Prospective Memory Impairments in Schizophrenic Patients

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Objective: Memory impairment is one of the most pervasive cognitive dysfunctions in schizophrenic patients. The aim of the current study was to conduct the most comprehensive assessment of how prospective memory (PM) is affected in schizophrenia in comparison with healthy controls.

Methods: In this study, 30 first-episode schizophrenic patients who fulfilled the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders based on the diagnostic interview were recruited from eight regional psychiatric clinics in Iran. All participants were males (age 27-42). Moreover, 28 healthy controls were recruited from the same social-class as the patients. The Prospective and Retrospective Memory Questionnaire (PRMQ), PM tasks, and the Virtual Week Board Game were administered. Moreover, clinical symptoms were rated using the positive and negative symptoms scale.

Results: The results showed that in all of the memory types, the group with dominant positive symptoms was superior to the group with dominant negative symptoms. In addition, the results showed that in all of the memory types, the control group had superiority to the schizophrenic group. The most considerable differences between groups were in time-based PM tasks, irregular event-based virtual week tasks, and retrospective tasks (PRMQ).

Conclusion: The current study confirmed that schizophrenic patients have severe PM deficits.

Declaration of interest: None.

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Introduction

Cognitive deficits are considered a key feature of schizophrenia. Although many schizophrenic patients respond to treatments, their cognitive deficits are long-term and can lead to poor social and occupational outcomes (1). Memory impairment is one of the most pervasive cognitive dysfunctions in schizophrenic patients (2-4). Most previous studies on memory impairments in schizophrenia have been focused on retrospective memory (RM) (5-7). Nonetheless, there are few studies that have focused on the nature and degree of prospective memory (PM) deficits among this clinical group (8).

PM is one of the most essential components of daily life, because it literally remembers to remember. PM is an aspect of episodic memory that involves the construction, maintenance, and the execution of future intentions and has significant implications for daily functioning (9).

The main characteristics of PM include: a) a delay between encoding and running the intended action; b) during the delay, the individual has to be engaged in an ongoing task; and c) there is no external reminder for the intended action. Hence, compared to RM, there is more demand on self-initiation in PM (10).

Furthermore, PM can be divided into 3 types based on the nature of the associated cue and the future intention; time-based, event-based, and activity-based (11).

Hypothetically, PM depends upon the integrity of multiple cognitive abilities associated with frontostriatal and temporolimbic

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systems (12), including executive functions, working memory, episodic RM, and information processing speed (13).

The cognitive impairments caused by schizophrenia are numerous and disabling (14-17). Schizophrenia is associated with mild-to-moderate impairment in several cognitive domains, including attention, language, executive functions, and memory (14, 16, 18). Emerging evidence indicates that individuals with schizophrenia may exhibit deficits in PM, a dissociable and ecologically important aspect of episodic memory entailing the formation, maintenance, and execution of future intentions (19).

Moreover, schizophrenic patients have functional connectivity impairment suggesting impairment in the frontal lobes, temporal lobes, and other areas (20). Based on these findings, it is logical to assume that individuals with schizophrenia have PM impairment (21-22). Realizing the nature and the extent of PM deficits in these patients would provide crucial information about their behaviors and help in finding the most efficient management and rehabilitation (22).

Until the present day, only a few empirical studies on PM in schizophrenic patients have been published. Some previous studies have found that event-based and time-based PM were impaired to the same degree (6, 23), whereas others have shown that time-based PM is significantly more impaired than event-based PM (23, 24). The duration of illness and demographic variables cannot be well understood as the results of previous studies were inconsistent. For instance, some studies found significant relationships between PM and dominant negative symptoms (23, 25), but some others did not (26, 27).

Thus, clarifying these relationships is important for understanding the nature and the extent of PM impairment in schizophrenic patients. Findings that clarify the nature of PM impairment in patients with schizophrenia are not only crucial for schizophrenia management, but also for disease prevention in terms of identification of vulnerable individuals and gene candidates. Thus, the main aim of the current study was to conduct a comprehensive assessment of PM deficits (the nature and the extent) in schizophrenic patients, by investigating different types of PM failures observed in their performances.

