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# Conceptual disorganization weakens links in cognitive pathways: Disentangling neurocognition, social cognition, and metacognition in schizophrenia

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## ABSTRACT

Disentangling links between neurocognition, social cognition, and metacognition offers the potential to improve interventions for these cognitive processes. Disorganized symptoms have shown promise for explaining the limiting relationship that neurocognition holds with both social cognition and metacognition. In this study, primary aims included: 1) testing whether conceptual disorganization, a specific disorganized symptom, moderated relationships between cognitive processes, and 2) examining the level of conceptual disorganization necessary for links between cognitive processes to break down. To accomplish these aims, comprehensive assessments of conceptual disorganization, neurocognition, social cognition, and metacognition were administered to 67 people with schizophrenia-spectrum disorders. We found that conceptual disorganization significantly moderated the relationship between neurocognition and metacognition, with links between cognitive processes weakening when conceptual disorganization is present even at minimal levels of severity. There was no evidence that conceptual disorganization—or any other specific disorganized symptom—drove the limiting relationship of neurocognition on social cognition. Based on our findings, conceptual disorganization appears to be a critical piece of the puzzle when disentangling the relationship between neurocognition and metacognition. Roles of specific disorganized symptoms in the neurocognition – social cognition relationship were less clear. Findings from this study suggest that disorganized symptoms are an important treatment consideration when aiming to improve cognitive impairments.

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## 1. Introduction

Repeating a seven-digit phone number, recognizing fear instead of surprise on a person's face, and thinking about how you fit into a social group are all processes that go awry in schizophrenia; determining how these processes are connected is a critical step to understanding them. Cognitive impairments, such as those described in the previous sentence, are cardinal symptoms of schizophrenia (Frith, 1992; Green, 1996; Green et al., 2008; Lysaker et al., 2005; Penn et al., 1997). Neurocognition, social cognition, and metacognition represent separate—but related—types of cognitive impairments (Allen et al., 2007; Fanning et al., 2012; Lysaker et al., 2013; Pinkham et al., 2003). Of these, neurocognitive impairments are the most often cited in literature and involve reductions in abilities ranging from processing speed to executive functioning (Green, 1996; Green et al., 2004; Saykin et al., 1991). Social cognitive impairments

consist of deficiencies in the processes (e.g., theory of mind, emotion recognition, emotion processing) required for consolidating social situational factors and perceptions to draw inferences about other people (Green et al., 2008). Metacognitive impairments reflect problems with a spectrum of mental activities, ranging from discrete (e.g., recognizing specific thoughts and feelings) to synthetic acts (e.g., integrating an array of intentions, thoughts, feelings, and connections between events into a complex representation of oneself and others; Dimaggio and Lysaker, 2015; Lysaker et al., 2013).

Disentangling the links between neurocognition, social cognition, and metacognition offers the potential to map connections within cognitive pathways and, in turn, design interventions to more effectively target cognitive impairments. It has been suggested that adequate neurocognition is a necessary, but not sufficient, requirement for exhibiting more complex abilities such as social cognition and metacognition (Fanning et al., 2012; Penn et al., 1997; Lysaker et al., 2010). If this is the case, a person with schizophrenia who demonstrates effective neurocognition calls on these abilities when they connect social situational factors and perceptions (or discrete and

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synthetic acts for metacognition) to draw inferences, whereas those with poor neurocognition are unable to make these connections. Thus, neurocognitive functioning appears to be an essential first stage and a limiting factor in social cognitive and metacognitive performance. Importantly, the limiting relationship of neurocognition on social cognition and metacognition is likely influenced by additional factors. Examining potential moderators would allow us to understand the likelihood that neurocognitive abilities could be effectively harnessed for social cognition and metacognition by illustrating when links between cognitive processes are strongest—and weakest.

Disorganized symptoms have exhibited promise as a moderator for the limiting relationship that neurocognition holds with both social cognition and metacognition. They are more strongly related to cognitive processes than reality distortion or negative symptoms (Hamm et al., 2012; Ventura et al., 2010; Ventura et al., 2013) and are inversely associated with long-term functioning (Evans et al., 2004; Shenton et al., 1992; Smith et al., 2002). A recent study from our group demonstrated that disorganized symptoms are an integral link in cognitive pathways, with connections between cognitive processes weakening as disorganized symptoms increase (Minor and Lysaker, 2014). This finding suggests that when disorganized symptoms are present, people with schizophrenia are no longer able to effectively utilize the neurocognitive abilities necessary for performing social cognitive or metacognitive tasks. It is also in line with classic and contemporary models of disorganization in schizophrenia (Bleuler, 1911; Hardy-Bayle et al., 2003). In particular, it harkens back to Bleuler's belief that disruptions in cognitive processes lead to difficulties forming complex thoughts and engaging in goal-directed behaviors (Bleuler, 1911). According to Bleuler, a "loosening of associations"—similar to current conceptualizations of disorganized symptoms—is at the core of these cognitive disruptions.

