

## Prospective memory in schizophrenia: Further clarification of nature of impairment

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### Abstract

Prospective memory (PM) refers to the ability to execute a delayed intention and is different from retrospective memory (RM) in its nature and underlying mechanism (e.g., intention formation, maintenance, detection of PM cue and intention execution). Although preliminary studies have found PM impairment in patients with schizophrenia, the nature and magnitude of this problem in this clinical group is not yet fully known. The current study aimed to further clarify the nature of this impairment in schizophrenia. Fifty-four patients with schizophrenia and fifty-four healthy volunteers matched on demographic variables, IQ and executive functions took part in the study. Time-, event-, and activity-based PM tasks and a set of neurocognitive tests were administered to the participants. Results showed that patients with schizophrenia performed significantly worse on all sub-types of PM tasks, even after controlling for neurocognitive functions such as working memory, verbal memory, visual memory, and executive function. These findings suggest PM deficit is a primary deficit rather than a secondary consequence of neurocognitive impairments in schizophrenia. Analysis found that PM deficits may be mainly due to the impairment of the cue detection and intention retrieval stage.

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### 1. Introduction

Meta-analytic studies have indicated that patients with schizophrenia show severe memory impairment in various domains (Aleman et al., 1999; Heinrichs and

Zakzanis, 1998; Lee and Park, 2005; Pelletier et al., 2005; Piskulic et al., 2007). However, most previous studies were limited to the study of retrospective memory (RM), that is, the memory for past information.

In recent years, researchers have shifted their attention to study memory deficits in schizophrenia involving prospective memory (PM), the ability to remember to do something at a particular moment in the future, or the timely execution of an intended goal. PM is considered important for both healthy people and clinical groups because impairments in PM (e.g., forgetting to turn up for appointments or take medication) have implications for everyday functioning and independent living in the community. Preliminary findings also suggest that there may be dissociation between subjective complaints of PM impairments in everyday life and corresponding objective performances (Chan et al., 2008b). PM impairments have also been reported by caregivers of Alzheimer's patients as more frustrating than RM impairments (Smith et al., 2000). These findings have significant implications for the management and rehabilitation of patients with schizophrenia and other neurological disorders (Kurtz et al., 2001; Shum et al., 2003; Smith et al., 2000).

Theoretically, PM can be divided into three types according to the nature of cues. They are time-based PM, meaning to execute an intention at an exact time or after a specific period of time (e.g., to remember to have a meeting at 6:00 pm); event-based PM, meaning to execute an intention when an event or cue appears (e.g., to remember to give a message when a classmate turns up); and activity-based PM, meaning to execute an intention after finishing another task (e.g., to remember to reply to an email after lunch) (Einstein and McDaniel, 1990; Kvavilashvili and Ellis, 1996). Moreover, there are several stages underlying PM performance, namely (1) forming an intention; (2) maintaining the intention; (3) detection of cue for retrieval of the intention; and (4) execution of the intention (Ellis, 1996).

To date, nine studies have examined the PM deficits in schizophrenia (Chan et al., 2008b; Elvevag et al., 2003; Henry et al., 2007; Kondel, 2002; Kumar et al., 2005; Shum et al., 2004; Twamley et al., in press; Wang et al., in press; Woods et al., 2007). Among these studies, two (viz., Kondel, 2002; Twamley et al., in press) did not include a control group, and two (viz., Elvevag et al., 2003; Kumar et al., 2005) focused on only one type of PM. Only five of the studies adopted a more systematic approach to examine PM in schizophrenia.

Shum et al. (2004) found that patients with schizophrenia performed significantly worse than controls on all three types of PM (time-, event-, and activity-based).

However, Shum et al. did not study the relationship between PM performance and clinical variables such as medication and duration of illness.

Woods et al. (2007) used the Memory for Intentions Screening Test (MIST) and found that these patients had comparable deficits on time- and event-based PM tasks; and the participants did not show significant difference on recognition trials after completion of all PM tasks. The authors, therefore, concluded that the PM deficits of schizophrenic patients occurred mainly in the cue detection and intention retrieval stage, and that the first two stages (viz., intention formation and intention maintenance) were relatively intact. Henry et al. (2007) used the virtual week test and found that schizophrenia patients were impaired on PM, irrespective of specific PM task demands. The authors demonstrated that the PM deficits in patients still remained significant after controlling for IQ, executive function and RM, and suggested that the PM deficits observed in these patients were primary not secondary impairments of schizophrenia. However, the Henry et al. (2007) and Woods et al. (2007) studies had relatively small ( $N=30$  for Henry et al., 2007;  $N=41$  for Woods et al., 2007) sample sizes and were limited by the heterogeneous sample with a wider range of participants such as schizoaffective disorder patients. We need to validate their results in another sample with reasonable sample size.

Wang et al. (in press) found that patients with schizophrenia and individuals with psychometrically defined schizotypal personality were impaired in time- and event-based PM. However, the generalizability of their findings was limited by the small sample size. Although a subsequent independent study (Chan et al., 2008b) with a larger sample corroborated the original findings, these two studies have not specifically addressed the issue of whether PM deficit is a primary or secondary cause in schizophrenia (refer to Henry et al., 2007).

It has been found that executive function plays an important role in PM (Kondel, 2002; Shum et al., 2004; Woods et al., 2007), and that IQ may also be related to PM. However, previous studies that examined PM in patients with schizophrenia did not measure executive function (Elvevag et al., 2003; Wang et al., in press; Woods et al., 2007) or did not match this function in of patients and controls (Chan et al., 2008b; Henry et al., 2007; Shum et al., 2004). Similarly, many of the previous studies did not measure or match the IQ of patients and controls (Chan et al., 2008b; Kumar et al., 2005; Shum et al., 2004; Wang et al., in press; Woods et al., 2007). Careful matching of these two variables between patients and control is important to determine and clarify the nature of PM in schizophrenia.

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