favour"). We created composite measures of distrust and greed by averaging across the two relevant items (Cronbach's alphas = .71 and .89, respectively, for distrust and greed).

Data analysis

We used the distrust and greed assessment to divide participants who selected to compete into two categories: one category consisted of participants for whom distrust exceeded greed (distrust-based competition) and the other category consisted of participants for whom greed exceeded distrust (greed-based competition). A further category consisted of participants who selected the co-operative choice (co-operation). By so doing, we created three choice alternatives: co-operation vs. distrust-based competition vs. greed-based competition. For each alternative, we coded (0 = *Absent*, 1 = *Present*) whether participants "selected" it. We first tested the point-biserial correlations of trait and state paranoia with each of the resulting three dichotomous choice variables. We then proceeded with meditational analyses.

Results and discussion

In Study 3, 96 (63%) participants chose to co-operate and 56 (37%) chose to compete. Overall, Study 3 replicated the findings of Studies 1 and 2, with a small significant positive correlation between state paranoia and competition ($r_{PB} = .15$, $p = .05$). A summary of PDG choices across all three studies is shown in Table 1.

Among those who chose to compete, distrust exceeded greed for 27 participants, and greed exceeded distrust for the remaining 29 participants. Mean scores on the PS were 32.5 ($SD = 8.1$) for those who co-operated; 32.4 ($SD = 9.1$) for those who competed with greed motive, and 37.7 ($SD = 11.6$) for those who competed with distrust motive. Mean scores on the SPS were 13.61 ($SD = 3.1$) for those who co-operated, 13.45 ($SD = 3.4$) for those who competed with greed motive, and 15.93 ($SD = 4.1$) for those who competed with distrust motive.

As predicted, there was a significant positive correlation between trait paranoia (as assessed by the PS) and distrust-based competition ($r_{PB} = .22$, $p = .008$), but not between trait paranoia and

Table 1. *Summary of PDG choice across the three studies*

	Co-operate	*Compete*
Study 1	114 (65%)	64 (35%)
Study 2	61 (56%)	24 (49%) computer opponent 25 (51%) human opponent
Study 3	96 (63%)	27 (18%) distrust motive 29 (19%) greed motive

greed-based competition ($r_{PB} = -.06$, $p = .47$), nor between trait paranoia and co-operation ($r_{PB} = -.13$, $p = .13$). Furthermore, there was a significant positive correlation between state paranoia (as assessed by the SPS) and distrust-based competition ($r_{PB} = .26$, $p = .002$), but not between state paranoia and greed-based competition ($r_{PB} = -.09$, $p = .28$), nor between state paranoia and co-operation ($r_{PB} = -.13$, $p = .11$).[2]

Next, we examined whether the association between trait paranoia and distrust-based competition was mediated by state paranoia. That is, is there evidence that trait paranoia is linked with distrust-based competition because it predisposes individuals to experience paranoia in the PDG context (i.e., state paranoia)? To test this, we first confirmed that there was a significant positive correlation between trait paranoia (the independent variable) and state paranoia (the mediator; $r = .33$, $p = .001$). Next, we conducted a logistic regression analysis in which fear-based competition was regressed simultaneously onto both trait and state paranoia. This analysis revealed that state paranoia significantly predicted increased distrust-based competition above and beyond trait paranoia, $B = 0.18$, $SE = 0.08$, $\chi^2(1) = 5.10$, $p = .024$. When controlling for state paranoia, the association between trait paranoia and distrust-based competition was no longer significant, $B = 0.03$, $SE = 0.03$, $\chi^2(1) = 1.94$, $p = .16$. As a final step, we used a bootstrapping analysis (Preacher & Hayes, 2004) to test the indirect trait paranoia effect on distrust-based competition via state paranoia. The indirect effect was significant: mean bootstrap estimate = .003 ($SE = 0.001$), 95% confidence interval = .001/.007. These results suggest that the association between trait paranoia and distrust-based competition is fully mediated by state paranoia.

Study 3 provides a more fine-grained understanding of the association between state paranoia and competition: state paranoia was associated with increased distrust-based (but not greed-based) competition. This finding captures the interpersonal nature of paranoia by demonstrating that it encompasses the expectation that interaction partners harbour malevolent intentions. In addition, the meditational analysis provides the first evidence for a process model linking trait paranoia to paranoid behaviour in interpersonal context. Specifically, trait paranoia increased distrust-based competition because it predisposed participants to experience state paranoia in interpersonal interactions. Finally, because in interpersonal relations competition begets competition (Axelrod, 1984), these findings also provide insight into the self-fulfilling nature of paranoid cognitions.

GENERAL DISCUSSION

The PDG is a well-established experimental paradigm but it has not been used before to study non-clinical paranoia. All three studies found a significant relationship between state paranoia and competition in the PDG with non-clinical samples. Study 1, involving undergraduate students and members of the general population, found that higher state paranoia was positively associated with the choice to compete. Study 2 found that this association was significant only when participants perceived they were playing the PDG against another person (compared to a computer). We regard this as important evidence for what was previously assumed but not empirically tested—that paranoia is inherently interpersonal in nature. In Study 3, we found that (1) both trait and state paranoia were positively associated with distrust-based competition (but not with greed-based competition), and (2) that state paranoia mediated the link between trait paranoia and distrust-based competition, suggesting that trait paranoia increases distrust-based competition because it predisposes individuals to experience state paranoia in the interpersonal PDG context. To summarise, distrust-based competition in the

[2] Note that results for co-operation are redundant with those for distrust-based competition and greed-based competition because knowledge of any two choice alternatives allows for perfect prediction of the third alternative.

