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Knowledge corruption for visual perception in individuals high on paranoia

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ABSTRACT

Studies revealed that patients with paranoid schizophrenia display overconfidence in errors for memory and social cognition tasks. The present investigation examined whether this pattern holds true for visual perception tasks.

Nonclinical participants were recruited via an online panel. Individuals were asked to complete a questionnaire that included the Paranoia Checklist and were then presented with 24 blurry pictures; half contained a hidden object while the other half showed snowy (visual) noise. Participants were asked to state whether the visual items contained an object and how confident they were in their judgment. Data from 1966 individuals were included following a conservative selection process.

Participants high on core paranoid symptoms showed a poor calibration of confidence for correct versus incorrect responses. In particular, participants high on paranoia displayed overconfidence in incorrect responses and demonstrated a 20% error rate for responses made with high confidence compared to a 12% error rate in participants with low paranoia scores. Interestingly, paranoia scores declined after performance of the task.

For the first time, overconfidence in errors was demonstrated among individuals with high levels of paranoia using a visual perception task, tentatively suggesting it is a ubiquitous phenomenon. In view of the significant decline in paranoia across time, bias modification programs may incorporate items such as the one employed here to teach patients with clinical paranoia the fallibility of human cognition, which may foster subsequent symptom improvement.

1. Introduction

For decades paranoid schizophrenia has been judged as psychologically inaccessible, that is, not amenable to understanding. Delusions proper, as Jaspers (1973) called them, were regarded as ideas that could not be derived from any explicable source, for example, biographical factors (Walker, 1991). While the potential contribution of genetic and biological influences to paranoid schizophrenia is undisputed (O'Donovan et al., 2009), new studies have elucidated important psychological mechanisms, for example cognitive biases, that are putatively involved in the formation and maintenance of positive symptoms. Cognitive biases are defined as distortions in the processing, selection and appraisal of information (Moritz et al., 2010). Apart from jumping to conclusions (i.e., patients gather less information for decision-making than controls; for a review see Fine et al., 2007; Garety et al., 1991; Moritz and Woodward, 2005) and a bias against disconfirmatory evidence (i.e., counterevidence is not sufficiently considered for reasoning; Moritz and Woodward, 2006a; Woodward et al., 2007, 2006, 2008), numerous studies have elucidated that patients are also poor in their calibration of confidence (Gaweda et al., 2012; Moritz and Woodward, 2002; Moritz et al., 2008, 2003; Peters et al., 2007). While confidence of those affected by paranoid schizophrenia is usually enhanced for erroneous judgments in comparison to controls, they are often less confident than controls when they are actually correct (the latter bias, however, is less well established). This pattern has been termed reduced "confidence gap" (e.g., Moritz et al., 2003), which in combination with an enhanced error rate culminates in inflated "knowledge corruption" (i.e., the proportion of high confident errors on all high confident responses). In other words, a substantial share of what the

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participant believes to be factual is wrong. It has been argued that this bias may promote paranoid ideation: If patients cannot distinguish between correct and incorrect *subjective facts*, consequential misjudgments up to the point of delusional misconceptions may occur (for a review see Moritz and Woodward, 2006b). Importantly, overconfidence in errors and other biases have been found to be present even in neutral (not delusion-relevant) scenarios, thereby precluding tautological inferences.

Experimental studies on overconfidence in errors have been mainly conducted using memory tests (Gaweda et al., 2012; Moritz and Woodward, 2002; Moritz et al., 2008, 2003; Peters et al., 2007, 2013). More recently, this line of research has been extended to the domain of social cognition. For example, using two face recognition paradigms, we found that patients with schizophrenia are overconfident regarding erroneous social judgments (Kother et al., 2012; Moritz et al., 2012). In our view, (social) errors per se are not problematic if held in check by doubt ("well, that guy over there *seems* angry… let's see what he is up to"). However, if a person is utterly *convinced* about the correctness of his or her judgments, this may prompt serious responses ("That guy over there *is* angry at me – well then: fight or flight?"). To illustrate, in a recent study (Moritz and Van Quaquebeke, 2014) we explored the impact of delusional conviction on emotion and behavior in a psychometric high-risk study by asking participants how they would act or feel if a secret service were after them (fictive scenario), graded for confidence ranging from 20% to 100% conviction. We detected a linear relationship: the higher the level of subjective conviction, the more likely participants considered grave consequences such as arming themselves and being prepared to hurt someone when feeling threatened.

As we have explained in more detail elsewhere (Moritz et al., 2008), a reduced confidence gap likely stems from liberal acceptance, which has also been implicated in the jumping to conclusions bias (Moritz et al., 2007). Studies suggest that patients with paranoia have a lowered threshold for accepting hypotheses as true, thereby limiting the probability to detect evidence that may run counter to their false judgments, while a premature termination of search processes in turn limits chances of finding valid clues for correct judgments (which may potentially decrease confidence judgments; Moritz et al., 2008). Longer search processes and more conservative criteria may not entirely prevent errors but enhance the probability that these will gain less momentum as they are associated with some kind of "not trustworthy" tag (Moritz et al., 2003, p. 137).

