



Overconfidence in incorrect perceptual judgments in patients with schizophrenia



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ABSTRACT

Background: Patients with schizophrenia show overconfidence in memory and social cognition errors. The present investigation examined whether this cognitive distortion also manifests in perceptual tasks.

Methods: A total of 55 individuals with schizophrenia, 58 with obsessive–compulsive disorder (OCD) as well as 45 non-clinical controls were presented 24 blurry black and white pictures, half of which contained a hidden object; the other half contained (“snowy”) visual noise. Participants had to judge whether the pictures depicted an object or not and how confident they were in this judgment.

Results: Participants with schizophrenia showed overconfidence in errors and an enhanced knowledge corruption index (i.e. rate of high-confident errors on all high-confident responses) relative to both control groups. In contrast, accuracy scores did not differ between clinical groups. Metacognitive parameters were correlated with self-rated levels of current paranoia.

Discussion: To the best of our knowledge, this is the first study to demonstrate overconfidence in errors among individuals with psychosis using a visual perception task. Speaking to the specificity of this abnormality for schizophrenia and its pathogenetic relevance, overconfidence in errors and knowledge corruption were elevated in patients with schizophrenia relative to both control groups and were correlated with paranoia.

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1. Introduction

Delusional ideas are commonly defined as false beliefs that are held with conviction and are not amenable to change. Although there is no symptom pathognomonic for schizophrenia (Carpenter et al., 1973), extreme paranoid beliefs such as feeling persecuted by the secret service or the feeling that electrodes have been implanted into one's head by a criminal organization are indicative of schizophrenia-spectrum disorders. Importantly, some delusion-prone ideas, such as feelings of being watched, are quite frequent in the general population (Ellett et al., 2003; Lincoln, 2007; Moritz and Van Quaquebeke, 2014; Peters et al., 1999; Verdoux and van Os, 2002). Freeman (2006) estimated that 1% to 3% of the nonclinical population have clinically relevant delusions; another 5% to 6% display milder delusions, and 10% to 15% have fairly regular subclinical delusional ideations (see also van Os et al., 2009, 2010).

Paranoid ideas usually do not come out of the blue as was presumed decades ago, but evolve over time (Fusar-Poli et al., 2013; Klosterkötter, 1992) and are often closely linked to biographical and situational

factors. There is accumulating evidence that cognitive biases are involved in the development of psychotic symptoms. Biases are defined as distortions in the processing, selection and appraisal of information (Moritz et al., 2010b). Cognitive biases are not abnormal per se and do not necessarily lead to problems. To illustrate, biases like a self-serving attribution and unrealistic optimism are fairly normal and may even promote well-being (Pohl, 2004). However, specific cognitive biases, such as jumping to conclusions, may – in combination with other factors – become toxic and result in severe psychopathological problems (Moritz et al., 2010a). The focus of much research in schizophrenia has been the jumping to conclusions bias (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), the bias against disconfirmatory evidence (i.e., counterevidence is not considered for reasoning; Moritz and Woodward, 2006b; Woodward et al., 2006, 2007, 2008), as well as overconfidence in errors. The latter bias constitutes the main focus of the present article.

Numerous studies have shown that patients with schizophrenia are poor at calibrating their level of confidence (Gaweda et al., 2012; Moritz and Woodward, 2002; Moritz et al., 2003, 2008; Peters et al., 2007, 2013). Apart from questionnaires such as the Beck Cognitive Insight Scale (BCIS; e.g. “My interpretations of my experiences are definitely right.”; Beck et al., 2004), which require a high level of introspection (some patients may not be aware of their biases; Freeman et al., 2006;

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Köther et al., 2012), response confidence is often captured by experimental cognitive tasks. When compared to healthy and psychiatric controls, response confidence is usually enhanced for erroneous judgments in schizophrenia patients. In contrast, some studies demonstrate that patients are less confident than controls when they are actually correct. We have coined the term *reduced confidence gap* for this response pattern (i.e., enhanced confidence in errors versus reduced confidence in correct responses). The majority of studies on overconfidence have been conducted with memory tasks (Gaweda et al., 2012; Moritz and Woodward, 2002; Moritz et al., 2003, 2008; Peters et al., 2007, 2013). Recently, overconfidence in errors has been replicated with social cognition tasks, whereby facial recognition items were complemented by confidence judgments (Köther et al., 2012; Moritz et al., 2012b).

Factors that modulate overconfidence in errors and/or underconfidence in correct responses are only partially understood. Using difficult knowledge questions, we recently found underconfidence in correct responses, but no difference in overconfidence in errors between groups. We argue that awareness of one's deficits may enhance reluctance to make strong (high-confident) judgments. Moreover, the dopamine system is likely involved. Antipsychotic medication attenuates confidence (Andreou et al., 2014; Moritz et al., 2003), while dopamine in turn enhances certainty (Lou et al., 2011). Importantly, overconfidence in errors and other biases has been found to be present in neutral (i.e. delusion-irrelevant) scenarios, precluding tautological inferences.

