Hostile attribution bias in schizophrenia-spectrum disorders: narrative review of the literature and persisting questions

Benjamin Buck, Julia Browne, Emily C. Gagen & David L. Penn

Published online: 31 Mar 2020.

Submit your article to this journal ☑

Article views: 219

View related articles ☑

View Crossmark data ☑

Taylor & Francis
Taylor & Francis Group

REVIEW ARTICLE

Check for updates

Hostile attribution bias in schizophrenia-spectrum disorders: narrative review of the literature and persisting questions

Benjamin Buck[a], Julia Browne[b], Emily C. Gagen[c] and David L. Penn[d,e]

[a]Behavioral Research in Technology and Engineering (BRiTE) Center, Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, USA; [b]Department of Psychiatry, Massachusetts General Hospital, Boston, MA, USA; [c]Research Service, Providence VA Medical Center, Providence, RI, USA; [d]Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA; [e]School of Behavioural and Health Sciences, Australian Catholic University, Melbourne, VIC, Australia

ABSTRACT

Background: Social cognition is often aberrant or impaired in psychotic disorders and related to functional outcomes. In particular, one core social cognitive bias – hostile attribution bias – is proposed to be implicated in paranoia, anxiety, mood disturbances and interpersonal conflict outcomes. However, questions remain about this domain's specificity to psychosis and its relationship to general functional outcomes.

Aims: The present paper offers a descriptive and critical review of the literature on hostile attribution bias in psychotic disorders, in order to examine (1) its impact on persecutory symptoms in schizophrenia-spectrum disorders, (2) impact on other related psychopathology among those experiencing psychosis and (3) relationship to functioning.

Methods: Twenty-eight studies included in this review after parallel literature searches of PsycINFO and PubMed.

Results: Evidence from these studies highlighted that hostile attribution bias is elevated in schizophrenia, and that it is related to anxiety, depression and interpersonal conflict outcomes.

Conclusion: While results suggest that hostile attributions are elevated in schizophrenia and associated with symptoms and functioning, there exist numerous persisting questions in the study of this area, including identifying which measures are most effective and determining how it presents: as a state or trait-like characteristic, via dual processes, and its situational variation.

Introduction

A growing base of research (Green & Leitman, 2007) has suggested that social cognition – "a domain of cognition that involves the perception, interpretation, and processing of social information" (Penn et al., 1997, p. 115) – constitutes a core impairment in schizophrenia (Savla et al., 2013). These impairments are distinct from negative symptoms (Sergi et al., 2007) and related to real-world outcomes both independently of (Fett et al., 2011) and as a mediator of the relationship of (Schmidt et al., 2011; Vauth et al., 2004) neurocognition to functioning. As social cognition impairments are also generally responsive to psychosocial interventions (Kurtz & Richardson, 2012; Kurtz et al., 2016), a central focus of schizophrenia research has been developing an understanding of the best methods to assess and treat these impairments.

Social cognition in schizophrenia comprises (1) abilities to correctly interpret social information, or *social cognition skills* and (2) specific patterns of open-ended interpretations of social situations, or *social cognitive biases* (Mancuso et al., 2011; Roberts & Pinkham, 2013). Each social cognition *skill* describes a singular ability to arrive at a clear correct answer, thus each skill presents an area in which an individual is either impaired or skilled. These skills – which include emotion perception (Kohler et al., 2010), theory of mind (Bora et al., 2009) and social perception (Sergi et al., 2006) – are related to neurocognition (Fett et al., 2011; Sergi et al., 2007; Van Hooren et al., 2008), independent living skills, social skills and social functioning (Mancuso et al., 2011). Differently, *social cognition biases* do not assess one's ability to *correctly* respond in a right-or-wrong determination, but rather examine the *style* with which one tends to respond in certain social circumstances. In this way, pathological responding is not identified solely through so-called "deficits," but instead, through extreme response patterns.

Much of the work on social cognitive biases – and particularly those regarded as "attributional styles" or "attributional biases" – has regarded them as comprising a monolithic category (Pinkham, 2014; Pinkham et al., 2014). However, an examination of each bias in psychosis reveals that while they all involve patterns in interpreting others' actions, each bias has its own unique etiology and impact on behavior (Combs et al., 2007). For example, the tendency to attribute negative events to the external world and

positive events to oneself (*externalizing bias or EB*; Bentall et al., 1994) is thought to result in grandiose or defensive thoughts protecting the individual's self-esteem. Differently, hostile attribution bias is the tendency to interpret others' actions as intention and hostile rather than the object of chance, accidental or benevolent intention (Combs et al., 2007; Pinkham et al., 2014). This bias is thought to increase individuals' anger, hostility and threat through misinterpretation of others' motives, and has been hypothesized to play a constitutive and maintenance role in an array of psychopathology. While both of these domains are regarded to be "attributional styles," they are theoretically and empirically distinct (Combs et al., 2007).

There is a need for work that reviews the unique aspects of attributional styles or biases implicated in schizophrenia for a number of reasons. Specifically, they are theorized to centrally impact delusions and paranoia, some of the most debilitating and distressing symptoms of psychosis (Combs et al., 2007; Mancuso et al., 2011; Pinkham et al., 2014). Hostile attribution bias provides an identifiable cognitive pattern that might contribute to these elevations. However, many questions remain in this area. First, it remains unclear whether hostile attributions are a constitutive part of schizophrenia, whether they are specific only to paranoia, or whether they are linked with other comorbid symptoms like depression. Second, it is unknown whether and how hostile attributions might contribute to dysfunction. Previous research both suggests that hostile attributions are unrelated to general assessments of social and role functioning (Pinkham, Penn, et al., 2016) and that they impact current interpersonal conflicts (Buck et al., 2017) and future levels of symptoms (Buck, Pinkham, et al., 2016). As such, synthesizing this research is necessary to resolve such ostensible contradictions.

The present paper offers a descriptive and critical review of the literature on hostile attribution bias in psychotic disorders in order to examine the initial theoretical models that underlie these questions. Accordingly, this model will examine hostile attribution bias according to its (1) relevance in psychosis, including relationships to psychotic symptoms and elevations in schizophrenia, (2) impact on other related psychopathology among those experiencing psychosis and (3) relationship to functioning.

Methods

Search strategy

Studies were identified via parallel literature searches of PubMed and PsycINFO. Search terms included various synonyms for hostile attribution bias when used in conjunction with schizophrenia-spectrum or related disorders. For a full list of search terms, see Appendix. Reference lists of selected studies were also examined to ensure relevant papers were included for review; however, manuscripts were only included if they presented original data and as such, theoretical reviews, meta-analyses, case studies or case control studies were not included. Studies were reviewed if they (1) were written in English, (2) examined hostile attribution

bias, defined as the increased tendency to interpret others' actions in a hostile or threatening manner, (3) involved study participants diagnosed with schizophrenia, schizoaffective disorder or another psychotic disorder (greater than 30% of sample) or if relationships to psychosis-related domains (i.e. paranoia) were examined and (4) presented relationships to a functional outcome. Studies assessing interventions, as well as those examining other social cognitive or attributional biases – i.e. self-causation bias, externalizing bias or personalizing bias – were not included in the present review.

Using the aforementioned criteria, 28 peer-reviewed manuscripts were included in the review (Table 1; see Figure 1 for PRISMA diagram). Four assessments were used to operationalize hostile attribution bias in this population. Two measures – the Social Information Processing Attribution and Emotional Response Questionnaire (SIP-AEQ, Coccaro et al., 2009; $n = 1$) and the External Hostile Attribution Scale (EHAS, McNiel et al., 2003; $n = 1$) were each used in each only one of the studies reviewed; the most commonly used assessment was the Ambiguous Intention Hostility Questionnaire (AIHQ, Combs et al., 2007; $n = 23$).

Findings from each paper were summarized in four areas, including (1) relationships of hostile attribution bias to schizophrenia and persecutory or general positive symptoms, including group differences between individuals diagnosed with psychotic disorders and non-clinical samples, (2) relationships of hostile attribution bias to other symptoms of psychopathology non-specific to psychosis (e.g. depression, anxiety, anger, etc.) and (3) relationships between hostile attributions and functional outcomes, including work, social and role functioning.

Measures

Ambiguous Intention Hostility Questionnaire

The AIHQ (Combs et al., 2007) is a paper and-pencil vignette task that presents individuals with ambiguous scenarios (e.g. "You walk past a bunch of teenagers at a mall, and they start to laugh") and asks three questions with ratings provided on a Likert scale: "did [the person(s)] do this to you on purpose?", "how angry would it make you feel?" and "how much would you blame [the person(s)]?". The participant also generates an attribution for why the event occurred, and what would be their hypothetical behavioral response. The Likert scale questions are summed to calculate a *blame score* and the open-ended responses are evaluated by an independent rater (also on a Likert scale) for how hostile is the attribution and how aggressive is the hypothetical behavioral response. Thus, the *hostility bias* describes the tendency for an individual to interpret another person's action as ill-wishing or hostile, the *aggression bias* describes the tendency for the individual to respond to ambiguous situations with antisocial or aggressive behaviors (e.g. to shout at others), and the *blame score* is an index measure combining judgments of blame and feelings of anger. Each scenario item is varied by its ambiguity, and

Table 1. Overview of studies examining relationships to social cognition, psychotic symptoms, general psychopathology and functional outcomes ($n = 28$).

