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A two-stage cognitive theory of the positive symptoms of psychosis. Highlighting the role of lowered decision thresholds

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ABSTRACT

Objectives: We outline a two-stage heuristic account for the pathogenesis of the positive symptoms of psychosis.
Methods: A narrative review on the empirical evidence of the liberal acceptance (LA) account of positive symptoms is presented.
Hypothesis: At the heart of our theory is the idea that psychosis is characterized by a lowered decision threshold, which results in the premature acceptance of hypotheses that a nonpsychotic individual would reject. Once the hypothesis is judged as valid, counterevidence is not sought anymore due to a bias against disconfirmatory evidence as well as confirmation biases, consolidating the false hypothesis. As a result of LA, confidence in errors is enhanced relative to controls. Subjective probabilities are initially low for hypotheses in individuals with delusions, and delusional ideas at stage 1 (belief formation) are often fragile. In the course of the second stage (belief maintenance), fleeting delusional ideas evolve into fixed false beliefs, particularly if the delusional idea is congruent with the emotional state and provides "meaning". LA may also contribute to hallucinations through a misattribution of (partially) normal sensory phenomena. Interventions such as metacognitive training that aim to "plant the seeds of doubt" decrease positive symptoms by encouraging individuals to seek more information and to attenuate confidence. The effect of antipsychotic medication is explained by its doubt-inducing properties.
Limitations: The model needs to be confirmed by longitudinal designs that allow an examination of causal relationships. Evidence is currently weak for hallucinations.
Conclusions: The theory may account for positive symptoms in a subgroup of patients. Future directions are outlined.

1. A two-stage theory of the positive symptoms of psychosis

The basic principles of the heuristic model of positive symptoms in psychosis laid down in this article have evolved over the last decade, starting with an article in 2004 (Moritz & Woodward, 2004). This manuscript will try to bring the pieces together. While our theory hopes to provide a parsimonious explanation for the formation of positive symptoms, delusions, hallucinations and so-called first-rank symptoms (e.g., thought insertion; Schneider, 1959) by the same mechanism, our assumptions do not claim to account for every single case of psychotic experience. With Bleuler (1911/1950) who coined the plural diagnostic term *schizophrenias* we concur that psychosis is presumably a multicausal disorder.[1] Therefore, putting forward this theory does not refute or challenge prior cognitive theories (e.g., Coltheart, Langdon, & McKay, 2011; Davies, Coltheart, Langdon, & Breen, 2001; Fletcher & Frith,

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[1] In keeping with standard nomenclature we will nevertheless use the singular term *psychosis* in the remainder of the article.

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2009; Kapur, 2003; Maher, 2006). In fact, these accounts, which view aberrant input (rather than reasoning) as the driving process of delusion formation, are considered powerful explanations for overvalued ideas and autochthonous delusions (i.e., Jaspers *wahneinfall*: a sudden delusional idea that comes "out of the blue" without identifiable preceding events) following a strong sensory or neurological component ("surprising experiences demand surprising explanations", p. 360; Corlett, Taylor, Wang, Fletcher, & Krystal, 2010). We will first present our basic two-stage theory, whereby stage 1 (belief formation) is at the heart of the heuristic model. In this context, we present empirical evidence for its validity and describe how our theory may accommodate specific (at times counter-intuitive) peculiarities of positive symptoms (e.g., long course until positive symptoms are full-blown, initial inconsequentiality). We then turn to stage 2 of the account, which explains how delusional ideas may or may not evolve to incorrigible convictions, before discussing how existing treatments such as antipsychotic medication, as well as metacognitive and reasoning training, exert their effect. While our approach highlights a cognitive mechanism, we will explain why ameliorating emotion regulation and improving mood may also be important for the treatment of positive symptoms. This review will not cover genetic or brain imaging data as our focus is in the cognitive processes of positive symptoms. Another blind spot is that the review will not deal with other prominent syndromes in psychosis like disorganization and negative symptoms. While our theory might be extended to accommodate these symptoms, we will not elaborate on this subject because empirical data are presently lacking.

We also would like to acknowledge the important contribution of theorists like Daniel Freeman and Philippa Garety (Freeman, Garety, Kuipers, Fowler, & Bebbington, 2002; Garety & Freeman, 1999, 2013) as well as Richard Bentall (e.g., Bentall, Corcoran, Howard, Blackwood, & Kinderman, 2001) and an early theory by Christopher Frith (1979), whose models have been very influential, especially for the second stage of our theory.