A reduced confidence gap (e.g., Moritz et al., 2003) in combination with an enhanced error rate may culminate in a state termed inflated "knowledge corruption" (i.e., the proportion of high confidence errors on all high confident responses). In other words, a high proportion of what the individual believes to be true is actually wrong. If individuals cannot distinguish between correct and incorrect *subjective facts*, momentous mistakes may happen, which may foster paranoid ideation (for a review see Moritz and Woodward, 2006c). In line with this, a recent study found a linear relationship between the level of subjective conviction for a (simulated) paranoid scenario, and emotional, as well as behavioral consequences, for example, arming oneself and being prepared to hurt someone when feeling threatened (Moritz and Van Quaquebeke, 2014). In our view, errors are not necessarily momentous if a false assumption is further tested and is not regarded as a definite truth. However, caution is warranted as some studies have not found cross-sectional associations between high confidence errors and delusional ideation (e.g., Moritz and Woodward, 2006c).

So far, most studies on overconfidence have employed memory or social cognition tests. Replication is needed for perceptual tasks. A multitude of investigations suggests that perceptual functions are compromised in the disorder (Chen, 2011; Silverstein and Keane, 2011; Tan et al., 2013; van Assche and Giersch, 2011; Yoon et al., 2013), including early visual processes (Knebel et al., 2011). One of the best replicated visual deficits pertains to smooth pursuit movements as well as other eye tracking dysfunctions (Levy et al., 2010; O'Driscoll and Callahan, 2008), which recently has been linked with a failure to use efference copy information (Spering et al., 2013). As Javitt (2009) points out, impairments in basic perceptual processes may elicit higher order cognitive processing deficits. Hence, the study of visual, auditory and other perceptual aspects may help to reveal more about the origins of cognitive deficits in schizophrenia.

As of yet, it has not been studied whether errors in perceptual tasks are also accompanied by overconfident appraisals. In a recent investigation on a nonclinical population (Moritz et al., 2014), we assessed whether the liability to delusions would be associated with overconfidence in errors in a perceptual task (embedded figures task) that did not demand memory or social skills. Healthy individuals with high scores on core paranoid symptoms were overconfident in incorrect responses and demonstrated a significantly enhanced knowledge corruption index relative to subjects with lower scores (20% vs. 12%).

For the present study, we hypothesized that schizophrenia patients would display overconfidence in errors for perceptual judgments and

would show an enhanced knowledge corruption relative to both healthy and psychiatric controls. We chose patients with obsessive-compulsive disorder as the psychiatric control group because of interesting similarities and differences to psychosis. While OCD has been sometimes dubbed "disorder of doubt", as patients constantly worry about things they usually know are unfounded and absurd, paranoia can be dubbed "disorder of conviction" as confidence in delusional beliefs is high *per definitionem*. At the same time, the demarcation is sometimes blurry as many OCD patients perceive their obsessions as partly perceptual (Moritz et al. 2014a) and a subgroup of OCD patients shows poor illness insight, which has been added to the DSM-V, recently.

2. Methods

2.1. Participants

The present study was part of a larger trial investigating the effects of mindfulness training on subjective well-being in patients with schizophrenia spectrum disorders and obsessive-compulsive disorder (OCD) compared with healthy controls. Participants were allocated either to mindfulness training (self-help manual attached as pdf file) or a waitlist control group and were assessed before and six weeks after treatment. We report cross-sectional data from the post assessment, which included the visual perception task (not presented at baseline). The effect of the intervention will be presented elsewhere. In short, mindfulness did not have any impact on psychosis symptoms in any of the three groups. Therefore, the treatment trial did not confound results for the present project.

Different recruitment strategies were applied. A number of participants with schizophrenia and OCD were recruited using lists of previously discharged patients of the Departments of Psychiatry and Psychotherapy of the University Clinic Hamburg-Eppendorf (UKE) and the Central Institute of Mental Health Mannheim (CIMH). All participants had been previously treated in one of our institutions and had provided written informed consent to be recontacted for future studies. Other individuals had participated in previous online studies (some of these trials requested a diagnostic telephone interview with the MINI diagnostic instrument (Sheehan et al., 1998) to confirm the primary psychiatric diagnosis). Additional subjects were recruited with the help of the German association for OCD (DGZ) and several moderated German online discussion platforms providing people with OCD or psychosis with the opportunity to exchange information. A study was posted on these platforms (e.g., www.psychose.de) and a web-link provided access to the internet questionnaire. Participation was anonymous to foster unbiased responses (this made it impossible to discern the proportion of patients with previously verified diagnoses). Nonclinical participants were recruited from online panels and via word of mouth.

2.2. Security and inclusion criteria

The study was implemented with unipark®/questback®. Electronic informed consent was obtained online from participants in accordance with the department of data security in Hamburg and the local Ethics committee. "Cookies" prevented multiple accesses from the same computer. The following exclusion criteria were applied; 1. age below 18 or above 65 years, 2. failure to complete the questionnaires 3. no diagnosis of either schizophrenia or OCD (applies to the clinical groups only), 4. disclosure that the participant had not responded openly (final question), and 5. a diagnosis of bipolar disorder. We also excluded subjects with stereotypical responses (same value entered on the psychometric scales) and checked for deviant responses on the psychosis lie scale (Moritz et al., 2013a). For OCD, a diagnosis of OCD on the web-based screening questionnaire (WSQ; Donker et al., 2009) for common mental disorders was mandatory, whereas a prior episode of schizophrenia or bipolar disorder led to exclusion. For healthy controls, suspected

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