Materials and Methods

The convenient sampling method was used because of the nature of the study; the authors aimed to find as many first-episode schizophrenic patients as they could at the time of the study.

A total of 31 episodic schizophrenic patients who fulfilled the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) based on diagnostic interviews (using the structured clinical interview for DSM-IV-TR) were recruited from 8 regional psychiatric clinics in Mashhad, Iran, during April to May 2010 (28). All participants were males, and they were between the ages of 27 and 42. Patients with a history of neurological illness or drug dependence (according to clinical records, and information from the interview with the patients and/or their families) were excluded. Clinical symptoms were rated using the Positive and Negative Symptoms Scale (PANSS) (29).

Moreover, 28 healthy controls were also recruited from the same social-class and neighborhood as the patients. Furthermore, the control and study group participants were matched in terms of age, educational level, and social class. None of the healthy controls had family history of psychiatric illnesses, suffered from a neurological illness, or had a history of drug abuse/dependence. The study was approved by the Ethics Committee of the School of Psychology, Semnan University, Iran, (17 March 2010; 98/88/2051).

To measure both objective and subjective PM performance of the participants, this study has used two types of PM test.

Subjective measures of PM

The Prospective and Retrospective Memory Questionnaire (PRMQ) was used to examine the subjective measures of PM. The PRMQ is a 16-item questionnaire. Each participant was asked to rate the frequency of occurrence of each type of memory failure in their daily life on a 5-point scale. Confirmatory factor analysis indicated that

the PRMQ consists of a general memory factor together with additional prospective and RM factors among a group of the general adult population (30).

The reliabilities were also acceptable (alpha = 0.80-0.98), and the demographic variables were not found to influence ratings (31). The Farsi version of the questionnaire was used for the current study. In the current study, this version has been shown to have an impressive internal consistency (Cronbach's α = 0.97) and test-retest reliability (r_{tt} = 0.73).

Objective measures of PM

Virtual Week Board Game: Virtual week has been used to assess PM (32). Virtual week is a computer-based board game, in which the participants move around the board with the roll of the dice. As participants move around the board, they must make choices regarding their daily activities and remember to do some activities that are similar to their daily activities (PM tasks). Each day of virtual week includes 8 PM tasks (4 regular, 4 irregular), which allows the identification of any type of PM impairment. The Farsi version of the questionnaire was used for the current study. In the current study, this version has been shown to have an impressive internal consistency (Cronbach's α = 0.74). In addition, the split-half reliability of the virtual week (not the computer-based version) was estimated to be 0.90 for the overall measure, and 0.79, 0.65, and 0.77 for the regular, irregular, and time-check tasks, respectively.

PM-tasks: The computer-based "PM-tasks" has 3 subtypes; event-based, time-based, and activity-based tasks. Ongoing tasks are divided into semantic and perceptual tasks. In the semantic event-based PM task, a 4-character phrase is presented in the center of the screen, and the participants are required to judge whether the phrases are idioms or not.

The semantic time-based PM task is the same as the semantic event-based PM task except that a clock is placed at the upper right side of the screen and the participants are required to monitor the time throughout the session. The perceptual time-based PM task is the same as the perceptual event-based PM task except that a clock is placed at the upper right side of the screen and participants are asked to monitor the clock and press the spacebar every 1 minute. The Farsi version of this tool was used in the current study, this version has been shown to have an impressive internal consistency (Cronbach's α = 0.85).

The PANSS is a 30-item (7 items for positive and 7 for negative symptoms, and 16 items for general psychopathology), 7-point rating instrument which has adapted 18 items from the brief psychiatric rating scale (33) and 12 items from the psychopathology rating scale (34). The Farsi version of the PANSS was used for the current study. This scale has been shown to have an impressive consistency (r = 0.99).