1.1. Stage 1: How false ideas enter and dominate consciousness (belief formation)

Unlike a number of theories of the positive symptoms of psychosis which posit that delusions derive as essentially normal explanations from "out-of-the-ordinary experiences" (p. 181, Maher, 2006) such as hallucinations, neuropsychological impairment or other erroneous *input* (Davies et al., 2001; Frith, 1979; Kapur, 2003; Maher, 1999, 2006), or theories that confine themselves to single core psychotic symptoms such as paranoia (Bentall, Corcoran, Howard, Blackwood, & Kinderman, 2001; Freeman & Garety, 2014; Freeman et al., 2002), we propose that, in a subgroup of patients, the same basic pathological mechanisms are at work in all major positive symptoms.

Picking up a metaphor used in one of our last empirical studies (Moritz, Scheu et al., 2016), we regard as a key cognitive aberration in psychosis that patients reason like "bad statisticians", that is, that they assign meaning and momentum to weakly supported evidence. A central claim is that the decision threshold for accepting hypotheses is lowered in psychosis; hypotheses that a healthy or nonpsychotic patient would reject, or put on hold until further validity checks are made, are accepted as possible (Moritz & Woodward, 2004; Moritz, Woodward, & Lambert, 2007; Moritz, Woodward, Jelinek, & Klinge, 2008; Moritz et al., 2009). Of note, strange thoughts (e.g., people are making remarks about me; feelings of being looked at) at times also occur in non-psychotic patients. What distinguishes psychotic from non-psychotic individuals is the weight these thoughts receive and the reactions they elicit (Lincoln, Möbius, Huber, Nagel, & Moritz, 2014).

1.1.1. Empirical evidence

Importantly, we assume this mechanism to be general and not confined to delusional or emotion-laden situations. Evidence for this theory comes from different lines of research.

1.1.1.1. Plausibility scores for absurd hypotheses

A recent meta-analysis (McLean, Mattiske, & Balzan, 2016) on parameters predominantly collected with the bias against disconfirmatory evidence paradigm (BADE; Buchy, Woodward, & Liotti, 2007; Sanford, Veckenstedt, Moritz, Balzan, & Woodward, 2014; Woodward, Buchy, Moritz, & Liotti, 2007; Woodward, Moritz, & Chen, 2006) suggests that individuals with schizophrenia assign higher plausibility to interpretations (verbally or nonverbally presented response options for a scenario) that nonpsychotic individuals would reject as absurd. This was typically examined using non-delusion relevant material in order to avoid tautological inferences (for results on plausibility judgements for delusional scenarios see LaRocco & Warman, 2009). In our very first study (Moritz & Woodward, 2004), which already outlined a sketch for the present theory, we used ambiguous pictures from the Thematic Apperception Test (TAT). While patients and controls did not differ with respect to well-supported interpretations of presented pictures, patients rated absurd scenarios as much more plausible than controls. Interestingly, in patients who received higher antipsychotic doses, this pattern was attenuated (we will turn to the potential significance of this and other psychopharmacological findings later).

1.1.1.2. Decision threshold for conclusions

Building upon experimental designs of Hausmann and Läge (e.g., 2008), in studies analogous to the "Who Wants to be a Millionaire" TV game show (Moritz, Woodward, & Hausmann, 2006; Moritz, Göritz, et al., 2015), we asked patients and controls to provide probability estimates to response options and then asked them, whether they would make a decision or reject any of the options/hypotheses presented, based on their subjective probability estimates. Importantly, such judgments were optional; even if participants were 99% sure, they were free to make a decision or not. In other studies (Moritz, Scheu et al., 2016; Moritz, Van Quaquebeke, & Lincoln, 2012), we adopted variants of the beads task[2] (Garety, Hemsley, & Wessely, 1991) and asked patients after each drawn item for their probability estimates, and again, whether or not they would make a decision. The "millionaire quiz" and modified beads task studies allowed us to dissociate the point of conclusion-drawing from subjective probability estimates and to determine the individual decision threshold, that is, the probability estimate an individual deems sufficient for a decision/firm judgment. In these studies (Moritz, Scheu et al., 2016; Moritz et al., 2009, 2012; Moritz, Woodward, et al., 2006; Veckenstedt et al., 2011), we found that patients based decisions on much lower probability estimates than controls (e.g. 82% relative to 93% in Moritz, Scheu et al., 2016) and this parameter proved a better discriminator between groups than the conventional jumping to conclusions

[2] Beads are drawn from one of two containers with usually opposing ratios of colors (e.g. container A: 85% green, 15% red; container B: opposite). The participant has to deduce by means of the sequence of beads from which of the two containers beads originate. Jumping to conclusions is usually defined as a (premature) decision after one or two beads.

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