

Deficits in cue detection and intention retrieval underlie prospective memory impairment in schizophrenia

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Abstract

Emerging evidence indicates that individuals with schizophrenia (SCZ) may exhibit deficits in prospective memory (ProM), a dissociable and ecologically important aspect of episodic memory entailing the formation, maintenance, and execution of future intentions. The present study aimed to elucidate the component processes of ProM impairment in 41 individuals with SCZ relative to 41 demographically similar healthy comparison (HC) participants. Results revealed that the SCZ group performed worse than HCs on overall ProM, with comparable deficits on time- and event-based ProM trials. In the SCZ cohort, better ProM performance was associated with younger age and less severe negative symptoms. Although a significantly greater number of Task Substitution and Loss of Time errors were evident in the SCZ group as compared to HCs, the most prevalent error type in SCZ was characterized by a complete failure to respond to the ProM cue. Importantly, the SCZ and HC groups did not differ on a post-test multiple-choice recognition trial, suggesting adequate formation and maintenance (i.e., retention) of the ProM cue-intention pairing when self-directed monitoring and retrieval demands were minimized. Findings indicate that SCZ is associated with impairment in the cue detection and self-initiated retrieval components of executing future intentions, which is consistent with a possible prefrontostriatal loop neuropathogenesis. Further studies are needed to explore the neurobiological mechanisms of SCZ-associated ProM impairment and the impact of such deficits on daily functioning (e.g., medication compliance).

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1. Introduction

Schizophrenia (SCZ) is associated with mild-to-moderate impairment in several cognitive domains, in-

cluding attention, language, executive functions, and memory (e.g., [Bowie and Harvey, 2005](#); [Elvevåg and Goldberg, 2000](#); [Heaton et al., 2001](#)). Episodic memory impairment is particularly prevalent in SCZ ([Aleman et al., 1999](#)) and is associated with more severe negative symptoms ([Aleman et al., 1999](#)) and poorer functional outcomes ([Green et al., 2004](#)). The profile of SCZ-associated episodic memory deficits typically involves deficient strategic encoding and retrieval, with broadly intact consolidation (i.e., the capacity to retain

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information over time; Aleman et al., 1999). Dysfunction within prefrontal systems and, to a lesser extent, medial temporal networks, is thought to underlie SCZ-associated episodic memory deficits (Achim and LePage, 2005).

To date, research on episodic memory in SCZ has focused on retrospective memory (i.e., explicitly prompted recall of past events), whereas studies of prospective memory (ProM) (i.e., “remembering to remember”) have been relatively scarce (Shum et al., 2001). ProM refers to the formation, maintenance, and execution of future intentions (Kvavilashvili and Ellis, 1996), which can be classified as either event-based (e.g., remembering to take a medication after every meal) or time-based (e.g., remembering to take a medication at a particular time of day). ProM is of considerable theoretical relevance because it is singly dissociable from retrospective memory (i.e., retrospective memory is necessary, but not sufficient for ProM). Moreover, pervasive ProM failures may hinder the performance of instrumental activities of daily living (IADLs; e.g., medication adherence). Thus, the clinical and theoretical importance of understanding the prevalence, cognitive and neurobiological mechanisms, and functional impact of ProM impairment in SCZ is clear.

To our knowledge, only four studies have been published on ProM in SCZ. Kondel (2002) reported that individuals with SCZ-associated executive dysfunction were slowed in recognizing the content of intended actions. More recent SCZ studies revealed evidence of impairment on simple measures of event-based ProM in which an external stimulus (e.g., a target word imbedded in a general knowledge test) served as the cue for performing the intention (Elvevåg et al., 2003; Kumar et al., 2005; Shum et al., 2004). Shum et al. (2004) went on to demonstrate a disproportionate deficit in time-based ProM in SCZ, perhaps indicating a particular impairment in the executive aspects of ProM (Shum et al., 2004).

Importantly, however, no prior studies have explicated the component processes of SCZ-associated ProM deficits, which may clarify cognitive substrates, inform remediation planning, and improve functional outcomes (Kurtz et al., 2001). The current study was therefore guided by a 4-stage conceptual model of ProM component processes (see Carey et al., 2006): (1) The *intention formation* stage of ProM is the formation of the intention and its corresponding action, which involves the generation and encoding of an action plan. (2) The *delay maintenance interval* stage describes the delay between initial encoding and the point at which the intention is realized, during which time another activity is ongoing so as to prevent overt rehearsal. (3) The *self-*

initiated cue recognition and intention retrieval stage involves recognizing a cue and searching retrospective memory for the correct intention. This stage, which is considered the defining feature of ProM, differs from conventional tasks in which an experimenter explicitly prompts the search for recall. (4) The *intention execution* stage involves performing the ProM task and evaluating its accuracy and completeness.

In light of the profile and neural substrates of SCZ-associated episodic memory deficits, we hypothesized that individuals with SCZ would evidence impairment in the first (i.e., intention formation) and third (i.e., self-initiated cue recognition and intention retrieval) stages of the conceptual model of ProM as compared to demographically similar healthy comparison subjects (HCs). Considering the findings of Shum et al. (2004), we also hypothesized that individuals with SCZ would demonstrate a greater deficit in time-based than event-based ProM. Finally, the severity of the global ProM impairment was expected to correlate with SCZ disease burden variables (e.g., negative symptoms).

2. Method

2.1. Participants

The present study used a cross-sectional, static-group comparison design that included 41 outpatients with SCZ and 41 demographically comparable HCs (see Table 1). Diagnoses of SCZ were made by treating psychiatrists according to the *Diagnostic and Statistical Manual of Mental Disorders (4th ed., American Psychiatric Association, 1994)* and were confirmed by retrospective chart reviews. SCZ volunteers were self-referred via waiting room flyers or by their health care providers to participate in a cognitive training study. The community-based HC volunteers were recruited via public flyers and newspaper advertisements. Individuals with mental retardation, current substance-related disorders, neurological conditions known to affect cognition (e.g., seizure disorders), or head injuries with loss of consciousness greater than 30 min were excluded.

2.2. Materials and methods

The local Institutional Review Board approved the study protocol. All participants were administered the Memory for Intentions Screening Test (MIST; Raskin, 2004). As shown in Table 2, the MIST is a standardized test comprised of eight ProM tasks that are counter-balanced on delay interval (i.e., 2- vs. 15-min), cue type (i.e., event- vs. time-based), and response (action vs.

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