For the present study, we were interested in whether overconfidence in errors extends to (non-social) visual perception. Consistent evidence suggests that patients with schizophrenia share problems with perception and perceptual organization, which impacts on important outcomes such as social cognition (Silverstein and Keane, 2011). While deficits have been detected across a wide range of domains, they are perhaps best studied and understood for the visual modality (for reviews see Chen, 2011; Green et al., 2009; Tan et al., 2013; Yoon et al., 2013). However, to the best of our knowledge, response confidence for visual judgments has not been tested before. To address this question, we adopted a psychometric high-risk approach (Chapman and Chapman, 1988, 1985; Lenzenweger and Korfine, 1994): A large number of participants were recruited from the general population and divided into high and mean-to-low scorers on a paranoia scale. This approach is well-established since paranoid ideas are present to a variable degree in the normal population and are not confined to patients with paranoid schizophrenia. According to Freeman (2006), 1–3% of the nonclinical population have clinically relevant delusions; another 5–6% display delusions with milder severity, and a further 10–15% have fairly regular delusional ideation (see also van Os et al., 2009). At least 50% of the population exhibits minor paranoid ideas such as "There might be negative comments being circulated about me" at least once a month (Moritz and Van Quaquebeke, 2014). An advantage of this kind of research over a clinical study with individuals diagnosed with paranoid schizophrenia is that patients are usually medicated with antipsychotic agents that may confound results. Recent cross-sectional studies suggest that higher neuroleptic dosages dampen overconfidence in errors (Moritz et al., 2003), which has been recently replicated experimentally: Nonclinical subjects who were given a small dosage of antipsychotics showed decreased confidence for error responses on a memory task (Andreou et al., 2014).

We expected that participants high on paranoia would commit more errors on a visual illusions task and would show higher confidence in errors than controls. A subsidiary aim of the study was to explore if paranoia scores would decrease following the visual illusions task, as demonstrated previously (Moritz et al., 2014), suggesting that the administration of difficult cognitive items in conjunction with confidence ratings alone may lower delusional ideation.

2. Methods

2.1. Participants and procedure

Participants were recruited by means of WiSo-Panel, a German academic online service providing researchers with the opportunity to advertise scientific studies (for the reliability of data of this and related services see Göritz, 2007; Judge et al., 2006; Piccolo and Colquitt, 2006). The online survey was programmed using "unipark" (Globalpark AG/Questback). The study was announced as an investigation assessing the impact of mood on perception. A total of 11,846 individuals from the general population were invited to participate, out of which 2008 (17%) completed the core part of our study (Paranoia Checklist and illusion paradigm). Blind to analyses, data of 42 participants were discarded who had either entered the same value throughout in the psychopathological scales ($n=21$), had disclosed that they had not responded openly ($n=14$), or had made nonsense entries on the items relating to what objects (if any) they had seen on the illusion test ($n=7$; e.g., "fgjf erzerz") resulting in a total of 1966 participants that were included in the analyses. No financial incentive was paid. Instead, participants were offered downloads of mindfulness and relaxation exercises at the end of the survey.

2.2. Questionnaires

Participants first provided informed consent and were then asked about their age, gender, educational level and current job situation.

Before and after the visual illusion test (see below) we administered a questionnaire comprising three scales that probed for different psychopathological syndromes: paranoia, depression, and obsessive-compulsiveness (see below). Items were presented in random order and were rated on a 5-point Likert scale ranging from "fully applies" to "does not apply at all". On both occasions (i.e., before and after the visual illusion test), the 18 frequency items of the *Paranoia Checklist* (Freeman et al., 2005) were administered. Previous studies have confirmed good psychometric properties for this scale (Freeman et al., 2005; Lincoln et al., 2010a, 2010b). Being indicative of its construct validity, the Paranoia Checklist correlates with the jumping to conclusions bias (Moritz et al., 2012), which is implicated in the pathogenesis of delusions (Fine et al., 2007). Factor analysis (Moritz et al., 2012) indicated that the scale is best represented by two dimensions called suspiciousness ("Bad things are being said about me behind my back") and core paranoia ("I can detect coded messages about me in the press/TV/radio"). In a yet unpublished study (Moritz et al., 2014) the Paranoia Checklist frequency scale had a high test retest reliability while at the same time being sensitive to change (approximately 10% improvement following a short cognitive intervention).

Along with the Paranoia Checklist, we administered the 20-item "Center for Epidemiologic Studies-Depression Scale" (CES-D; Hautzinger and Brähler, 1993; Radloff, 1977) on both occasions. To obscure the rationale of the assessment, 10 items from the 18-item *Obsessive Compulsive Inventory – R* (OCI-R; Foa et al., 2002) were incorporated into the questionnaire. Administration of different scales allowed us to explore whether any effects were specific for paranoia.

2.3. Visual pattern perception (snowy pictures tasks)

Next, participants were asked to complete a variant of the snowy pictures task, which was adapted from Whitson and Galinsky (2008). Participants were