PDG provides a behavioural signature or marker of non-clinical paranoia.

The studies reported in this paper make a number of contributions to the literature on non-clinical paranoia. First, the PDG is offered as a new experimental paradigm to study non-clinical paranoia, alongside virtual reality environments (Freeman et al., 2008) and laboratory procedures involving the juxtaposition of heightened self-awareness plus (possible or explicit) task failure (Bodner & Mikulincer, 1998; Ellett & Chadwick, 2007). The PDG has the advantage of being inexpensive and transportable, and research can be internet based. A second contribution concerns the identification of distrust-based competition as a behavioural signature or marker of paranoia to complement existing self-report measures. Future research might assess whether distrust-based competition is sensitive to changes in non-clinical paranoia that occur either naturalistically or following intervention. A third contribution is that the PDG paradigm enables researchers to systematically vary features of the other player (i.e., the opponent). In the present research we capitalised on this to examine the interpersonal nature of paranoia by manipulating whether participants interacted with another person or a computer (Study 2). Further research could advance theory on paranoia by exploring the role of additional features, such as whether the opponent is an in-group or out-group member, and whether the opponent is an individual or a group acting collectively.

As with virtual-reality research, the PDG paradigm establishes that state paranoia can occur in the absence of objective harm from others. At the time of rating state paranoia, and choosing how to respond, our participants had had no contact with their opponent. Distrust-based competition is thus a "top down" decision. This overcomes difficulties with self-report measures, in which the issue of truth or falsity of paranoid inferences is more difficult to establish. Also, and again as is true with virtual-reality environments, it appears that some participants attributed malevolent intentions towards what is ostensibly a programmed computer (Study 2). In clinical paranoia, it is very common for themes involving electronic devices, particularly computers, to be part of paranoid ideation, and initial evidence here suggests that it might also be a relevant theme in a non-clinical context. Future research might usefully further explore threat beliefs regarding objects, assessing whether the object is truly anthropomorphised, or if participants attribute malevolent intent to a person behind the machine.

The current research touches on wider research and conceptual areas. While the present research has focused on links between paranoia and behavioural choice on the PDG, there is a wider literature on economic models and choice. In general economic models, for example, the majority of people are assumed to act out of self-interest, though there is thought to be a fraction that is also motivated by fairness considerations (Fehr & Schmidt, 1999, p. 818). Fairness is modelled as "self-centred inequity aversion"—that is, dislike of outcomes that are perceived as inequitable and involve the self. In terms of the present research, inequity aversion would work to reduce the number of people choosing to compete on a first trial, so cannot account for the repeated positive correlation between paranoia and competition. However, future research on paranoia within the PDG might consider a wider range of motivations for choice beyond that which was used in the present research. Also, there are important conceptual issues around the relationship between paranoia and other related constructs such as (dis)trust and hostility. Indeed, trust has been examined in the context of the PDG (e.g., Insko et al., 2005) and more broadly within the field of behavioural game theory (Camerer, 2003) in both non-clinical and clinical samples (e.g., Unoka, Seres, Aspan, Bodi, & Keri, 2009). There is a lack of research investigating the relationship between distrust and non-clinical paranoia. We would propose conceptually a "one circle within another" Venn diagram, such that paranoia, defined by the presence of inferred malevolent intent towards the self, be viewed as one specific subset of the wider concept of distrust. Thus, while paranoia by definition contains an element of distrust of another's motives, it

is possible that distrust can exist without paranoia—that is, one may consider another to be untrustworthy without assuming malevolence. Future research is needed to elucidate these relationships further.

The current findings are consistent with a growing body of survey studies showing paranoia to be common in the general population (e.g., Ellett et al., 2003; Fenigstein & Vanable, 1992). We found that under very specific experimental conditions, around 30% of participants showed evidence of paranoid cognitions and displayed the behavioural signature of paranoia—distrust-based competition. This is consistent with a recent large-scale survey ($n = 7281$) of the general population, showing that paranoid cognitions occurred in around one third of participants (Freeman et al., 2011). However, we would caution against assuming that paranoia observed in these studies is dimensional with clinical paranoia. Costello (1994) sets out the necessary conditions to establish dimensionality in terms of either phenomenology or vulnerability, and it is unclear that these have been met.

It is nonetheless reasonable to ask why trait paranoia might be so common in the non-clinical population. Bentall and colleagues (e.g., Bentall et al., 2001) have long conceptualised clinical paranoia as a specific instance of the common human tendency to make self-serving attributions (Campbell & Sedikides, 1999). A paranoid inference is hypothesised to limit a discrepancy between ideal and actual self-representations by attributing responsibility for a negative event externally (to circumstances, or another person), rather than internally to oneself. In the face of much evidence that paranoia is predominantly associated with low, and not just vulnerable (as originally proposed), self-esteem, Bentall and colleagues reformulated their model to propose that only in specific subgroups of paranoid individuals is paranoia associated with relatively preserved self-esteem (e.g., Bentall et al., 2001)—linking this reformulation with Trower and Chadwick's (1995) elaboration of two distinct types of paranoia: Poor Me (where others' behaviour is viewed as an undeserved persecution) and Bad Me (where others' behaviour is viewed as a punishment for inherent badness). More generally, Ellett et al. (2003) proposed from an evolutionary perspective that paranoia is a trait that was selected and distributed in humans due to its adaptive value. Personal safety is clearly an ecologically important problem, and paranoia is first and foremost a perception of interpersonal threat. The evolutionary maxim—better safe than sorry—might thus explain why clinical paranoia is so notoriously resistant to change and why even non-clinical paranoia, once triggered in experimental settings, can be persistent (Ellett & Chadwick, 2007).

Coda

The PDG goes to the heart of paranoia—it is interpersonal, it concerns threat and perceptions of others' malevolent intentions towards the self, and it encapsulates environmental uncertainty (i.e., with regard to the opponent's choice). The present research provides compelling evidence for conceptualising distrust-based competition in the PDG as a behavioural signature or marker of paranoia. This makes the PDG a promising new paradigm for advancing theory and research on non-clinical paranoia in the general population.

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REFERENCES

Axelrod, R. (1984). *The evolution of cooperation*. New York, NY: Basic Books.

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

Bodner, E., & Mikulincer, M. (1998). Learned helplessness and the occurrence of depressive-like and paranoid-like responses: The role of attentional focus. *Journal of Personality and Social Psychology*, *74*, 110–1023.

Camerer, C. (2003). *Behavioral Game Theory: Experiments in strategic interaction*. Princeton, NJ: Princeton University Press.

Campbell, W. K., & Sedikides, C. (1999). Self-threat magnifies the self-serving bias: A meta-analytic integration. *Review of General Psychology*, *3*, 23–43.

Cohen, T. R., Wildschut, T., & Insko, C. A. (2010). How communication increases interpersonal cooperation in mixed-motive situations. *Journal of Experimental Social Psychology*, *46*, 39–50.

Costello, C. G. (1994). Two dimensional views of psychopathology. *Behaviour, Research & Therapy*, *32*, 391–402.

Dresher, M. (1961). *The mathematics of games of strategies: Theory and applications*. Englewood Cliffs, NJ: Prentice-Hall.

Ellett, L., & Chadwick, P. (2007). Paranoid cognitions, failure, and focus of attention in college students. *Cognition and Emotion*, *21*, 558–576.

Ellett, L., Lopes, B., & Chadwick, P. (2003). Paranoia in a nonclinical population of college students. *The Journal of Nervous and Mental Disease*, *191*, 425–430.

Fehr, E., & Schmidt, K. M. (1999). A theory of fairness and competition. *The Quarterly Journal of Economics*, *114*, 817–868.

Fenigstein, A., & Vanable, P. (1992). Persecutory ideation and self consciousness. *Journal of Personality and Social Psychology*, *62*, 129–138.

Flood, M. M. (1952). *Some experimental games* (Research Memorandum RM-789). Santa Monica, CA: RAND corporation.

Freeman, D., & Garety, P. A. (2000). Comments of the content of persecutory delusions: Does the definition need clarification? *British Journal of Clinical Psychology*, *39*, 407–415.

Freeman, D., McManus, S., Brugha, T., Meltzer, H., Jenkins, R., & Bebbington, P. (2011). Concomitants of paranoia in the general population. *Psychological Medicine*, *41*, 923–926.

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

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

Insko, C. A., Kirchner, J. L., Pinter, B., Efaw, J., & Wildschut, T. (2005). Interindividual–intergroup discontinuity as a function of trust and categorization: The paradox of expected cooperation. *Journal of Personality and Social Psychology*, *88*, 365–385.

Poundstone, W. (1992). *Prisoner's dilemma*. New York, NY: Anchor Books.

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, *36*, 717–731.

Pruitt, D. G., & Kimmel, M. J. (1977). Twenty years of experimental gaming: Critique, synthesis, and suggestions for the future. In M. R. Rosenzweig & L. W. Porter (Eds.), *Annual review of psychology* (Vol. 28, pp. 363–392). Palo Alto, CA: Annual Reviews.

Ridley, M. (1996). *The origins of virtue*. London, UK: Viking.

Strauss, J. S. (1969). Hallucinations and delusions as points on continua function. *Archives of General Psychiatry*, *21*, 581–586.

Trower, P., & Chadwick, P. (1995). Pathways to defence of the self: A theory of two types of paranoia. *Clinical Psychology: Science and Practice*, *2*, 263–278.

Unoka, Z., Seres, I., Aspan, N., Bodi, N., & Keri, S. (2009). Trust game reveals restricted interpersonal interactions in patients with borderline personality disorder. *Journal of Personality Disorders*, *23*(4), 399–409.