Although findings from Minor and Lysaker (2014) support previous models, no one has yet examined how specific types of disorganized symptoms affect the limiting relationship of neurocognition on social cognition and metacognition. Conceptual disorganization is a disorganized symptom that is assessed using descriptors (e.g., loose associations, disrupted goal-directed sequencing, illogicality) that are similar to Bleuler's "loosening of associations" paradigm; thus, it is likely to play a prominent role. If conceptual disorganization is found to moderate relationships between cognitive processes, it is also essential to determine the level of severity where links between neurocognition, social cognition, and metacognition weaken. Identifying specific moderators and showing the level of severity necessary for neurocognition to no longer exert influence on social cognition and metacognition have important potential clinical ramifications. Accomplishing these goals could lead to more refined treatment targets (i.e., conceptual disorganization) in an effort to improve cognitive impairments.

### 1.1. Aims of the study

This study had two primary aims. First, we examined whether conceptual disorganization moderated the effects of neurocognition on social cognition and metacognition. Second, we determined the level of conceptual disorganization severity necessary for neurocognition to no longer exert significant influence on social cognition and metacognition.

## 2. Materials and methods

### 2.1. Participants

Participants consisted of 67 outpatients with DSM-IV-TR (American Psychological Association, 2000) diagnoses of schizophrenia ( $n = 45$ ) or schizoaffective disorder ( $n = 22$ ). Diagnoses were confirmed using the Structured Clinical Interview for DSM-IV-TR Disorders-Patient Edition (SCID-I/P; First et al., 2002). All participants were recruited from a Midwestern VA Medical Center and were part of the sample reported in a

previous paper (Minor and Lysaker, 2014). Exclusion criteria consisted of: a) any change in medication, housing, or outpatient status (e.g., hospitalizations) within the past 30 days; b) active substance dependence; and c) a documented intellectual disability at any time point (based on medical record review). This study was part of a larger randomized controlled trial that focused on the effects of cognitive remediation in Serious Mental Illness. For this study, only baseline scores were examined (i.e., prior to intervention). All procedures were approved by local Institutional Review Boards. Demographic and clinical data for participants are reported in Table 1.

### 2.2. Measures

#### 2.2.1. Conceptual disorganization

Conceptual disorganization is an item on the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987) that reflects loose associations, disrupted goal-directed sequencing, and circumstantiality. Conceptual disorganization is 1 of 7 specific disorganized symptoms measured on the PANSS; other disorganized symptoms include: 1) difficulty in abstract thinking; 2) stereotyped thinking; 3) lack of insight; 4) poor attention; 5) tension; and 6) mannerisms/posturing (Bell et al., 1994). The PANSS is a 30-item scale, with each item ranging from 1 ("absent") to 7 ("extreme"). The overall scale has exhibited strong internal consistency (Kay et al., 1987), predictive validity (Bell et al., 1992), and interrater reliability (Bell et al., 1992; Lysaker et al., 2013). For this study, all research staff were trained on the PANSS and demonstrated good interrater reliability ( $\alpha \geq 0.80$ ).

#### 2.2.2. Neurocognition

The Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS; Nuechterlein et al., 2008) was designed specifically to measure neurocognitive functioning in schizophrenia and has been widely used in populations across the schizophrenia-spectrum

**Table 1**  
Demographic and clinical variables of sample ( $n = 67$ ).

Demographic	Mean	SD <sup>1</sup>
Age	50.49	10.46
Education	12.69	2.22
Annual income	\$908.64	\$895.11
Male (%)		94.0
Female (%)		6.0
Caucasian (%)		37.3
African-American (%)		61.2
Other race (%)		1.5
Single (%)		46.3
Married (%)		44.8
Separated or divorced (%)		9.0
Clinical	Mean	SD
Age of first hospitalization	28.90	12.19
Total hospitalizations	5.12	4.80
Current chlorprom. equiv. <sup>2</sup>	382.96	419.29
Previous alcohol abuse (%)		19.4
Previous drug abuse (%)		25.8
Primary measures	Mean	SD
Conceptual disorganization	1.99	1.26
Neurocognition <i>t</i> -score	24.05	10.30
SocCog <sup>3</sup> : emotion proc <sup>4</sup> <i>t</i> -score	35.25	11.86
SocCog: Emotion recognition	12.81	3.67
SocCog: TOM <sup>5</sup> (Hinting)	13.01	4.09
SocCog: TOM (SAT-MC <sup>6</sup> )	11.39	4.18
Metacognition	11.34	3.89

<sup>1</sup> SD: standard deviation.

<sup>2</sup> Chlorprom. Equiv.: chlorpromazine equivalent.

<sup>3</sup> SocCog: social cognition.

<sup>4</sup> Proc: processing.

<sup>5</sup> TOM: theory of mind.

<sup>6</sup> SAT-MC: social attributions test-multiple choice.

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