Year	Author(s)	Clinical group	Control group	Measure	Relationship to psychotic symptoms and/or social cognition	Relationship to general psychopathology	Relationship to functioning
2003	McNiel et al.	110 inpatients (20% SCZ, 13% other psychosis, 54% mood disorders, 37% SUDs, 59% M, 40.7 years, 21% AA, 20% Other, 59% White)	–	EHAS	Higher levels of external attributional bias were significantly correlated with increased paranoia.	Higher levels of external attributional bias were significantly correlated with increased anger and treat/control override symptoms.	Higher levels of external attributional bias were significantly correlated with increased self-reported violence.
2005	Waldheter et al.	29 inpatients (41.4% SCZ, 24.1% SCZA, 10.3% BPD, 86% M, 33.1 years, 86% Black, 14% White)	–	AIHQ	–	–	Higher levels of hostile attributional bias were significantly correlated with increased frequency but not severity of violence. Yet, higher levels of hostile attributional bias significantly predicted violence severity but not violence frequency above and beyond symptoms, neuropsychological functioning, demographics and violence severity history.
2007	Combs, Penn, Wicher et al.	–	322 NPCs (51.5% M, 19.55 years, 68.0% White, 32.0% Non-White)	AIHQ	Higher levels of hostile attributional bias were significantly correlated with increased paranoia and hostile paranoia/suspiciousness. Additionally, hostile attributional bias added variance beyond demographics, personalizing bias, existing hostility scales and psychosis proneness measures in predicting paranoia.	–	–
2009	Combs et al.	32 inpatients (100% SCZ-PD, 53% M, 41.8 years, 46% White) 28 inpatients (100% SCZ-nPD, 32% male, 43.0 years, 53% White)	50 NPCs (18% male, 22.1 years, 83% White)	AIHQ	Participants with persecutory delusions reported higher levels of hostility, blame and aggression for ambiguous situations on the AIHQ as compared to participations without persecutory delusions and NPCs. Higher levels of hostile attributional bias were significantly correlated with increased paranoia	Higher levels of hostile attributional bias were significantly correlated with increased depressive symptoms and fear of negative evaluation but not self-esteem.	–

(continued)

Table 1. Continued.

Year	Author(s)	Clinical group	Control group	Measure	Relationship to psychotic symptoms and/or social cognition	Relationship to general psychopathology	Relationship to functioning
					and persecutory ideation. Hostile attributional bias was a significant unique predictor of paranoia in a model containing demographics, depressive symptoms, self-esteem, fear of negative evaluation, self-consciousnesses and externalizing/personalizing bias.		–
2010	An et al.	24 UHR (14% M, 20.0 years, 100% Japanese) 20 FEP inpatients/outpatients (8% M, 21.3 years, 100% Japanese)	39 NPC (16% M, 19.7 years, 100% Japanese)	AIHQ	FEP participants had elevated hostile attributional bias scores. UHR participants had elevated attribution bias scores for hostility and blaming. In UHR participants, elevated hostile attributional bias was significantly correlated with increased paranoia and suspiciousness/persecution. In FEP participants, elevated hostile attributional bias was significantly correlated with increased paranoia but not suspiciousness/persecution	In UHR participants, relationships between hostile attributional bias and paranoia were reduced (and no longer significant at $p < .05$) when controlling for depression and self-esteem. In FEP participants, controlling for self-esteem, relationship between hostile attributional bias and paranoia were no longer significant yet the relationship increased when controlling for depressive symptoms.	
2011	Mancuso et al.	85 outpatients (68.2% SCZ, 22.4% SCZA, 9.4% PDNOS, 89.4% M, 48.5 years, 52.9% Black, 30.6% White)	–	AIHQ	Elevated hostile attributional bias was significantly correlated with increased positive symptoms but not measures of social cognition.	Elevated hostile attributional bias was significantly correlated with increased agitation and depression/anxiety.	Hostile attributional bias was not significantly correlated with measures of functioning.
2012	Edwards & Bond	62 forensic inpatients (74% SCZ, 15% SCZA, 100% M, 39 years)	–	SIP-AEQ	Elevated hostile attributional bias was significantly correlated with increased physical aggression script accessibility but not other types of aggressive script accessibility.	Low self-concept and high narcissism precited hostile attributional bias.	–
2013	Combs et al.	26 SP undergrads (20% M, 22.1 years, 60% White)	31 undergrads with low scores on PS (10% M,	AIHQ	The high paranoia group had significantly higher	–	–

(continued)

Table 1. Continued.

Year	Author(s)	Clinical group	Control group	Measure	Relationship to psychotic symptoms and/or social cognition	Relationship to general psychopathology	Relationship to functioning
			22.5 years, 70% White)		hostile attributional bias scores on the hostility and blame subscales of the AIHQ but not the aggression subscale as compared to the low paranoia group.		
2013	Jeon et al.	–	263 NPCs (50.6% M, 21.1 years, 100% Korean)	AIHQ	Lower hostile attributional bias was significantly associated with theory of mind questionnaire scores.	Elevated hostile attributional bias was significantly correlated with increased trait anxiety and anger but not self-esteem.	–
2013	Zaytseva et al.	44 FEP: separated into paranoid (n = 20; 60% M, 28.7 years, race unknown) and non-paranoid (n = 24; 50% M, 25.1 years, race unknown) groups	36 controls (44% M, 27.9 years, race unknown)	AIHQ	Paranoid participants had elevated hostility and blame scores in intentional and accidental situations whereas non-paranoid participants had elevated hostility and blame scores in accidental situations as compared to controls. Elevated hostile attributional bias in intentional situations was significantly correlated with suspiciousness, poor rapport, aggressive tendency with emotional withdrawal, and preoccupation. Elevated hostile attributional bias in accidental situations was significantly correlated with anger and uncooperativeness. Elevated hostile attributional bias in ambiguous situations was significantly correlated with lack of spontaneity and flow of conversation, poor rapport and aggressive tendencies with anxiety.	–	–

Table 1. Continued.

Year	Author(s)	Clinical group	Control group	Measure	Relationship to psychotic symptoms and/or social cognition	Relationship to general psychopathology	Relationship to functioning
2014	Buck et al.	45 outpatients w/ SCZ or SCZA (67% M, 38.5 years, 64% White)	50 NPCs (66% M, 39.9 years, 68% White)	AIHQ	Hostile attributional bias was overall not significantly associated with the total, emotion perception, or attribution index of the narrative of emotions task.	–	–
2014	Kanie et al.	52 inpatients/outpatients, (100% SCZ (53.8% M, 38.1 years, 100% Japanese)	53 NPCs (47.1% M, 37.8 years, 100% Japanese)	AIHQ	NPCs had significantly higher blame and hostility scores on the AIHQ as compared to participants with schizophrenia. Elevated hostile attributional bias was significantly correlated with lower theory of mind and higher hostility bias.	–	–
2015	Healey et al.	62 outpatients w/ SCZ or SCZA (66.1% M, 39.6 years, 64.5% White)	50 NPCs (66% M, 39.9 years, 68% White)	AIHQ	Participants with SCZ had significantly higher blame and hostility scores but lower aggression scores than NPCs. In participants with SCZ, elevated hostile attributional bias (aggression index) was significantly correlated with lower overall social cognitive ability. Hostile attributional bias was significantly correlated with face emotion discrimination (positively with aggression index and negatively with blame index). In NPCs, elevated hostile attributional bias (blame index) was significantly correlated with poorer emotion perception and theory of mind.	–	In participants with SCZ, elevated hostile attributional bias was significantly correlated with lower quality of life (social index subscale)
2015	Lahera et al.	49 outpatients w/ SCZ (57.1% M, 40.4 years) 46 outpatients w/ BPD (67% M, 38.6 years)	50 NPCs (42% M, 43.4 years)	AIHQ	Participants with SCZ and participants with BPD had significantly higher scores on aggression and hostility subscales of the AIHQ as compared to	–	In participants with SCZ, elevated hostile attributional bias was significantly correlated with lower global functioning.

(continued)

Table 1. Continued.

Year	Author(s)	Clinical group	Control group	Measure	Relationship to psychotic symptoms and/or social cognition	Relationship to general psychopathology	Relationship to functioning
2015	Lo & Siu	30 outpatients w/ SCZ (53% M, 24.3 years)	–	SCSQ (translated into Chinese)	NPCs. In participants with SCZ, elevated hostile attributional bias (hostility and aggression) was significantly correlated with elevated general and negative symptoms. Paranoid attributional style was not significantly related to emotion perception. Significantly negatively correlated with theory of mind.	–	Paranoid attributional style was not significantly related to work performance.
2015	Pinkham et al.	179 outpatients (54% SCZ, 46% SCZA, 65% M, 42.1 years, 53% Black, 42% White)	104 NPCs (47% M, 39.2 years, 53% Black, 41% White)	AIHQ	Participants with SCZ had significantly higher blame and hostility scores but not aggression scores on the AIHQ as compared to NPCs.	–	Hostile attributional bias was not significantly correlated with measures of functioning.
2016	Pinkham et al.	81 SCZ-P outpatients (67% M, 39.1 years, 56% Black, 38% White) 66 SCZ-NP outpatients (73% M, 38.0 years, 42% Black, 50% White)	–	AIHQ	Paranoid participants with SCZ had significantly higher blame and hostility scores but not aggression scores on the AIHQ as compared to non-paranoid participants with SCZ.	–	–
2016	Buck, Healey et al.	66 outpatients (100% SCZ or SCZA, 67% M, 39.7 years, 63.6% White, 36.4% Black)	50 NPC (66% M, 39.8 years, 68% White, 32% Black)	AIHQ	Hostile attributional bias was not significantly correlated with measures of social cognitive skill. Elevated hostile attributional bias was significantly correlated with increased positive symptoms.	Elevated hostile attributional bias was significantly correlated with increased emotional discomfort and total symptoms.	Elevated hostile attributional bias was significantly correlated with lower quality of life but not with measures of functioning.
2016	Buck, Pinkham et al.	220 outpatients (100% SCZ or SCZA, 62.7% M, 42.3 years, 40% White, 54.1% Black)	–	AIHQ	Elevated hostile attributional bias was significantly correlated with greater paranoia and hostility. In combination with the trustworthiness scale, hostile attributional bias added variance predicting paranoia beyond social cognitive skills.	Concurrently, elevated hostile attributional bias was significantly correlated with increased emotional discomfort and suspiciousness/persecution. Prospectively, elevated hostile attributional bias was significantly correlated with	Elevated hostile attributional bias was significantly correlated with lower functioning.