All the tests were carried out in a room designed for conducting this study in 2 sessions of morning and afternoon. First, the PRMQ (which is a pencil-paper questionnaire), and then, the PM computerized tasks were carried out. The 4 PM-tasks were given in the following order: semantic time-based, perceptual event-based, semantic event-based, and perceptual time-based. The Virtual Week was used to measure PM in the form of some activities similar to daily activities. Finally, the participants were interviewed, and rated using the PANSS.

Results

The mean and standard deviation of all the variables was reported in table 1. In patients with dominant positive symptoms, the mean PM and all Virtual Week scales were higher than the scores of patients with dominant negative symptoms (mean difference = 0.99). In PRMQ, as was expected, the results showed the opposite. In Virtual Week, maximum and minimum differences were observed in irregular time-based and irregular event-based tasks, respectively.

T-test with Bonferroni correction was used to compare schizophrenic patients with dominant PANSS. The results showed that in all memory types, schizophrenic patients with dominant positive symptoms were more successful than those with dominant negative symptoms (Table 1).

Furthermore, t-test with Bonferroni correction was used to compare controls and

schizophrenic samples. Results demonstrated that in all memory types, the control group was more successful compared with the schizophrenic group (Table 2). Most of the differences were found in time-based PM tasks, irregular event-based Virtual Week tasks, and retrospective PRMQ tasks.

Discussion

The purpose of the present study was to investigate PM, its different components, and the relationship between PM and clinical symptoms of schizophrenic patients (compared with the control group). The results suggested that schizophrenic patients, compared with normal participants, had lower success rate in PM. This result was consistent with similar studies which have found that PM performance of the general population is more successful than schizophrenic patients (6, 23-25, 27, 35-37). In addition, this result was consistent with that of neuropsychology studies that have reported that PM impairment is related to deficit in the frontal lobe (38).

Based on the results of the present study, it has been demonstrated that the performance of schizophrenic patients in time-based tasks is less successful than event-based tasks of PM. This result is consistent with that of some studies (24, 27), which have reported less successful time-based PM performance in comparison with event-based PM performance in schizophrenic patients. However, its results are inconsistent with other studies that have reported the same level of impairment for schizophrenic patients in time-based and event-based tasks (6, 23, 39), because this study found that schizophrenic patients were less successful in time-based than event-based PM performance. A possible explanation for this inconsistency is the essence of time-based and event-based tasks. Event-based tasks that were presented in this study provided recognition cues that were more practical, but such similar conditions have not been used for time-based tasks.

Table 1. Comparison of memory impairments between schizophrenic patients with dominant positive and negative symptoms

Variables	Positive symptoms (n = 17)	Negative symptoms (n = 13)	Mean difference
	Mean ± SD†	Mean ± SD†	
PM‡ (total)	-0.37 ± 0.22	-1.36 ± 0.34	-0.986**
PRMQ§ (total)	0.76 ± 0.31	1.09 ± 0.21	0.325**
Virtual week			
Regular event-based	0.77 ± 0.17	0.37 ± 0.10	-0.393**
Regular time-based	0.66 ± 0.23	0.30 ± 0.14	-0.357**
Irregular event-based	0.61 ± 0.17	0.27 ± 0.14	-0.340**
Irregular time-based	0.66 ± 0.22	0.23 ± 0.14	-0.426**
Irregular beginning	0.64 ± 0.19	0.26 ± 0.11	-0.379**
Irregular during	0.64 ± 0.15	0.25 ± 0.14	-0.387**

*All mean differences were statistically significant, **P < 0.05;
† Standard deviation; ‡ Prospective questionnaire; § Prospective and retrospective memory questionnaire

Table 2. Comparison of Memory Impairments in schizophrenic patients (n = 30) and control group (n = 30)

Variables	T	Df	Mean difference
PM† scales			
Event-based	09.681	58.000	1.466**
Time-based	12.093	40.186*	2.450**
Activity-based	14.316	29.000	0.483**
Total	13.664	43.698*	1.605**
Virtual week scales			
Regular event-based	07.493	34.002*	0.353**
Regular time-based	07.741	37.710*	0.403**
Irregular event-based	11.779	30.757*	0.510**
Irregular time-based	08.192	33.280*	0.446**
Irregular beginning	09.559	34.228	0.453**
Irregular during	11.089	30.789	0.503**
PRMQ‡ scales			
Prospective and retrospective	-17.439	58.000	-16.460**
Prospective	-12.843	58.000	-7.460**
Retrospective	-16.736	58.000	-09.00**
Short term	-17.179	58.000	-08.93**
Long term	-14.673	58.000	-07.53**

*df was adjusted for unequal variances assumption, **P < 0.01;
† Prospective questionnaire; ‡ Prospective and retrospective memory questionnaire

In addition, the present study showed that schizophrenic patients, in comparison with the general population, had less successful performance in all PM tasks. This result was consistent with previous findings (6).

This study showed that schizophrenic patients with dominant positive symptoms had better performance in PM tasks in comparison with the patients with dominant negative symptoms. These results are consistent with some studies that have reported that schizophrenic patients with severe social withdrawal are unable to remember external cues and convert their goals into actions (17, 23). However, these results were inconsistent with some studies that have shown no relation between patients' performance and their symptoms (23-26). A probable explanation is that in this study all of the patients were first-episodic patients, who have never taken any medications for their condition or been hospitalized, whereas the previous study subjects were on medication and/or had been hospitalized before or during the study.

Other findings of the present study showed that objective and subjective deficits of schizophrenic patients were significantly different. Some researchers reported that schizophrenic patients' performances were less successful than the control group in all PM task types (27). This result was consistent with the finding of the present study; schizophrenic patients had less successful performance in computerized tasks in comparison with the control group. Moreover, their performance in computerized tasks differed from that in subjective tasks. Chan et al. reported that schizophrenic patients have no insight and cannot report deficits of their subjective PM (35). The present study showed that schizophrenic patients, in comparison with the control group, had poorer performance in subjective tasks. Therefore, there is no evidence to confirm the reports of Chan et al. (35). However, different samples of schizophrenic patients could be a probable explanation for this inconsistency.

The first limitation of this study could be that the participants were recruited from only 8 regional psychiatric clinics in Mashhad, Iran. Hence, the findings may not be generalized to other regions of Iran. The second limitation is related to research design. The present study design is ex-post facto; therefore, we cannot make a causal inference from the results. Finally, one of the most important limitations of this study was the use of male participants alone.

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Authors' contributions

This paper is extracted from the MSc thesis in clinical psychology of AF. IB conceived and designed the evaluation and helped to draft the paper. AF participated in designing the evaluation, collected the clinical data, performed the statistical analysis, and revised the paper. ST reevaluated the clinical data, reanalyzed the clinical and statistical data, and revised the paper. All authors read and approved the final manuscript.

References

1. Fett AK, Viechtbauer W, Dominguez MD, Penn DL, van OJ, Krabbendam L. The relationship between neurocognition and social cognition with functional outcomes in schizophrenia: a meta-analysis. Neurosci Biobehav Rev 2011; 35(3): 573-88.
2. Hori H, Noguchi H, Hashimoto R, Okabe S, Saitoh O, Kunugi H. IQ decline and memory impairment in Japanese patients with chronic schizophrenia. Psychiatry Res 2008; 158(2): 251-5.
3. Palmer BW, Savla GN, Fellows IE, Twamley EW, Jeste DV, Lacro JP. Do people with schizophrenia have differential impairment in episodic memory and/or working memory relative to other cognitive abilities? Schizophr Res 2010; 116(2-3): 259-65.
4. Martin CD, Baudouin JY, Franck N, Guillaume F, Guillem F, Tiberghien G, et

al. Impairment not only in remembering but also in knowing previously seen faces and words in schizophrenia. Psychiatry Res 2011; 188(1): 18-23.
5. Feinstein A, Goldberg TE, Nowlin B, Weinberger DR. Types and characteristics of remote memory impairment in schizophrenia. Schizophr Res 1998; 30(2): 155-63.
6. Henry JD, Rendell PG, Kliegel M, Altgassen M. Prospective memory in schizophrenia: primary or secondary impairment? Schizophr Res 2007; 95(1-3): 179-85.
7. Bell MD, Johannesen JK, Greig TC, Wexler BE. Memory profiles in schizophrenia: categorization validity and stability. Schizophr Res 2010; 118(1-3): 26-33.
8. Wang Y, Cui J, Chan RC, Deng Y, Shi H, Hong X, et al. Meta-analysis of prospective memory in schizophrenia: nature, extent, and correlates. Schizophr Res 2009; 114(1-3): 64-70.
9. Kvavilashvili L, Ellis J. Varieties of intention: Some distinctions and classifications. In: Brandimonte M, Einstein G, McDaniel M, editors. Prospective memory: Theory and applications. Hillsdale, NJ: L. Erlbaum; 1996.
10. McDaniel MA, Einstein GO, Stout AC, Morgan Z. Aging and maintaining intentions over delays: do it or lose it. Psychol Aging 2003; 18(4): 823-35.
11. Einstein GO, McDaniel MA. Normal aging and prospective memory. J Exp Psychol Learn Mem Cogn 1990; 16(4): 717-26.
12. Simons JS, Scholvinck ML, Gilbert SJ, Frith CD, Burgess PW. Differential components of prospective memory? Evidence from fMRI. Neuropsychologia 2006; 44(8): 1388-97.
13. Carey CL, Woods SP, Rippeth JD, Heaton RK, Grant I. Prospective memory in HIV-1 infection. J Clin Exp Neuropsychol 2006; 28(4): 536-48.
14. Elvevag B, Goldberg TE. Cognitive impairment in schizophrenia is the core of the disorder. Crit Rev Neurobiol 2000; 14(1): 1-21.
15. Green MF, Kern RS, Heaton RK. Longitudinal studies of cognition and functional outcome in schizophrenia: implications for MATRICS. Schizophr Res 2004; 72(1): 41-51.
16. Heaton RK, Gladsjo JA, Palmer BW, Kuck J, Marcotte TD, Jeste DV. Stability and course of neuropsychological deficits in schizophrenia. Arch Gen Psychiatry 2001; 58(1): 24-32.
17. Twamley EW, Doshi RR, Nayak GV, Palmer BW, Golshan S, Heaton RK, et al. Generalized cognitive impairments, ability to perform everyday tasks, and level of independence in community living situations of older patients with psychosis. Am J Psychiatry 2002; 159(12): 2013-20.
18. Bowie CR, Harvey PD. Cognition in schizophrenia: impairments, determinants, and functional importance. Psychiatr Clin North Am 2005; 28(3): 613-33, 626.
19. Achim AM, Lepage M. Episodic memory-related activation in schizophrenia: meta-analysis. Br J Psychiatry 2005; 187: 500-9.
20. Stephan KE, Baldeweg T, Friston KJ. Synaptic plasticity and dysconnection in schizophrenia. Biol Psychiatry 2006; 59(10): 929-39.
21. Burgess PW, Quayle A, Frith CD. Brain regions involved in prospective memory as determined by positron emission tomography. Neuropsychologia 2001; 39(6): 545-55.
22. Shum D, Leung JP, Ungvari GS, Tang WK. Schizophrenia and prospective memory :A new direction for clinical practice and research. Hong Kong J Psychiatry 2001; 11(2): 23-6.
23. Woods SP, Twamley EW, Dawson MS, Narvaez JM, Jeste DV. Deficits in cue detection and intention retrieval underlie prospective memory impairment in schizophrenia. Schizophr Res 2007; 90(1-3): 344-50.
24. Shum D, Ungvari GS, Tang WK, Leung JP. Performance of schizophrenia patients on time-, event-, and activity-based prospective memory tasks. Schizophr Bull 2004; 30(4): 693-701.
25. Twamley EW, Woods SP, Zurhellen CH, Vertinski M, Narvaez JM, Mausbach BT, et al. Neuropsychological substrates and everyday functioning implications of

prospective memory impairment in schizophrenia. Schizophr Res 2008; 106(1): 42-9.
26. Kumar D, Nizamie HS, Jahan M. