



Research Paper

Risk perception in paranoia and anxiety: Two investigations across clinical and non-clinical populations

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ABSTRACT

Objectives: It is common, among clinical and non-clinical populations alike, for paranoia and anxiety to co-occur. It has been suggested that anxiety and its related appraisal styles may contribute to development of paranoia. We aimed to evaluate different aspects of risk perception in relation to paranoia and anxiety and to identify specific aspects that may differentiate paranoia from anxiety. This paper consists of two inter-related studies.

Methods: Study 1 compared 30 patients with persecutory delusions, 21 patients with generalized anxiety disorder and 52 healthy controls. Study 2 compared 30 non-clinical individuals with high levels of paranoia and anxiety, 28 individuals with high anxiety only and 36 healthy controls. Within each study, the two symptomatic groups were matched on level of anxiety. Four dimensions of risk perception (i.e. likelihood, harm, controllability, and intentionality) were compared across groups, as measured by the locally validated Risk Perception Questionnaire.

Results: In both studies, the paranoia and the anxiety groups reported an elevated perceived likelihood of negative events than controls respectively. Only the paranoia groups reported an elevated perceived harm of neutral events than controls. In Study 2, the two at-risk groups attributed more harm and intentionality to negative events than controls.

Conclusion: Although perception of negative events was characteristic in anxiety (with or without paranoia), a biased perception of neutral events as risky was unique to the addition of paranoia. Implications to the transdiagnostic and continual view of psychopathology, and mechanism-based interventions were discussed.

1. Introduction

Recent advancement in understanding mental disorders has seen two paradigm shifts. Firstly, rather than treating mental disorders as completely distinct with clear-cut boundaries, there is an increase in emphasis on the similarities and differences across disorders (Harvey, 2004; Rietdijk et al., 2009). This approach takes into account the fact that psychiatric comorbidity is common (Kessler et al., 2005), and that one condition may develop into another over time (Plana-Ripoll et al., 2019). Secondly, more researchers have adopted a single-symptom approach (Owen et al., 2011) and proposed etiological models for specific symptoms (e.g. Freeman et al., 2002). It has been postulated, such as in the Research Domain Criteria (RDoc) framework, that

examining specific psychiatric phenomena that commonly co-occur may unveil potential mechanisms that maintain both conditions and those that lead to differential outcomes (Insel et al., 2010; Nolen-Hoeksema and Watkins, 2011).

Persecutory delusions, which are defined as beliefs about current or anticipated harm being intended by others to oneself (Freeman and Garety, 2000), are one of the most common symptoms experienced by individuals with schizophrenia spectrum disorders (Bebbington and Freeman, 2017). Milder variants of persecutory delusions, usually experienced as paranoid beliefs, are commonly reported by individuals in the general population (Johns et al., 2004). Research has shown that persecutory delusions and non-clinical paranoia are along the same etiological continuity (Freeman et al., 2010).

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Anxiety is a common complaint of both clinical and non-clinical individuals with paranoia. Among patients who have comorbid schizophrenia and anxiety disorders, a majority (63.6%) had delusions of a paranoid subtype (Nebioglu and Altindag, 2009). Patients with persecutory delusions reported comparable levels of general anxiety to patients with generalized anxiety disorder (GAD) (Freeman and Garety, 1999; Startup et al., 2007). In a recent cluster analysis study, Sun et al. (Sun et al., 2018) revealed that non-patients who reported high paranoia had at least a moderate level of general anxiety, but individuals who reported high anxiety might not be at a heightened risk for paranoia. This finding supports the idea that paranoia and anxiety may share common underpinnings (Freeman et al., 2002), and leads to an intriguing question of how a common risk factor may lead to anxiety in some individuals, but anxiety and paranoia in others (Nolen-Hoeksema and Watkins, 2011).

Risk perception is 'the subjective assessment of the probability of a specified type of accident happening and how concerned we are with the consequences' (Sjöberg et al., 2004). Although the concept encompasses both evaluation of likelihood and the consequences of a negative outcome, most studies that investigated risk perception in paranoia and anxiety focused on likelihood of negative events only. Phenomenally, paranoia and anxiety both pertain to the theme of anticipated risk (Freeman et al., 2002). A more comprehensive understanding of risk perception across diagnoses is warranted (Berenbaum, 2010).

1.1. Perceived likelihood

Kaney et al. (Kaney et al., 1997) first reported an elevated estimate of the likelihood of future negative events among patients with paranoia, a finding that was replicated by Corcoran et al. (Corcoran et al., 2006). Modifying Kaney et al.'s (Kaney et al., 1997) questionnaire, Freeman et al. (Freeman et al., 2013) found that paranoia was associated with greater likelihood estimates for negative events happening to self, but not for them happening to others. The association between paranoia and expectations of negative events was replicated in other clinical and non-clinical samples (Bennett and Corcoran, 2010; Bentall et al., 2008).

Compared to non-anxious individuals, patients with GAD and non-clinical individuals high in trait anxiety reported an elevated perceived likelihood of negative events happening to them (Butler and Mathews, 1983; MacLeod and Byrne, 1996). Among non-clinical samples, the association between perceived likelihood of negative events and level of anxiety attracted equivocal results (Bennett and Corcoran, 2010; Miranda and Mennin, 2007).

1.2. Perceived harm

Compared to non-anxious individuals, patients with GAD and non-clinical individuals high in trait anxiety anticipated greater harm of undesirable events (Butler and Mathews, 1983; Berenbaum et al., 2007). There is to date no direct investigation of the association between paranoia and perceived harm of either negative or ambiguous events. However, paranoia is characterized by an aberrant fear of being harmed by others (Freeman and Garety, 2000). As patients with persecutory delusions tended to misinterpret neutral faces as negative and fearful faces as angry and threatening (Pinkham et al., 2011; Tso et al., 2015), and paranoid thinking was triggered by ambiguity in non-clinical individuals in experimental settings (Ellett and Chadwick, 2007; Ellett et al., 2013), it would be of interest to examine whether an elevated harmfulness rating for ambiguous events would be present in paranoia.

1.3. Perceived controllability

Although healthy individuals tended to believe that they are more in

control than they actually are (McKenna, 1993), patients with GAD had consistently reported uncontrollability and powerlessness over threatening events, and perceived uncontrollability over threats was associated with severity of GAD symptoms (Stapinski et al., 2010a; Stapinski et al., 2010b) (Stapinski et al., 2010a, 2010b). Paranoia is characterized by the belief that one's life is controlled by powerful others, which has been considered as a sense of external locus of control (Kaney and Bentall, 1989). This sense of uncontrollability had been reported by non-clinical populations with paranoia as well as patients (Moritz et al., 2007; Pickering et al., 2008).

1.4. Perceived intentionality

Perceived intentionality of a person inflicting harm is a defining feature of persecutory delusions (Freeman and Garety, 2000). Individuals with persecutory delusions tended to attribute negative events to external-personal causes (Bentall et al., 2009), and a higher tendency to attribute intention to events distinguished patients with psychosis from patients with depression (Peters et al., 2014). Among clinical and non-clinical individuals alike, paranoid thinking was associated with a greater perceived criminal and hostile intent for ambiguous situations (Combs et al., 2009; Jack and Egan, 2016). On the contrary, research on perceived intentionality and general anxiety is anecdotal (Erickson and Pincus, 2005). It is likely that perceived intentionality of events distinguishes paranoia from anxious thoughts (Freeman, 2007).

In sum, although it has been theorised that perception of future threat initiates the anxiety and paranoia processes (Freeman et al., 2002; Borkovec et al., 2004), previous empirical studies focused more on perceived likelihood than other aspects of risk perception. Besides, despite common co-occurrence of the two phenomena, most studies of paranoia and risk perception did not control for the effect of anxiety, and direct comparison between individuals with anxiety and individuals with both paranoia and anxiety is lacking. Therefore, the current paper aimed to address various aspects of risk perception in relation to paranoia and anxiety and to identify the aspects of risk perception that contribute to paranoia specifically.

Informed by the current literature, we considered general anxiety and paranoia as dimensional constructs that spread across the clinical and non-clinical populations (Endler and Kocovski, 2001; Kendall and Watson, 1989). Study 1 compared risk perception between patients with persecutory delusions, patients with GAD, and healthy controls. Study 2 aimed to replicate the findings with an analogous sample of non-patients who scored high on both paranoia and anxiety, against those who scored high on anxiety only and healthy individuals. As depression has been shown to be associated with anxiety (Moritz et al., 2017) and paranoia (Freeman et al., 2005), for the sake of robustness, we performed the above comparisons once again with levels of depression being controlled for.

Major hypotheses for both studies were as follows:

1. elevated perceived likelihood of negative events will be reported by both paranoia and anxiety groups;
2. elevated perceived harm for neutral events will only be reported by the paranoia group;
3. decreased perceived controllability over negative events will be reported by both paranoia and anxiety groups;
4. elevated perceived intentionality for negative events will only be reported by the paranoia group.

2. Study 1

2.1. Methods

Study 1 was approved by the Joint Chinese University of Hong Kong – New Territories East Cluster Clinical Research Ethics Committee

(CRE-2013.262) and the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (UW 13-284).

2.1.1. Participant

The sample consisted of three groups of adults (age 18–65): (i) patients with schizophrenia spectrum disorders presenting with persecutory delusions ('Paranoia', defined as scoring ≥ 3 on item 8 of the Scale for the Assessment of Positive Symptoms (SAPS; (Andreasen, 1984)), (ii) patients with GAD presenting with at least a mild level of anxiety ('Anxiety', defined as scoring ≥ 5 on the GAD-7 Scale (Spitzer et al., 2006a)), and (iii) individuals without a psychiatric diagnosis (healthy controls, 'HC', defined by self-reported absence of any personal or family history of psychiatric disorders). Exclusion criteria for all groups were: a primary diagnosis of drug-induced psychosis, intellectual disability, neurological/organic brain disorders, or a lack of ample proficiency in Cantonese Chinese to support completion of the study procedure.

Patients were recruited from four out-patient psychiatric clinics across Hong Kong. The research team sought written consent from individual participants and performed a full Structured Clinical Interview for DSM-IV (SCID; (So et al., 2003a; So et al., 2003b)). The HC group was recruited from the general community through mass mailing, advertising around the university campus, and informal social networks.

2.1.2. Sample size calculation

A priori power calculation was conducted by using GPower 3.1.9.2 on the basis of multivariate analysis of variance (MANOVA) repeated measures (assuming a medium effect size $f = 0.25$, $\alpha = 0.05$, power = 0.8, correlations among repeated measures = 0.5). A required total sample size of 90 (30 for each group) was yielded.

2.1.3. Measures

Severity of psychotic symptoms was assessed with the Positive and Negative Syndrome Scale (PANSS; (Kay et al., 1987)) and SAPS (Andreasen, 1984). The 30-item PANSS interview yields a positive symptom subscore, a negative symptom subscore, a general psychopathology subscore, and a total score. The Chinese version of PANSS has been validated in Hong Kong (Chang et al., 2011). The 35-item SAPS assesses four domains of positive symptoms: hallucinations, delusions, bizarre behavior, and formal thought disorder. Psychometric properties of the Chinese version were good to excellent (Phillips et al., 1991).

Level of depression was assessed with the Beck Depression Inventory – II (BDI-II; (Beck et al., 1996) and level of anxiety was assessed with the 20-item anxiety state subscale of the State-Trait Anxiety Inventory (STAI; (Spielberger et al., 1983)). Both BDI-II and STAI (Chinese versions) have been validated with good psychometrics (Byrne et al., 2004; Shek, 1988). Level of intellectual functioning was assessed with the Wechsler Adult Intelligence Scale – III short form (Wechsler, 1997).

Risk perception was assessed with the Risk Perception

Questionnaire (RPQ; (Chan et al., 2014)), which consists of 15 negative scenarios and 10 neutral scenarios drawn from Kaney et al. (Kaney et al., 1997) and Freeman et al. (Freeman et al., 2013). For each scenario, participants are required to rate their perceived likelihood of happening in the near future, perceived harm, perceived controllability and perceived intentionality on 7-point Likert scales (1 = 'Not at all', 7 = 'Very much'). Four average dimensional scores for negative and neutral scenarios are reported separately (range = 1 to 7).

The original items from Kaney et al. (Kaney et al., 1997) and Freeman et al. (Freeman et al., 2013) were translated into Chinese and back-translated into English by bilingual psychologists. Our pilot study ((Chan et al., 2014); $n = 61$) yielded excellent internal consistencies for the four subscales: likelihood ($\alpha = 0.85$ – 0.90), harm ($\alpha = 0.89$ – 0.91), controllability ($\alpha = 0.86$ – 0.87) and intentionality ($\alpha = 0.89$ – 0.90). The current samples reported good internal reliabilities for the four subscales (Study 1: $\alpha = 0.82$ – 0.93 , Study 2: $\alpha = 0.71$ – 0.91).

2.1.4. Statistical analysis

Analysis of variance (ANOVA) and chi-square analysis were conducted to compare demographics and clinical variables across groups. We compared groups on each dimension of risk perception by conducting multivariate analysis of variance (MANOVA), followed by a series of ANOVA. Bonferroni correction was applied to control for multiple comparisons. Where there was a significant group difference on a demographic variable or depression, main findings were tested again with that variable being controlled for using analysis of covariance (ANCOVA).

2.2. Results

2.2.1. Demographic and clinical characteristics

We approached 30 patients with schizophrenia spectrum disorder (Paranoia), 38 patients with GAD (Anxiety), and 52 healthy participants (HC). Fifteen patients with GAD did not meet the recruitment criteria and two refused to join the study. The final sample consisted of 30 patients in the Paranoia group, 21 patients in the Anxiety group, and 52 participants in the HC group. Within the Paranoia group, 26 participants (89.66%) had a diagnosis of schizophrenia, two (6.90%) had a diagnosis of delusional disorder, and one (3.45%) had a diagnosis of psychotic disorder not otherwise specified. The average clinical rating scores of the Paranoia group were as follows: PANSS total = 68.50 (range = 39–137, $SD = 19.67$), PANSS positive = 20.23 (range = 8–32, $SD = 5.02$), PANSS negative = 11.80 (range = 7–36, $SD = 6.27$), PANSS general = 36.47 (range = 17–73, $SD = 11.35$), SAPS global delusions = 4.13 (range = 3–5, $SD = 0.63$), SAPS persecutory delusions = 4.07 (range = 3–5, $SD = 0.79$). All participants within the Anxiety group met the criteria for GAD. The Anxiety group reported an average level of anxiety (on GAD-7) of 10.71 (range 7–16, $SD = 2.47$).

As shown in Table 1, the three groups were matched on gender, age, and years of education. ANOVA and post-hoc pairwise comparisons

Table 1
Study 1 – sample characteristics.

	Paranoia (n = 30)	Anxiety (n = 21)	HC (n = 52)	Group comparisons
Male, number (%)	9 (30.0%)	8 (38.1%)	20 (38.5%)	$\chi^2_{(2)} = 0.65, p = 0.724$
Age (years)	36.97 (12.79)	43.52 (13.36)	38.81 (13.05)	$F_{(2)} = 1.62, SS = 550.13, p = 0.203$
Education (years)	11.90 (2.63)	11.95 (2.89)	12.35 (3.21)	$F_{(2)} = 0.26, SS = 4.68, p = 0.770$
Sum of 3 WAIS-III subscores	22.13 ^b (6.27)	30.86 ^a (5.25)	30.80 ^a (5.87)	$F_{(2)} = 19.77, SS = 1349.48, p < 0.001, \eta^2 = 0.30$
STAI-S	51.20 ^a (11.49)	48.05 ^a (10.41)	36.08 ^b (10.22)	$F_{(2)} = 22.27, SS = 5043.93, p < 0.001, \eta^2 = 0.31$
BDI-II	18.43 ^a (14.75)	16.05 ^a (9.48)	5.52 ^b (5.91)	$F_{(2)} = 18.85, SS = 3633.88, p < 0.001, \eta^2 = 0.28$

Note: ^{a, b} represent significant post-hoc differences with $a > b$. WAIS-III = Wechsler Adult Intelligence Scale-III; STAI-S = State-Trait Anxiety Inventory; BDI-II = Beck Depression Inventory-II.

Table 2
Study 1 – risk perception across groups.

	Paranoia (n = 30)	Anxiety (n = 21)	HC (n = 52)	Group comparisons
Neutral: Likelihood	3.97 (1.41)	4.37 (0.89)	4.04 (1.18)	$F_{(2)} = 0.75, SS = 2.14, p = 0.475$
Neutral: Harm	2.00 ^a (1.09)	1.41 ^b (0.62)	1.18 ^b (0.37)	$F_{(2)} = 12.89, SS = 12.33, p < 0.001, \eta_p^2 = 0.21$
Neutral: Controllability	3.13 (1.37)	3.11 (1.32)	3.14 (1.62)	$F_{(2)} = 0.003, SS = 0.02, p = 0.997$
Neutral: Intentionality	3.48 (1.50)	3.31 (1.38)	3.30 (1.70)	$F_{(2)} = 0.13, SS = 0.65, p = 0.878$
Negative: Likelihood	3.80 ^a (1.14)	3.70 ^a (1.27)	2.90 ^b (1.22)	$F_{(2)} = 6.55, SS = 19.11, p = 0.002, \eta_p^2 = 0.117$
Negative: Harm	3.66 (1.26)	3.71 (1.69)	3.08 (1.50)	$F_{(2)} = 2.10, SS = 9.15, p = 0.128$
Negative: Controllability	2.86 (1.28)	2.87 (1.22)	2.94 (1.27)	$F_{(2)} = 0.042, SS = 0.13, p = 0.959$
Negative: Intentionality	3.59 (1.23)	3.36 (1.29)	3.00 (1.45)	$F_{(2)} = 1.85, SS = 6.83, p = 0.162$

Note: ^{a, b} represent significant post-hoc differences with $a > b$.

revealed that the Paranoia group had a significantly lower level of estimated IQ than the Anxiety and HC groups ($ps < 0.001$). The two clinical groups reported significantly higher levels of anxiety ($ps < 0.001$) and depression ($ps < 0.001$) than HC, but they were not significantly different from each other (for anxiety: $p = 0.90$; for depression: $p > 0.99$).

2.2.2. Group comparisons of risk perception

As shown in Table 2, in support of Hypothesis 1, there was a significant group difference in perceived likelihood of negative events. This result remained significant after controlling for difference in estimated IQ ($F_{(2)} = 4.96, p = 0.009, \eta_p^2 = 0.10$), but became non-significant after controlling for depression ($F_{(2)} = 0.12, p = 0.889$). Post-hoc analyses revealed that both Paranoia ($p = 0.005$) and Anxiety ($p = 0.036$) groups reported higher perceived likelihood of negative events than HC.

In support of Hypothesis 2, there was a significant group difference in perceived harm of neutral events. This result remained significant after controlling for difference in estimated IQ ($F_{(2)} = 5.06, p = 0.008, \eta_p^2 = 0.10$) or depression ($F_{(2)} = 7.05, p = 0.001, \eta_p^2 = 0.13$). Post-hoc analyses revealed that the Paranoia group reported a higher score than the Anxiety group ($p = 0.012$) and HC ($p < 0.001$), but there was no significant difference between the Anxiety group and HC ($p = 0.60$).

Contrary to Hypotheses 3 and 4, there were no significant group differences in controllability or intentionality for either neutral or negative events.

3. Study 2

To further evaluate the etiological value of risk perception for paranoia and anxiety and prevent potential contamination caused by clinical status and medication, study 2 aimed to examine risk perception in non-clinical individuals.

Table 3
Study 2 – sample characteristics.

	Paranoia (n = 30)	Anxiety (n = 28)	HC (n = 36)	Group comparisons
Male, number (%)	15 (50.0%)	10 (35.7%)	11 (30.6%)	$\chi^2_{(2)} = 2.73, p = 0.255$
Age (years)	21.00 (1.62)	20.79 (1.42)	21.06 (1.39)	$F_{(2,91)} = 0.28, SS = 1.23, p = 0.756$
Education (years)	14.07 (0.98)	13.93 (0.81)	14.11 (0.95)	$F_{(2,91)} = 0.32, SS = 0.55, p = 0.724$
GPTS	94.63 ^a (20.16)	51.11 ^b (7.95)	35.81 ^c (2.66)	$F_{(2,91)} = 196.03, SS = 59,201.92, p < 0.001, \eta^2 = 0.81$
GAD-7	14.40 ^a (3.46)	13.04 ^a (2.72)	0.72 ^b (0.82)	$F_{(2,91)} = 303.02, SS = 3791.99, p < 0.001, \eta^2 = 0.87$
PHQ-9	14.50 ^a (5.56)	12.43 ^a (5.04)	2.50 ^b (2.41)	$F_{(2,91)} = 70.00, SS = 2749.89, p < 0.001, \eta^2 = 0.61$

Note: ^{a, b, c} represent significant post-hoc differences with $a > b > c$. GPTS = Green et al. Paranoid Thought Scale; GAD-7 = Generalized Anxiety Disorder Scale; PHQ-9 = Patient Health Questionnaire-9.

Table 4
Study 2 – risk perception across groups.

	Paranoia (n = 30)	Anxiety (n = 28)	HC (n = 36)	Group comparisons
Neutral: Likelihood	4.66 (0.83)	4.32 (0.87)	4.27 (0.94)	$F_{(2,91)} = 1.79, SS = 2.82, p = 0.172$
Neutral: Harm	1.82 ^a (1.01)	1.40 ^b (0.33)	1.17 ^b (0.44)	$F_{(2,91)} = 8.14, SS = 7.01, p = 0.001, \eta_p^2 = 0.15$
Neutral: Controllability	3.59 (0.98)	3.49 (1.09)	3.41 (1.38)	$F_{(2,91)} = 0.19, SS = 0.52, p = 0.829$
Neutral: Intentionality	3.68 (1.32)	4.05 (1.55)	3.15 (1.52)	$F_{(2,91)} = 3.05, SS = 13.14, p = 0.052$
Negative: Likelihood	4.37 ^a (0.86)	3.86 ^a (0.74)	2.84 ^b (1.01)	$F_{(2,91)} = 25.70, SS = 40.66, p < 0.001, \eta_p^2 = 0.36$
Negative: Harm	5.01 ^a (0.78)	4.58 ^a (1.15)	3.14 ^b (1.27)	$F_{(2,91)} = 26.83, SS = 64.49, p < 0.001, \eta_p^2 = 0.37$
Negative: Controllability	3.20 (0.90)	2.75 (0.76)	3.11 (1.14)	$F_{(2,91)} = 1.79, SS = 3.32, p = 0.174$
Negative: Intentionality	4.09 ^a (0.92)	3.98 ^a (0.81)	2.84 ^b (1.13)	$F_{(2,91)} = 16.69, SS = 31.92, p < 0.001, \eta_p^2 = 0.27$

Note: ^{a, b} represent significant post-hoc differences with a > b.

psychometric properties (He et al., 2010; Yeung et al., 2008).

3.2. Results

3.2.1. Demographic and clinical characteristics

As shown in Table 3, the Paranoia group reported a high GPTS total score (range = 68–148) and a moderate GAD-7 score (range = 10–21). The Anxiety group reported an average GPTS score (range = 37–64) and a moderate GAD-7 score (range = 10–21). The HC group reported low GPTS (range = 32–40) and GAD-7 scores (range = 0–2). The three groups were matched on gender, age, and years of education. The Paranoia group had a significantly higher GPTS total score than the Anxiety group ($p < 0.001$), followed by the HC group ($ps < 0.001$). The Paranoia and Anxiety groups reported significantly higher levels of anxiety ($ps < 0.001$) and depression ($ps < 0.001$) than HC, but they did not differ significantly from each other (for anxiety: $p = 0.12$; for depression: $p = 0.24$).

3.2.2. Group comparisons of risk perception

As displayed in Table 4, in support of Hypothesis 1, there was a significant group difference in perceived likelihood of negative events. This became non-significant after controlling for depression ($F_{(2)} = 1.71, p = 0.187$). Post-hoc analyses revealed that both Paranoia and Anxiety groups reported higher levels of perceived likelihood of negative events than HC ($ps < 0.001$).

In support of Hypothesis 2, there was a significant group difference in perceived harm for neutral events, with the Paranoia group reporting a marginally higher score than the Anxiety group ($p = 0.050$) and a significantly higher score than HC ($p < 0.001$). The difference between the Anxiety and HC groups was not significant ($p > 0.050$). The effect of group became non-significant after controlling for depression ($F_{(2)} = 2.00, p = 0.141$). For negative events, both Paranoia and Anxiety groups attributed greater harm than HC ($ps < 0.001$), but they did not differ from each other ($p > 0.050$). This effect remained significant after controlling for depression ($F_{(2)} = 4.80, p = 0.010, \eta_p^2 = 0.10$).

Contrary to Hypothesis 3, there was no significant group difference in perceived controllability for either neutral or negative events. With regard to Hypothesis 4, while there was an overall significant group difference in perceived intentionality for negative events, both Paranoia and Anxiety groups reported higher scores than HC ($ps < 0.001$), and the two at-risk groups did not differ significantly from each other ($p > 0.990$). This remained significant after controlling for depression ($F_{(2)} = 4.60, p = 0.012, \eta_p^2 = 0.09$).

4. Discussion

The current studies were the first attempt to evaluate different aspects of risk perception in relation to paranoia and general anxiety and to delineate the specific aspects of risk perception that differentiate paranoia from general anxiety. Two related studies, one comparing

patients with psychotic delusions and patients with GAD, and the other comparing non-clinical individuals experiencing paranoia and general anxiety, were conducted. The current studies were merited by the adoption of a comprehensive assessment of risk perception (i.e. RPQ; (Chan et al., 2014)), which evaluates one's perception of risk through four separable aspects including perceived likelihood of happening, harm, controllability and intentionality of negative and neutral events. The tool was designed to tap risk perception in general, which is not confined to idiosyncratic personal experiences.

Across clinical and non-clinical samples, both paranoia groups and anxiety groups believed that aversive (but not neutral) events are more likely to happen to themselves in the near future than healthy individuals. This finding was consistent with previous studies that reported heightened likelihood of negative events among individuals with paranoia and individuals with anxiety respectively (Kaney et al., 1997; Freeman et al., 2013; Butler and Mathews, 1983). However, since both paranoia groups and anxiety groups had higher levels of depression than control groups, and group differences in risk likelihood ratings disappeared after controlling for depression, it remains a possibility that depression also plays a significant role in how individuals anticipate risk. There is some evidence that depression may be related to risk perception in non-psychiatric literature. For example, smokers who had a higher level of depression reported a greater likelihood of risks (Weinberger et al., 2008); perceived risk of being harmed by diabetes worsened depression among diabetic individuals (Imai et al., 2017). In addition, as it has been suggested that perceived likelihood of future risks are predicted by estimates of the frequency of similar experiences in the past (Tversky and Kahneman, 1973), our findings can be further testified by including a depression group and a measure of aversive life experiences.

Individuals with paranoia not only anticipated more negative events to be happening to them in the future, but also attributed more harm to neutral events. Although both paranoia groups and both anxiety groups attributed a comparable level of harm to *negative* events (and more so than healthy controls in Study 1), only the paranoia groups attributed more harm to *neutral* events than the anxiety groups and healthy controls in both studies. It is of note that, in both studies, the paranoia groups reported comparable levels of anxiety with the anxiety groups. Therefore, the group difference suggested that a biased threat appraisal of experiences may be specific to paranoia, even when an explicit sign of risk is absent. As suggested by Freeman (Freeman, 2007), such biased threat appraisal may interact with a sense of aberrant salience, attention bias, and emotional processes in maintaining paranoia. It is of note that the neutral scenarios included in the RPQ were interpersonal by nature. Our results corroborate with previous findings that patients with persecutory delusions perceived more threat from neutral faces (Pinkham et al., 2011; Tso et al., 2015) and attributed greater criminal intent, hostility and aggression to neutral or ambiguous situations (Combs et al., 2009; Jack and Egan, 2016). It may also reflect deeper negative schematic beliefs about others as untrustworthy and threatening, and self as vulnerable and/or bad in individuals with paranoia

(Smith et al., 2006). After controlling for depression, patients with persecutory delusions still perceived greater harm in neutral events than patients with GAD and healthy controls. In contrast, non-clinical individuals with paranoia no longer perceived elevated harm in neutral events, although they still perceived greater harm in negative events. The discrepancy between clinical and non-clinical groups may indicate that along the development of paranoia, a biased perception of harm becomes increasingly established and independent from negative mood.

Contrary to our hypothesis, we did not observe any significant group difference in perceived controllability for either negative or neutral events in both studies. Some participants had asked whether the controllability rating should refer to one's ability to control the happening of the event or the consequence of the event. As the idea of controllability may be less concrete than likelihood and harm, it is possible that this subscale had yielded less reliable results. We had discrepant findings in relation to perceived intentionality. Both the non-clinical paranoia and anxiety groups in Study 2 considered negative events as more intentional than controls. In Study 1, however, although the paranoia group reported a higher level of intentionality than the control group, such difference did not reach statistical significance. The discrepancy may be attributed to the greater standard deviation in responses in Study 1 than Study 2, and it is unclear how much biased risk perception may be mitigated by medication. If a shared increase in perceived intentionality of negative events across paranoia and anxiety groups is replicated in larger samples, this would suggest that perceived intentionality itself may not be a unique feature of paranoia. Rather, it is the combination of intentionality, a sense of 'self as target', and anticipated harm that differentiate paranoia from anxious thoughts (Freeman and Garety, 2000).

Several limitations are noticed. Firstly, numbers of participants in the two patient groups and two sub-clinical groups were small and were not equally distributed. This may have limited the power to detect group differences. Secondly, the risk perception questionnaire (Chan et al., 2014) was newly revised and a more detailed examination of the psychometric properties would be needed. Thirdly, the current studies used a cross-sectional design. Although we included clinical and sub-clinical individuals in two separate studies, the longitudinal relationships between risk perception and symptoms were not directly addressed. Fourthly, as individuals with paranoia tend to report a significant level of anxiety as well, we were not able to identify a valid paranoia-only group for comparison. Lastly, the absence of personal or family psychiatric history in the healthy control group in Study 1 was based on self-report only.

Against these caveats, our two inter-related studies suggested that individuals with anxiety (regardless of co-occurring paranoia) tend to interpret *negative* events as more likely to occur to them, more harmful and intended. However, a heightened perception of harm in relation to *neutral* events may be specific to paranoia. The consistent findings across the clinical and non-clinical samples lend support to dimensional models of paranoia and anxiety (Endler and Kocovski, 2001; Kendall and Watson, 1989). The presence of risk perception biases in non-clinical groups suggests that such appraisal styles are contributive to the formation of anxiety and paranoia. Our results lend support to applying transdiagnostic interventions for paranoia and anxiety that target risk likelihood (e.g. worry intervention; Foster et al., 2010), as well as the specific need for intervention that challenges unfounded perception of harm in relation to paranoia (Freeman et al., 2016).

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CRediT authorship contribution statement

Suzanne Ho-wai So: Writing - review & editing. **Xiaoqi Sun:** Writing - review & editing. **Gloria Hoi Kei Chan:** Writing - review & editing. **Iris Hiu Hung Chan:** Writing - review & editing. **Chui De Chiu:** Writing - review & editing. **Sherry Kit Wa Chan:** Writing - review & editing. **Wai Yin Elisabeth Wong:** Writing - review & editing. **Patrick Wing-leung Leung:** Writing - review & editing. **Eric Yu Hai Chen:** Writing - review & editing.

Declaration of competing interest

None.

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