Table 1. Continued.

Year	Author(s)	Clinical group	Control group	Measure	Relationship to psychotic symptoms and/or social cognition	Relationship to general psychopathology	Relationship to functioning
2016	Glenthøj et al.	65 UHR (44.6% M, 24.6 years, 92% from high income countries)	30 healthy controls (43.3% M, 24.2 years, 90% from high income countries)	SCSQ	UHR participants did not differ significantly from healthy controls on attributional bias.	increased emotional discomfort and hostility.	–
2017	Buck et al.	160 outpatients (100% SCZ, 73.1% M, 41.7 years, 46.3% White, 45.0% Black)	58 NPC (62.1% M, 42.7 years, 60.3% White, 32.8% Black)	AIHQ	Participants with SCZ had significantly higher blame and hostility scores but not aggression scores on the AIHQ as compared to NPCs. Elevated hostile attributional bias was significantly correlated with increased positive symptoms.	–	Elevated hostile attributional bias was significantly correlated with lower functioning and social competence. AIHQ accidental vignettes added variance predicting social competence and functional capacity beyond ambiguous vignettes. The AIHQ also added variance above and beyond measures of social functioning in predicting role functioning. Open-ended hostility bias and aggression bias items added variance above and beyond the blame scale items predicting role functioning.
2017	Bratton et al.	27 SCZ or SCZA (100% M, all in medium or high security prisons, 37.6 years)	–	AIHQ	Hostile attributional bias was not significantly correlated with paranoid thoughts or social cognition (emotion recognition and theory of mind).	–	–
2017	Hasson-Ohayon et al.	131 participants with SMI, majority SCZ (60% M, 39.3 years, 100% Israeli)	–	AIHQ	Hostile attributional bias was not significantly correlated with emotion recognition or theory of mind.	–	Elevated hostile attributional bias was significantly correlated with lower social quality of life and social skills. These relationships persisted controlling for social cognitive and neurocognitive skills.
2017	Darrell-Berry et al.	54 individuals (37% w/ psychotic disorder, 37% FEP, 26% UHR). Entire sample (including NPC, n = 174; 23.0 years, 40.2% M, 84.5% White)	120 NPCs (combined with clinical sample, same demographics reported in prior column)	AIHQ	Elevated hostile attributional bias was significantly correlated with increased paranoid thoughts and lower theory of mind.	Elevated hostile attributional bias was significantly correlated with increased anger, avoidant attachment and depressive symptoms.	–

(continued)

Table 1. Continued.

Year	Author(s)	Clinical group	Control group	Measure	Relationship to psychotic symptoms and/or social cognition	Relationship to general psychopathology	Relationship to functioning
2017	Ludwig et al.	38 outpatients (100% FEP, 86.7% M, 76.3% White)	39 NPCs (82.1% M, 74.4% White)	AIHQ	FEP participants did not differ significantly from NPCs on attributional bias.	–	Elevated hostile attributional bias (hostility and blame) was significantly correlated with self-reported lower functioning.
2018	Davidson et al.	48 outpatients w/ SCZ, SCZA, or other psychotic disorder (58.3% M, 51 years, 39.6% White)	–	AIHQ	Hostile attributional bias (hostility and blame but not aggression) was significantly correlated with positive and emotional symptoms.	–	Hostile attributional bias was not significantly correlated with quality of life.
2018	Kang et al.	65 UHR (60% M, 20.1 years)	83 NPCs (49.4% M, 20.8 years)	AIHQ	UHR participants had significantly higher blame and hostility scores on the AIHQ as compared to NPCs.	–	In UHR participants, elevated hostile attributional bias (hostility) was significantly correlated with lower problem-focused coping and increased wishful thinking. Elevated hostile attributional bias (blame) was significantly correlated with lower problem-focused coping and increased tension-reduction.
2018	Lo & Siu	62 outpatients w/ SCZ (45.2% M, 37.97 years)	19 NPCs (demographics not reported)	SCSQ (translated into Chinese)	Participants with SCZ had significantly higher scores of paranoid attributional style as compared to NPCs. Paranoid attributional bias was not significantly related to symptoms.	–	Elevated paranoid attributional style was significantly correlated with lower task orientation, self-control and attitude toward supervision.

BPD: bipolar disorder; FEP: first episode psychosis; HP: high-scoring in paranoia; LP: low-scoring in paranoia; M: male; NPC: non-psychiatric control; nPD: non-persecutory delusions; PD: persecutory delusions; PDNOS: psychotic disorder not otherwise specified; SCZ: schizophrenia; SCZA: schizoaffective disorder; SUD: substance use disorder; SMI: serious mental illness; SP: subclinical paranoia; UHR: ultra-high risk for psychosis; AIHQ: Ambiguous Intentions Hostility Questionnaire; EHAS: External Hostile Attribution Scale; SIP-AEQ: Social Information Processing-Attribution Emotion Questionnaire; SCSQ: Social Cognition Screening Questionnaire.
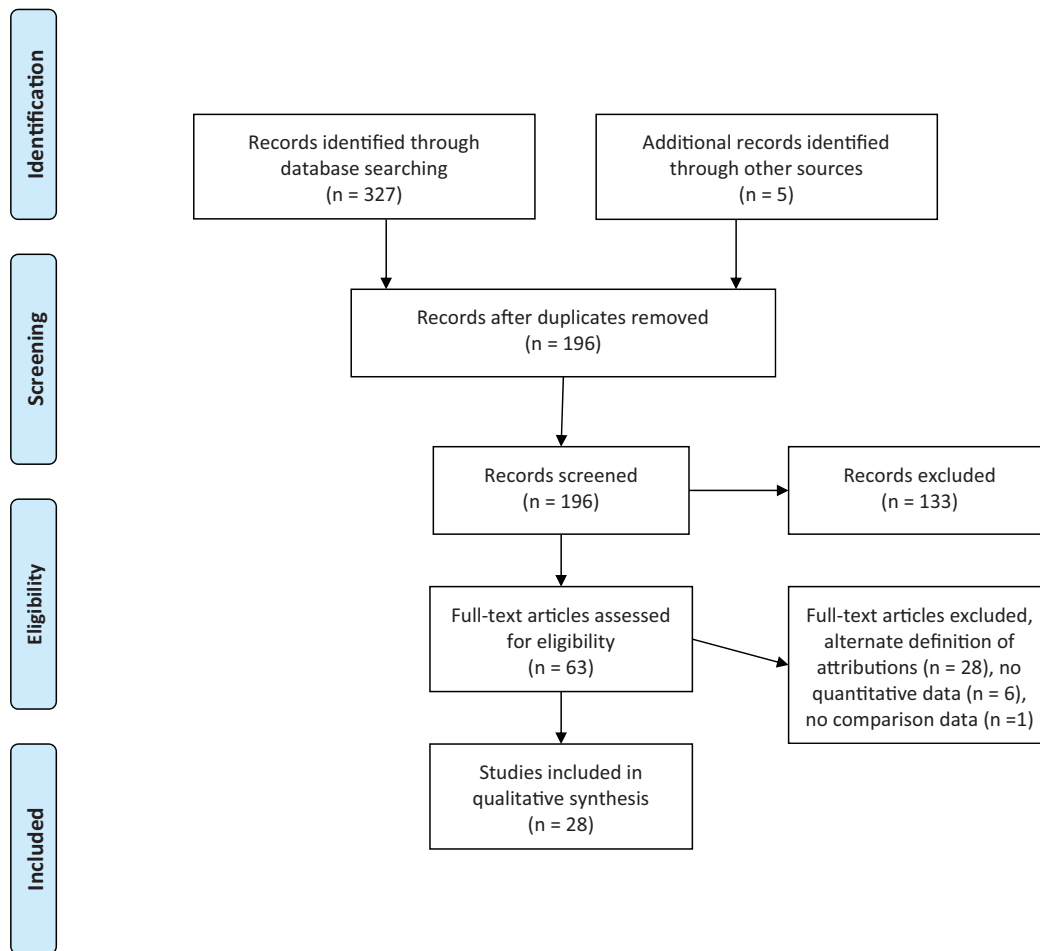#Relationship counter to the expected direction.

Figure 1. PRISMA diagram of reviewed studies. From Moher et al., 2009.

these items are separated into three categories: accidental (other actors seemingly acting unintentionally), intentional (other actors seemingly acting intentionally) and ambiguous (intentions of actors are unclear). Based on conclusions of the measure development study (Combs et al., 2007), most trials shortened the AIHQ to just the five ambiguous scenarios, citing higher relationships between the totals from these items and paranoia scores in a control sample. This version is referred to in the literature as the five-item version, the abbreviated AIHQ or the ambiguous items only.

Social Information Processing Attribution and Emotional Response Questionnaire

The SIP-AEQ (Coccaro et al., 2009) is a pencil and paper vignette task that examines individuals' reactions to socially ambiguous situations. Each of the 10 vignettes requires the participant to interpret the actions of others that generated adverse actions. The situations are followed by four Likert-scale questions aimed at determining (non mutually exclusive) interpretations of hostile intent, indirect hostile intent, instrumental hostile intent, and neutral or benign intent, as well as a negative affective response, both with regard to affect directed at oneself and at the other in the story.

External Hostile Attribution Scale

The EHAS (McNiel et al., 2003) is a 20-item self-report instrument that requires participants to report their tendency to interpret ambiguous social events with hostile and external attributions and react violently. Items cover six domains, including (1) perceiving that others intend to do the participant harm, (2) believing that he or she has been personally targeted, (3) perceiving intended harms as misdeeds committed by a specific perpetrator, (4) believing they are in imminent danger, (5) believing that physical force is the best means of protection or retaliation against a perpetrator and (6) attributing blame to the perpetrator on the basis of his or her dispositional qualities.

Social Cognition Screening Questionnaire (SCSQ)

The SCSQ (Roberts et al., 2011; Kanie et al., 2014) contains 10 short vignettes presenting a social interaction about which participants answer three yes-or-no questions. These questions are designed to assess the participants' memory of the vignette as well as their inferences about characters' intent in the interaction. When participants ascribe hostile intention toward the actor, that item is scored with a 1 for the hostility bias scale. In the present review, only findings that pertain to this hostility bias score are presented.

Results

Group differences and relationship to persecutory symptoms

Reviewed studies provided evidence for group differences between schizophrenia and control groups in several aspects comprising hostile attribution bias, particularly pertaining to attributions of blame and hostility. In five studies (Buck et al., 2017; Healey et al., 2015; Lahera et al., 2015; Lo & Siu; Pinkham, Penn, et al., 2016) individuals with schizophrenia demonstrated elevations in each of these domains relative to controls. There were fewer studies in the current review ($n = 4$; An et al., 2010; Darrell-Berry et al., 2017; Ludwig et al., 2017; Zaytseva et al., 2013) focused on differences between controls and individuals with early psychosis. No significant differences were found between participants with FEP and non-psychiatric controls (NPCs) in the first-episode psychosis (FEP) follow up to the SCOPE study (Ludwig et al., 2017), but Zaytseva et al. (2013) demonstrated that individuals with FEP had elevations across AIHQ subscales. Comparisons between individuals at high risk for psychosis were equivocal, with one study demonstrating significant elevations among the UHR participants (Kang et al., 2018), and one with non-significant differences between these groups (Glenthoj et al., 2016). One study (An et al., 2010) examined group differences between participants with FEP, participants at ultra-high risk (UHR) and NPCs. In these analyses, both FEP and UHR samples were elevated relative to controls in the hostility scale, only UHR individuals were elevated relative to controls in the blame scale, and in judgments of aggression, non-patient controls were elevated relative to both UHR and FEP samples. In two of the reviewed studies involving FEP individuals (An et al., 2010; Darrell-Berry et al., 2017) correlational analyses revealed stronger positive relationships of hostile attribution bias to paranoia across all disorder groups. This is also bolstered by Zaytseva et al. (2013) results demonstrating that individuals with FEP and paranoia were elevated in hostile attribution bias relative to those without paranoia.

These findings raise questions about whether hostile attribution bias is a central feature of schizophrenia, or only among those with paranoia. Indeed, elevations in hostile attribution biases appear most extreme among individuals with persecutory delusions. Combs et al. (2009) demonstrated that individuals with persecutory delusions (and schizophrenia) had elevations on all AIHQ subscales compared directly to both participants with schizophrenia without persecutory delusions and non-clinical controls. Participants with schizophrenia (but without persecutory delusions) did not differ from controls. In fact, the AIHQ has shown a small to moderate relationship with paranoia in undergraduate samples (Combs et al., 2007, 2013) and stronger relationships among paranoid individuals with a range of diagnoses (McNiel et al., 2003) as well as individuals at UHR (An et al., 2010), and individuals across the psychosis continuum (Darrell-Berry et al., 2017). Across populations, relationships of hostile attribution bias to paranoia and suspiciousness are found (with some exception, i.e.

Bratton et al., 2017) when assessing these domains in a number of ways, including objective personality test subscales (Combs et al., 2009; McNiel et al., 2003), self-report questionnaires (Chang et al., 2009; Combs et al., 2007, 2009; Darrell-Berry et al., 2017) and interview-based ratings of hostility/suspiciousness symptoms (An et al., 2010; Davidson et al., 2018; Mancuso et al., 2011). Each study reviewed here reported a significant relationship between at least one subscale of the AIHQ and a measure of paranoia or persecutory ideation, suggesting that there is indeed some degree of relationship between the two constructs.

Yet, little is known regarding the types of situations that elicit attributions most relevant to the development or maintenance of paranoia. In initial psychometric work on the AIHQ involving undergraduate samples (Combs et al., 2007), it was only the items featuring vignettes involving ambiguous vignettes that demonstrated relationships to paranoia in the hostility subscale. For the aggression subscale, only situational vignettes involving accidental items related to paranoia. In one unexpected finding, a Japanese sample of individuals with schizophrenia presented with lower hostile attribution bias in the intentional items relative to controls (Kanie et al., 2014). As the vast majority of papers involving the AIHQ have focused specifically on the ambiguous items, the impact of contextual cues on hostile attributions in psychotic disorder samples is unclear. Only recently (Buck et al., 2017) has the incremental validity of hostile attributions in non-ambiguous situations been re-examined. In this work, it appears that while hostile attributions in paradigmatically accidental items were not related to hostility and suspiciousness symptoms, they were strongly associated with skill-rated functional capacity. These findings suggest that the situational context impacts the likelihood of hostile attributions as well as their functional impact. For example, aberrant biases in non-ambiguous situations – to fail to detect hostility where it is likely to exist (i.e. intentional items) and to detect it where it is unlikely to exist (i.e. accidental items) – may be associated with poor general cognitive performance and dysfunction such that the individual is not "reading the situation correctly." Alternately, an individual who attributes hostility across situations (i.e. a consistent bias) may have intact general cognitive performance, but present with elevations in persecutory ideation and paranoia; as such, in these cases hostile attribution bias may serve as a bridge between the experience of stressful situations and symptoms of psychosis.

Ultimately, the studies reviewed provide evidence for several initial conclusions regarding the relationships between hostile attribution bias, psychosis and paranoia. First, elevations in attributions related to hostility and blame are present in individuals with chronic schizophrenia relative to controls. Second, hostile attribution bias is generally related to the level of paranoia or suspiciousness (assessed in a number of ways) both within a diagnosed sample and combining continuously across non-clinical and diagnosed individuals. Third, differences in results across different kinds of assessments of hostile attributions suggest that the

situational context might impact attributions in different ways across clinical groups.

Relationship to other symptoms

The hostile attribution bias appears related to a number of phenomena that are not specific to psychosis. In fact, hostile attribution bias was initially a construct of interest in the study of childhood disruptive behaviors and conduct disorder (Crick & Dodge, 1994). Indeed, a number of studies have addressed hostile attribution bias as a treatable construct linked with anger, conflict and aggressive behaviors. Indeed, a few studies demonstrate relationships of hostile attributions to state and trait anger in individuals without psychosis (Jeon et al., 2013) as well as across a range of psychiatric diagnoses (McNiel et al., 2003). Another study of inpatients with an array of diagnoses demonstrated that the hostile attribution bias is related to narcissism and aggressive cognition (Edwards & Bond, 2012). Importantly, these relationships present across populations, and not specifically among individuals with paranoia or schizophrenia, for whom fear and worry are closely linked to paranoia (Freeman & Garety, 2014).

One emerging question based on these findings is the extent to which hostile attribution bias is indicative primarily of underlying general negative affect, depression and anxiety. Depression involves cognitive patterns – i.e. those involving negative views of the self, others, and the world (Alloy et al., 1999) – that clearly overlap with paranoia and psychosis generally. As many as 30% of individuals with schizophrenia have clinically significant depressive symptoms (Majadas et al., 2012) and even higher estimates are reported in the early course of the disorder (Wassink et al., 1999). A few studies identified in the current review examined the relationship between hostile attribution bias and depression or anxiety. Specifically, Combs et al. (2009) reported that the AIHQ hostility scale was significantly related to depression in a combined schizophrenia and non-clinical sample. Only one study in this review examined relationships of the AIHQ to a specific anxiety measure (Jeon et al., 2013), and this study revealed a relationship between the AIHQ blame scale and anxiety in a non-clinical sample. Three studies found that clinician-rated totals of combined depression and anxiety symptoms appear to be related to the AIHQ blame scale (Buck, Pinkham, et al., 2016), as well as a combined full-version AIHQ (combining all subscales; Buck et al., 2017; Mancuso et al., 2011).

Although no studies compared a depressed or anxious sample to a schizophrenia sample in AIHQ scores, other statistical techniques have been employed to clarify these relationships. An et al. (2010) examined the effect of controlling for depression on the relationship between the AIHQ and paranoia and found that for individuals in the midst of a psychotic episode, controlling for depression *increased* the (already strong) relationship between AIHQ scores (both blame and hostility) and the paranoia scale. Yet, for individuals at ultra high risk for development of psychosis, controlling for depression decreased it, dropping this relationship to non-significant. They also noted that individuals at ultra high risk had significantly lower self-esteem than non-clinical controls and individuals in the midst of a first psychotic episode. As such, it may be that subclinical, or at-risk individuals might present with hostile attributional biases that are more closely related to depressive symptoms than to positive symptoms of psychosis. This would be indicative of a qualitative difference between those with psychosis and those at risk and that these attributional biases are sustained independently of mood symptoms in active phases of the disorder.

Relationship to functioning

One significant limitation in the study of hostile attribution bias in schizophrenia has been a lack of consistent relationships to functional outcomes. In the large, multi-site psychometric SCOPE study, Pinkham, Penn, et al. (2016) designated the AIHQ as "not recommended for further consideration" in the SCOPE battery in light of "limited relation with functional outcomes" including functional capacity, social functioning and social skills (p. 501). Indeed, both in SCOPE and in other studies, research examining relationships between hostile attribution bias and global functional outcomes has been mixed. In a combined sample of individuals with schizophrenia and bipolar disorder, the aggression subscale of the AIHQ was significantly negatively related to clinician-rated global functioning (Lahera et al., 2015). Similar samples have demonstrated significant relationships between the AIHQ and independent living skills, role functioning and social competence (Buck et al., 2017), as well as to social quality of life (Hasson-Ohayon et al., 2017; Healey et al., 2015). In a sample of individuals with FEP, the AIHQ blame and hostility scales were related to self-rated general functioning, but not to performance tasks of social functioning and functional capacity (Ludwig et al., 2017). Individuals at ultra-high risk with elevated hostile attributions also appear to present with poorer coping skills (Kang et al., 2018).

Other studies have suggested, however, that hostile attributions are not highly related to general functional outcomes. Mancuso et al. (2011) showed that a combined factor-derived AIHQ total score (combining hostility, blame and aggression) showed no relationships to measures of functioning, including a skills-based living skills measure, and interview-rated measures of independent living, social engagement and work skills. These patterns have also been replicated elsewhere, with other studies reporting a lack of relationships of hostile attribution bias to general functional outcomes (Buck, Pinkham, et al., 2016; Fett et al., 2011; Pinkham, Penn, et al., 2016) or quality of life (Davidson et al., 2018).

Several explanations might account for this. First, most simply, hostile attribution biases may not be impactful on functioning in psychotic disorders. Second, these findings might be impacted by limitations in measures of functioning. Further, and importantly, an ongoing question in this literature pertains to whether attributional biases are state or

trait characteristics (Green et al., 2008). A significant body of research already provides support for the view that externalizing attributions and other persecutory ideation often present or are exacerbated in the face of stress (Moritz et al., 2011), a threat to self-esteem (Thewissen et al., 2008; Thewissen et al., 2011) or other negative emotional states (Ben-Zeev et al., 2009, 2011). Such accounts suggest that hostile attribution bias impacts adaptive functioning (or lack thereof) in moment-to-moment interactions and conflicts with others, and not in static factors like employment or living status. If this is the case, extant cross-sectional studies could be thought to capture snapshots of individuals' current behavior. In such a scenario, state-like characteristics like those assessed with the AIHQ might be more closely related to other state outcomes, like depressed mood, anxiety or interpersonal conflict rather than to broad indicators of functioning.

Further, hostile attribution bias may not be reasonably expected to impact functioning as measured by the outcomes used in large-scale clinical trials (e.g. the ability to live independently, navigate public transit). Instead, hostile attribution biases are likely to more consistently impact areas of functioning related to biased social reasoning, like interpersonal conflicts, or fearful (i.e. avoidant), hostile or aggressive behaviors. Waldheter et al. (2005) showed that hostile attributional bias predicted violence on an inpatient unit both concurrently and prospectively, and similar relationships have been reported with self-reported aggressive behavior questionnaires (McNiel et al., 2003). Similarly, a re-evaluation of large-scale psychometric analysis data (Buck, Pinkham, et al., 2016) revealed that the AIHQ is more closely related to interpersonal conflict than general independent living or work skills. Healey et al. (2015) found no relationships of the AIHQ to general functional outcomes, but did report a significant negative relationship to specifically social components of quality of life. This was later replicated by Hasson-Ohayon et al. (2017). Thus, hostile attributional style might be a factor that affects one's propensity to engage in conflicts, both physical and verbal, and this in turn may interfere with an individual's social and interpersonal functioning.

Persisting questions and future directions

Measurement issues
A number of measurement limitations are apparent as a result of the present review. An overwhelming majority (n = 23) of these studies have relied upon a single measure, the AIHQ. Additionally, there are a number of questions related to ecological validity that cannot be answered by the present review about the differences between each measure; for example, it is unclear how vignettes that are written in second person (e.g. the AIHQ, Combs et al., 2007) might differ from those written in third-person (SIP-AEQ, Coccaro et al., 2009). Future research ought to examine whether self-report summaries correspond to hypothetical vignettes, laboratory tasks or ecological momentary assessment questionnaires. While the SIP-AEQ and AIHQ are similar methodologically, only the AIHQ has been subjected to an extensive psychometric review in a psychotic disorder sample (Buck et al., 2017). Within that review process, several limitations have been identified.

First, the incremental validity of trained rater subscales of extant measures is unclear beyond self-report totals. As mentioned, the AIHQ's aggression bias was regarded as having weak psychometric support initially (Combs et al., 2007) and subsequent research has supported this, as it has performed poorly in correlations with paranoia scales (Combs et al., 2007), hostility (Combs et al., 2009) and trait anger questionnaires (Jeon et al., 2013), and the hostility and blame subscales of the AIHQ (Buck, Healey, et al., 2016; Buck et al., 2017; Combs et al., 2009, Mancuso et al., 2011) itself. One reason for the unimpressive results of aggression items might be that they do not generate a range of responses, as reporting an aggressive action (e.g. a plan to fight an individual that slights the participant) is subject to social desirability bias and thus a relatively infrequent response. It is also unclear the extent to which the ascription of hostility and blame diverge, or if indeed they are two items measuring the same underlying construct. Previous research suggests that the two scales on the AIHQ are highly correlated with one another, both in psychotic disorder and control samples (Buck, Healey, et al., 2016; Combs et al., 2009; Mancuso et al., 2011).

Second, these vignette tasks consist of few items. It is possible that this limits their sensitivity and power to predict important outcomes or distinguish between clinical and control groups. Collecting a high number of observations in assessments of social cognitive biases is particularly important, as these biases reflect a general tendency to make social determinations in certain ways across situations and contexts. Additionally, the AIHQ's hostility and aggression biases involve open-ended responses that are later rated by trained researchers (Combs et al., 2007). This characteristic – because of its burden on providers and time – potentially limits the number of items, reducing variance in measure performance and therefore statistical power. Given the fact that self-reported AIHQ scales are related to interpersonal conflict outcomes without the help of these additional subscales (Buck et al., 2017), it raises questions about whether they should be included in clinical trials.

Third, biases in social judgments emerge across a range of situations that vary according to how obvious or demanding their cues are. For example, a situation where intention appears less ambiguous (e.g. "a person cuts you off in traffic") may result in a hostile attribution for a higher number of participants from both clinical and normative samples. A more ambiguous action, on the other hand (e.g. "you walk by a group of teenagers and they start to laugh") might generate varied responses, the patterns of which might relate to clinical factors. For example, because the initial large-scale analogue sample validation study showed highest convergent correlations for the AIHQ's ambiguous vignettes (Combs et al., 2007), most subsequent studies only included these items to simplify administration and reduce testing time. While this did successfully simplify the scale, it

potentially limited variability by both lowering the ceiling of the scale and raising its floor. And in fact, more recent work demonstrates that the AIHQ accidental items provide incremental validity above and beyond totals of the ambiguous items in predicting independent living skills and informant-reported levels of functioning (Buck et al., 2017). Thus, it should be noted that a planned and systematic varying of the demand of the situational cues might provide a more sensitive and holistic measurement of hostile attribution bias. Vignette measures are limited in that each item is more time consuming and exerts greater burden on participants. Other social cognitive tasks – for example, evaluating whether one detects hostile expressions in neutral or ambiguous faces – ought to be examined in a similar fashion in future research.

Further, as mentioned, social cognitive *biases* describe phenomena that differ from social cognitive *skills* in important ways that affect their measurement. While adaptive functioning in social cognitive skill consists of maximal numbers of "correct" responses (e.g. the *more skilled* the *better*), social cognitive biases are qualitatively different. In interpreting others' actions as hostile or intentional, it would neither be adaptive to *always* assume hostile intentions or to never do so. Rather, adaptive functioning in a social cognitive bias ought to be defined in relation to an adaptive level of hostile attribution according to the situational context of each item. Existing measures of hostile attribution bias in schizophrenia do not do this. Comparing mean values between groups allows for comparison of raw values, but it does not characterize whether the individual is demonstrating elevated responses because of an inability to understand situational cues (i.e. low discernibility) or an actual bias toward hostility (i.e. true bias). More sophisticated models that compare participant responses against *expected* responses might be more sensible.

Process orientation

Existing measures of hostile attribution bias provide access to the outcomes of biased social judgments. They do not provide information about the *processes* in which one engages in order to arrive at such judgments. A rich literature in social psychology has demonstrated that the process through which all individuals generate social judgments often involves two sets of related processes: automatic and controlled influences (Payne, 2001). While automatic processes are efficient, involuntary, immediate and operate outside the individual's awareness, controlled processes are effortful, controllable and conscious. According to such a model, cognitive processes are comprised of automatic reactions that can be accepted, rejected or amended "downstream" moments later with cognitive processing. Thus, cognitive processes (and particularly biases) are not the product only of immediate reactions, but one's ability to regulate and control such initial reactions.

While this has not been examined in depth, it may be that models of hostile attributions in psychosis are better described with a similar dual process model of automatic and controlled processes (Ward & Garety, 2019).

Preliminary research suggests that individuals with paranoia may have difficulty regulating automatic biases under stress (Moritz et al., 2011, 2015), may be more susceptible to primes (Hooker et al., 2011) or may present opposite biases across implicit and explicit conditions (Lyon et al., 1994). Existing hostile attribution bias measures ignore such processes. For example, the large-scale SCOPE study (Pinkham, Penn, et al., 2016; Pinkham et al., 2018) compared mean scores between clinical and control samples as well as correlations with symptom and functioning outcomes. These types of analyses do not address questions about how individuals make social judgments when in acute states of illness, experiencing high levels of stress or in a complex social situation more ecologically valid to the social environment. Indeed, such process-oriented models of social cognition are regarded as a "new frontier" for research in the area. As described by Roberts and Pinkham (2013) in their review of future directions for the study of social cognition in schizophrenia, "the dual process framework provides a strong basis for applying social psychological principles to the study of social cognition in schizophrenia," particularly in order to distinguish between "diminished controlled processing capacity, and excessively salient and aberrant automatic social cognitive impressions (p. 409)."

Theoretical model questions

One central question about hostile attribution bias pertains to its causal role in the emergence of paranoia. Of the studies reviewed here, there is not conclusive evidence for hostile attribution bias as a proximal, sufficient or necessary condition for paranoia. Further, as the definitions of each construct are similar, it could be the case that hostile attributions are definitionally linked to paranoia. Nonetheless, if these cognitive patterns are in some way tractable, particularly in response to treatment, the cognitive conceptualization allowed by the hostile attribution bias might be of import in treatment.

Another important question to be addressed with future advancements in methodology is the extent to which hostile attribution bias is a state or trait-like characteristic. Evolving models suggest that psychotic symptoms emerge from the experience of day-to-day stress (Lataster et al., 2013; Reininghaus et al., 2016). If hostile attribution bias explains connections between stress and psychotic symptoms, one-time, cross-sectional assessments might not be sufficient to capture the extent to which it impacts an individual's behavior. Methodologies that allow for ongoing, frequent, ecologically valid assessment (i.e. ecological momentary assessment or multimodal technology; Reininghaus et al., 2016; Ben-Zeev et al., 2017) might more effectively identify individuals with elevations in this type of bias.

Another limitation of the hostile attribution bias as currently studied is how it ostensibly combines several constructs into one assessment. Specifically, asking individuals to ascribe levels of blame and hostility to a range of negative events confounds immediate biases about negativity of others' actions with beliefs about the intentionality of others' actions. The scenarios of the AIHQ and SIP-AEQ are both

ambiguous and involve negative outcomes (e.g. a friend doesn't attend a dinner, an important person skips an appointment). In this way, it cannot be determined through the AIHQ whether individuals have an increased bias toward attributing intentionality in negative events specifically, or in all events. Instruments focused specifically on intentionality demonstrate that individuals with schizophrenia appear to assign intentionality to neutral actions (e.g. "he set the alarm off" being perceived as intentional rather than accidental) at higher rates than controls (Peters et al., 2014; Peyroux et al., 2014), though these measures have not been found to predict symptoms or functional outcomes.

It is also unclear if hostile attributional style is specific to the emergence of paranoia, or if it emerges as a result of (or concurrently with) other comorbid symptoms like anxiety and depression. While it appears hostile attributional bias is related to these other forms of psychopathology (Combs et al., 2009; Mancuso et al., 2011), it is possible that in the absence of depression, this bias might be a particularly strong indicator of psychosis (An et al., 2010) or that there may be a more complex relationship according to which this thinking affects the presentation of other symptoms (e.g. ideas of reference, Morrison & Cohen, 2014). Future work should also consider how other psychotic symptoms may interact with and be shaped by hostile attribution bias. For instance, it is possible that individuals elevated in negative symptoms may experience an inhibition of hostile attribution bias and/or persecutory ideation. Another area to consider is the influence of auditory hallucinations, which could influence cognitive appraisals and increase persecutory ideation as well. Finally, while particularly robust findings suggest that hostile attributional style has little impact on independent living skills, future work could also explore the range of more appropriate criterion validity outcomes that might be impacted by this bias, e.g. violence (Waldheter et al., 2005) or other conflict (Buck, Pinkham, et al., 2016).

Conclusion

The present review presents a developing literature on hostile attribution bias with an emphasis on a few key points: (1) evidence for elevations in hostile attribution bias in schizophrenia, particularly among those with paranoia or persecutory delusions, (2) preliminary evidence for relationships of hostile attribution bias to anxiety and depression and (3) limited evidence of hostile attribution bias to functional outcomes, but preliminary evidence for relationships to interpersonal conflict outcomes. There exist numerous persisting questions in the study of this domain, including identifying which measures most effectively capture it and determining the ways in which it presents: as a state or trait-like characteristic, via dual processes, its potential variation across situational contexts. A continued exploration of this area still shows promise, as a better understanding of this cross-diagnostic domain could provide a framework for addressing biased thinking that leads to persecutory delusions.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Alloy, L. B., Abramson, L. Y., Whitehouse, W. G., Hogan, M. E., Tashman, N. A., Steinberg, D. L., Rose, D. T., & Donovan, P. (1999). Depressogenic cognitive styles: Predictive validity, information processing and personality characteristics, and developmental origins. *Behaviour Research and Therapy*, 37(6), 503–531. https://doi.org/10.1016/S0005-7967(98)00157-0

An, S. K., Kang, J. I., Park, J. Y., Kim, K. R., Lee, S. Y., & Lee, E. (2010). Attribution bias in ultra-high risk for psychosis and first-episode schizophrenia. *Schizophrenia Research*, 118(1–3), 54–61. https://doi.org/10.1016/j.schres.2010.01.025

Bentall, R. P., Kinderman, P., & Kaney, S. (1994). The self, attributional processes and abnormal beliefs: Towards a model of persecutory delusions. *Behaviour Research and Therapy*, 32(3), 331–341. https://doi.org/10.1016/0005-7967(94)90131-7

Ben-Zeev, D., Brian, R., Wang, R., Wang, W., Campbell, A. T., Aung, M. S. H., Merrill, M., Tseng, V. W. S., Choudhury, T., Hauser, M., Kane, J. M., & Scherer, E. A. (2017). CrossCheck: Integrating self-report, behavioral sensing, and smartphone use to identify digital indicators of psychotic relapse. *Psychiatric Rehabilitation Journal*, 40(3), 266–275. https://doi.org/10.1037/prj0000243

Bora, E., Yucel, M., & Pantelis, C. (2009). Theory of mind impairment in schizophrenia: Meta-analysis. *Schizophrenia Research*, 109(1–3), 1–9. https://doi.org/10.1016/j.schres.2008.12.020

Bratton, H., O'Rourke, S., Tansey, L., & Hutton, P. (2017). Social cognition and paranoia in forensic inpatients with schizophrenia: A cross-sectional study. *Schizophrenia Research*, 184, 96–102. https://doi.org/10.1016/j.schres.2016.12.004

Ben-Zeev, D., Ellington, K., Swendsen, J., & Granholm, E. (2011). Examining a cognitive model of persecutory ideation in the daily life of people with schizophrenia: A computerized experience sampling study. *Schizophrenia Bulletin*, 37(6), 1248–1256. https://doi.org/10.1093/schbul/sbq041

Ben-Zeev, D., Granholm, E., & Cafri, G. (2009). Symptoms of depression and anxiety mediate the relationship between self-esteem and paranoia. *Schizophrenia Research*, 115(2-3), 377–378. https://doi.org/10.1016/j.schres.2009.06.009

Buck, B., Healey, K. M., Gagen, E. C., Roberts, D. L., & Penn, D. L. (2016). Social cognition in schizophrenia; Factor structure, clinical and functional correlates. *Journal of Mental Health*, 25(4), 330–337. https://doi.org/10.3109/09638237.2015.1124397

Buck, B., Iwanski, C., Healey, K. M., Green, M. F., Horan, W. P., Kern, R. S., Lee, J., Marder, S. R., Reise, S. P., & Penn, D. L. (2017). Improving measurement of attributional style in schizophrenia; a psychometric evaluation of the Ambiguous Intentions Hostility Questionnaire (AIHQ). *Journal of Psychiatric Research*, 89, 48–54.

Buck, B., Pinkham, A. E., Harvey, P. D., & Penn, D. L. (2016). Revisiting the validity of measures of social cognitive bias in schizophrenia: Additional results from the Social Cognition Psychometric Evaluation (SCOPE) study. *British Journal of Clinical Psychology*, 55(4), 441–454. https://doi.org/10.1111/bjc.12113

Chang, H., Lee, S. K., Kim, K. R., Lee, S. Y., Park, J. Y., Kim, E. J., Kang, J. I., Lee, E., & An, S. K. (2009). Development of Korean version of the ambiguous intentions hostility questionnaire (K-AIHQ). *Journal of the Korean Neuropsychiatric Association*, 48(1), 29–35.

Combs, D. R., Adams, S. D., Penn, D. L., Roberts, D., Tiegreen, J., & Stem, P. (2007). Social cognition and interaction training (SCIT) for inpatients with schizophrenia spectrum disorders: Preliminary findings. *Schizophrenia Research*, 91(1–3), 112–116. https://doi.org/10.1016/j.schres.2006.12.010

Combs, D. R., Finn, J. A., Wohlfahrt, W., Penn, D. L., & Basso, M. R. (2013). Social cognition and social functioning in nonclinical paranoia. *Cognitive Neuropsychiatry*, 18(6), 531–548. https://doi.org/10.1080/13546805.2013.766595

Combs, D. R., Penn, D. L., Chadwick, P., Trower, P., Michael, C. O., & Basso, M. R. (2007). Subtypes of paranoia in a nonclinical sample. *Cognitive Neuropsychiatry*, *12*(6), 537–553. https://doi.org/10.1080/13546800701707306

Combs, D. R., Penn, D. L., Michael, C. O., Basso, M. R., Wiedeman, R., Siebenmorgan, M., Tiegreen, J., & Chapman, D. (2009). Perceptions of hostility by persons with and without persecutory delusions. *Cognitive Neuropsychiatry*, *14*(1), 30–52. https://doi.org/10.1080/13546800902732970

Combs, D. R., Penn, D. L., Wicher, M., & Waldheter, E. (2007). The Ambiguous Intentions Hostility Questionnaire (AIHQ): A new measure for evaluating hostile social-cognitive biases in paranoia. *Cognitive Neuropsychiatry*, *12*(2), 128–143. https://doi.org/10.1080/13546800600787854

Coccaro, E. F., Noblett, K. L., & McCloskey, M. S. (2009). Attributional and emotional responses to socially ambiguous cues: Validation of a new assessment of social/emotional information processing in healthy adults and impulsive aggressive patients. *Journal of Psychiatric Research*, *43*(10), 915–925. https://doi.org/10.1016/j.jpsychires.2009.01.012

Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin*, *115*(1), 74–101. https://doi.org/10.1037/0033-2909.115.1.74

Darrell-Berry, H., Bucci, S., Palmier-Claus, J., Emsley, R., Drake, R., & Berry, K. (2017). Predictors and mediators of trait anger across the psychosis continuum: The role of attachment style, paranoia and social cognition. *Psychiatry Research*, *249*, 132–138. https://doi.org/10.1016/j.psychres.2017.01.007

Davidson, C. A., Lesser, R., Parente, L. T., & Fiszdon, J. M. (2018). Psychometrics of social cognitive measures for psychosis treatment research. *Schizophrenia Research*, *193*, 51–57.

Edwards, R., & Bond, A. J. (2012). Narcissism, self-concept clarity and aggressive cognitive bias amongst mentally disordered offenders. *Journal of Forensic Psychiatry & Psychology*, *23*(5–6), 620–634. https://doi.org/10.1080/14789949.2012.715180

Fett, A. K. J., Viechtbauer, W., Dominguez, M. D. G., Penn, D. L., van Os, J., & Krabbendam, L. (2011). The relationship between neurocognition and social cognition with functional outcomes in schizophrenia: A meta-analysis. *Neuroscience & Biobehavioral Reviews*, *35*(3), 573–588. https://doi.org/10.1016/j.neubiorev.2010.07.001

Freeman, D., & Garety, P. (2014). Advances in understanding and treating persecutory delusions: A review. *Social Psychiatry and Psychiatric Epidemiology*, *49*(8), 1179–1189.

Glenthøj, L. B., Fagerlund, B., Hjorthøj, C., Jepsen, J. R., Bak, N., Kristensen, T. D., Wenneberg, C., Krakauer, K., Roberts, D. L., & Nordentoft, M. (2016). Social cognition in patients at ultra-high risk for psychosis: What is the relation to social skills and functioning? *Schizophrenia Research: Cognition*, *5*, 21–27. https://doi.org/10.1016/j.scog.2016.06.004

Green, M. F., & Leitman, D. I. (2007). Social cognition in schizophrenia. *Schizophrenia Bulletin*, *34*(4), 670–672. https://doi.org/10.1093/schbul/sbn045

Green, M. F., Penn, D. L., Bentall, R., Carpenter, W. T., Gaebel, W., Gur, R. C., Kring, A. M., Park, S., Silverstein, S. M., & Heinssen, R. (2008). Social cognition in schizophrenia: An NIMH workshop on definitions, assessment, and research opportunities. *Schizophrenia Bulletin*, *34*(6), 1211–1220. https://doi.org/10.1093/schbul/sbm145

Hasson-Ohayon, I., Mashiach-Eizenberg, M., Arnon-Ribenfeld, N., Kravetz, S., & Roe, D. (2017). Neuro-cognition and social cognition elements of social functioning and social quality of life. *Psychiatry Research*, *258*, 538–543. https://doi.org/10.1016/j.psychres.2017.09.004

Healey, K. M., Combs, D. R., Gibson, C. M., Keefe, R. S., Roberts, D. L., & Penn, D. L. (2015). Observable social cognition – a rating scale: An interview-based assessment for schizophrenia. *Cognitive Neuropsychiatry*, *20*(3), 198–221.

Hooker, C. I., Tully, L. M., Verosky, S. C., Fisher, M., Holland, C., & Vinogradov, S. (2011). Can I trust you? Negative affective priming influences social judgments in schizophrenia. *Journal of Abnormal Psychology*, *120*(1), 98–107. https://doi.org/10.1037/a0020630

Jeon, I. H., Kim, K. R., Kim, H. H., Park, J. Y., Lee, M., Jo, H. H., Koo, S. J., Jeong, Y. J., Song, Y. Y., Kang, J. I., Lee, S. Y., Lee, E., & An, S. K. (2013). Attributional style in healthy persons: Its association with theory of mind skills. *Psychiatry Investigation*, *10*(1), 34–40. https://doi.org/10.4306/pi.2013.10.1.34

Kang, M., Bang, M., Lee, S. Y., Lee, E., Yoo, S. W., & An, S. K. (2018). Coping styles in individuals at ultra-high risk for psychosis: Associations with cognitive appraisals. *Psychiatry Research*, *264*, 162–168.

Kanie, A., Hagiya, K., Ashida, S., Pu, S., Kaneko, K., Mogami, T., Oshima, S., Motoya, M., Niwa, S., Inagaki, A., Ikebuchi, E., Kikuchi, A., Yamasaki, S., Iwata, K., Roberts, D. L., & Nakagome, K. (2014). New instrument for measuring multiple domains of social cognition: Construct validity of the Social Cognition Screening Questionnaire (Japanese version). *Psychiatry and Clinical Neurosciences*, *68*(9), 701–711. https://doi.org/10.1111/pcn.12181

Kohler, C. G., Walker, J. B., Martin, E. A., Healey, K. M., & Moberg, P. J. (2010). Facial emotion perception in schizophrenia: A meta-analytic review. *Schizophrenia Bulletin*, *36*(5), 1009–1019. https://doi.org/10.1093/schbul/sbn192

Kurtz, M. M., Gagen, E., Rocha, N. B., Machado, S., & Penn, D. L. (2016). Comprehensive treatments for social cognitive deficits in schizophrenia: A critical review and effect-size analysis of controlled studies. *Clinical Psychology Review*, *43*, 80–89. https://doi.org/10.1016/j.cpr.2015.09.003

Kurtz, M. M., & Richardson, C. L. (2012). Social cognitive training for schizophrenia: A meta-analytic investigation of controlled research. *Schizophrenia Bulletin*, *38*(5), 1092–1104. https://doi.org/10.1093/schbul/sbr036

Lahera, G., Herrera, S., Reinares, M., Benito, A., Rullas, M., González-Cases, J., & Vieta, E. (2015). Hostile attributions in bipolar disorder and schizophrenia contribute to poor social functioning. *Acta Psychiatrica Scandinavica*, *131*(6), 472–482. https://doi.org/10.1111/acps.12399

Lataster, T., Valmaggia, L., Lardinois, M., Van Os, J., & Myin-Germeys, I. (2013). Increased stress reactivity: A mechanism specifically associated with the positive symptoms of psychotic disorder. *Psychological Medicine*, *43*(7), 1389–1400. https://doi.org/10.1017/S0033291712002279

Lo, P. M., & Siu, A. M. (2017). Assessing social cognition of Persons with schizophrenia in a Chinese population: A pilot study. *Frontiers in Psychiatry*, *8*, 302. https://doi.org/10.3389/fpsyt.2017.00302

Ludwig, K. A., Pinkham, A. E., Harvey, P. D., Kelsven, S., & Penn, D. L. (2017). Social cognition psychometric evaluation (SCOPE) in people with early psychosis: A preliminary study. *Schizophrenia Research*, *190*, 136–143.

Lyon, H. M., Kaney, S., & Bentall, R. P. (1994). The defensive function of persecutory delusions. Evidence from attribution tasks. *The British Journal of Psychiatry*, *164*(5), 637–646. https://doi.org/10.1192/bjp.164.5.637

Majadas, S., Olivares, J., Galan, J., & Diez, T. (2012). Prevalence of depression and its relationship with other clinical characteristics in a sample of patients with stable schizophrenia. *Comprehensive Psychiatry*, *53*(2), 145–151. https://doi.org/10.1016/j.comppsych.2011.03.009

Mancuso, F., Horan, W. P., Kern, R. S., & Green, M. F. (2011). Social cognition in psychosis: Multidimensional structure, clinical correlates, and relationship with functional outcome. *Schizophrenia Research*, *125*(2–3), 143–151. https://doi.org/10.1016/j.schres.2010.11.007

McNiel, D. E., Eisner, J. P., & Binder, R. L. (2003). The relationship between aggressive attributional style and violence by psychiatric patients. *Journal of Consulting and Clinical Psychology*, *71*(2), 399–403.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & The PRISMA Group. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed1000097

Moritz, S., Burnette, P., Sperber, S., Köther, U., Hagemann-Goebel, M., Hartmann, M., & Lincoln, T. M. (2011). Elucidating the black box from stress to paranoia. *Schizophrenia Bulletin*, 37(6), 1311–1317. https://doi.org/10.1093/schbul/sbq055

Moritz, S., Köther, U., Hartmann, M., & Lincoln, T. M. (2015). Stress is a bad advisor. Stress primes poor decision making in deluded psychotic patients. *European Archives of Psychiatry and Clinical Neuroscience*, 265(6), 461–469. https://doi.org/10.1007/s00406-015-0585-1

Morrison, S. C., & Cohen, A. S. (2014). The moderating effects of perceived intentionality: Exploring the relationships between ideas of reference, paranoia and social anxiety in schizotypy. *Cognitive Neuropsychiatry*, 19(6), 527–539. https://doi.org/10.1080/13546805.2014.931839

Payne, B. K. (2001). Prejudice and perception: The role of automatic and controlled processes in misperceiving a weapon. *Journal of Personality and Social Psychology*, 81(2), 181–192. https://doi.org/10.1037/0022-3514.81.2.181

Penn, D. L., Corrigan, P. W., Bentall, R. P., Racenstein, J., & Newman, L. (1997). Social cognition in schizophrenia. *Psychological Bulletin*, 121(1), 114–132. https://doi.org/10.1037/0033-2909.121.1.114

Peters, E. R., Moritz, S., Schwannauer, M., Wiseman, Z., Greenwood, K. E., Scott, J., Beck, A. T., Donaldson, C., Hagen, R., Ross, K., Veckenstedt, R., Ison, R., Williams, S., Kuipers, E., & Garety, P. A. (2014). Cognitive Biases Questionnaire for Psychosis. *Schizophrenia Bulletin*, 40(2), 300–313. https://doi.org/10.1093/schbul/sbs199

Peyroux, E., Strickland, B., Tapiero, I., & Franck, N. (2014). The intentionality bias in schizophrenia. *Psychiatry Research*, 219(3), 426–430. https://doi.org/10.1016/j.psychres.2014.06.034

Pinkham, A. E. (2014). Social cognition in schizophrenia. *The Journal of Clinical Psychiatry*, 75(Suppl. 2), 14–19. https://doi.org/10.4088/JCP.13065su1.04

Pinkham, A. E., Penn, D. L., Green, M. F., Buck, B., Healey, K., & Harvey, P. D. (2014). The social cognition psychometric evaluation study: Results of the expert survey and RAND panel. *Schizophrenia Bulletin*, 40(4), 813–823. https://doi.org/10.1093/schbul/sbt081

Pinkham, A. E., Harvey, P. D., & Penn, D. L. (2016). Paranoid individuals with schizophrenia show greater social cognitive bias and worse social functioning than non-paranoid individuals with schizophrenia. *Schizophrenia Research: Cognition*, 3, 33–38. https://doi.org/10.1016/j.scog.2015.11.002

Pinkham, A. E., Harvey, P. D., & Penn, D. L. (2018). Social cognition psychometric evaluation: Results of the final validation study. *Schizophrenia Bulletin*, 44(4), 737–748.

Pinkham, A. E., Penn, D. L., Green, M. F., & Harvey, P. D. (2016). Social cognition psychometric evaluation: Results of the initial psychometric study. *Schizophrenia Bulletin*, 42(2), 494–504.

Reininghaus, U., Depp, C. A., & Myin-Germeys, I. (2016). Ecological interventionist causal models in psychosis: Targeting psychological mechanisms in daily life. *Schizophrenia Bulletin*, 42(2), 264–269. https://doi.org/10.1093/schbul/sbv193

Reininghaus, U., Kempton, M. J., Valmaggia, L., Craig, T. K. J., Garety, P., Onyejiaka, A., Gayer-Anderson, C., So, S. H., Hubbard, K., Beards, S., Dazzan, P., Pariante, C., Mondelli, V., Fisher, H. L., Mills, J. G., Viechtbauer, W., McGuire, P., van Os, J., Murray, R. M., … Morgan, C. (2016). Stress sensitivity, aberrant salience, and threat anticipation in early psychosis: An experience sampling study. *Schizophrenia Bulletin*, 42(3), 712–722. https://doi.org/10.1093/schbul/sbv190

Roberts, D. L., Fiszdon, J., & Tek, C. (2011). Initial validity of the Social Cognition Screening Questionnaire (SCSQ). *Schizophrenia Bulletin*, 37(S1), 280.

Roberts, D., & Pinkham, A. E. (2013). The future of social cognition in schizophrenia: Implications from the normative literature. In: D. L. Penn & D. Roberts (Eds.), *Social cognition in schizophrenia*. Oxford University Press.

Savla, G. N., Vella, L., Armstrong, C. C., Penn, D. L., & Twamley, E. W. (2013). Deficits in domains of social cognition in schizophrenia: A meta-analysis of the empirical evidence. *Schizophrenia Bulletin*, 39(5), 979–992. https://doi.org/10.1093/schbul/sbs080

Schmidt, S. J., Mueller, D. R., & Roder, V. (2011). Social cognition as a mediator variable between neurocognition and functional outcome in schizophrenia: Empirical review and new results by structural equation modeling. *Schizophrenia Bulletin*, 37(suppl 2), S41–S54. https://doi.org/10.1093/schbul/sbr079

Sergi, M., Green, M., Widmark, C., Reist, C., Erhart, S., Braff, D., Kee, K. S., Marder, S. R., & Mintz, J. (2007). Social cognition and neurocognition: Effects of risperidone, olanzapine, and haloperidol. *American Journal of Psychiatry*, 164(10), 1585–1592. https://doi.org/10.1176/appi.ajp.2007.06091515

Sergi, M. J., Rassovsky, Y., Nuechterlein, K. H., & Green, M. F. (2006). Social perception as a mediator of the influence of early visual processing on functional status in schizophrenia. *American Journal of Psychiatry*, 163(3), 448–454. https://doi.org/10.1176/appi.ajp.163.3.448

Swartz, M. S., Perkins, D. O., Stroup, T. S., Davis, S. M., Capuano, G., Rosenheck, R. A., Reimherr, F., McGee, M. F., Keefe, R. S. E., McEvoy, J. P., Hsiao, J. K., & Lieberman, J. A., & for the CATIE Investigators. (2007). Effects of antipsychotic medications on psychosocial functioning in patients with chronic schizophrenia: Findings from the NIMH CATIE study. *American* Journal of Psychiatry, 164(3), 428–436. https://doi.org/10.1176/ajp.2007.164.3.428

Thewissen, V., Bentall, R. P., Lecomte, T., van Os, J., & Myin-Germeys, I. (2008). Fluctuations in self-esteem and paranoia in the context of daily life. *Journal of Abnormal Psychology*, 117(1), 143–153. https://doi.org/10.1037/0021-843X.117.1.143

Thewissen, V., Bentall, R. P., Oorschot, M., À Campo, J., van Lierop, T., van Os, J., & Myin-Germeys, I. (2011). Emotions, self-esteem, and paranoid episodes: An experience sampling study. *British Journal of Clinical Psychology*, 50(2), 178–195. https://doi.org/10.1348/014466510X508677

Van Hooren, S., Versmissen, D., Janssen, I., Myin-Germeys, I., À Campo, J., Mengelers, R., van Os, J., & Krabbendam, L. (2008). Social cognition and neurocognition as independent domains in psychosis. *Schizophrenia Research*, 103(1–3), 257–265. https://doi.org/10.1016/j.schres.2008.02.022

Vauth, R., Rüsch, N., Wirtz, M., & Corrigan, P. W. (2004). Does social cognition influence the relation between neurocognitive deficits and vocational functioning in schizophrenia? *Psychiatry Research*, 128(2), 155–165. https://doi.org/10.1016/j.psychres.2004.05.018

Waldheter, E. J., Jones, N. T., Johnson, E. R., & Penn, D. L. (2005). Utility of social cognition and insight in the prediction of inpatient violence among individuals with a severe mental illness. *The Journal of Nervous and Mental Disease*, 193(9), 609–618. https://doi.org/10.1097/01.nmd.0000177788.25357.de

Ward, T., & Garety, P. A. (2019). Fast and slow thinking in distressing delusions: A review of the literature and implications for targeted therapy. *Schizophrenia Research*, 203, 80–87. https://doi.org/10.1016/j.schres.2017.08.045

Wassink, T. H., Flaum, M., Nopoulos, P., & Andreasen, N. C. (1999). Prevalence of depressive symptoms early in the course of schizophrenia. *The American Journal of Psychiatry*, 156(2), 315–316. https://doi.org/10.1176/ajp.156.2.315

Zaytseva, Y., Burova, V., Garakh, Z., & Gurovich, I. Y. (2013). Attributional style in first episode of schizophrenia and schizophrenia spectrum disorders with and without paranoid ideation. *Psychiatria Danubina*, 25(2), 329–331.

Appendix. PubMed and PsycINFO search terms (October 2018)

PsycINFO	PubMed
(AB "attributional style"	("attributional style" [tw]
OR TI "attributional style"	OR "attributional style" [tw]
OR MA "attributional style"	OR "attributional style" [tw]
OR AB "attributional bias"	OR "attributional bias" [tw]
OR TI "attributional bias"	OR "attributional bias" [tw]
OR MA "attributional bias"	OR "attributional bias" [tw]
OR AB "attribution bias"	OR "attribution bias" [tw]
OR TI "attribution bias"	OR "attribution bias" [tw]
OR MA "attribution bias"	OR "attribution bias" [tw]
OR AB "hostile attribution"	OR "hostile attribution" [tw]
OR TI "hostile attribution"	OR "hostile attribution" [tw]
OR MA "hostile attribution"	OR "hostile attribution" [tw]
OR AB "hostility bias"	OR "hostility bias" [tw]
OR TI "hostility bias"	OR "hostility bias" [tw]
OR MA "hostility bias"	OR "hostility bias" [tw]
OR AB "aggression bias"	OR "aggression bias" [tw]
OR TI "aggression bias"	OR "aggression bias" [tw]
OR MA "aggression bias")	OR "aggression bias" [tw])
AND	AND
(AB "schizophrenia"	("schizophrenia" [tw]
OR MA "schizophrenia"	OR "schizophrenia" [tw]
OR TI "schizophrenia"	OR "schizophrenia" [tw]
OR AB "psychosis"	OR "psychosis" [tw]
OR MA "psychosis"	OR "psychosis" [tw]
OR TI "psychosis"	OR "psychosis" [tw]
OR AB "paranoia"	OR "paranoia" [tw]
OR TI "paranoia"	OR "paranoia" [tw]
OR MA "paranoia"	OR "paranoia" [tw]
OR AB "psychotic"	OR "psychotic" [tw]
OR MA "psychotic"	OR "psychotic" [tw]
OR TI "psychotic"	OR "psychotic" [tw]
OR AB "schizoaffective"	OR "schizoaffective" [tw]
OR TI "schizoaffective"	OR "schizoaffective" [tw]
OR AB "schizoaffective")	OR "schizoaffective" [tw])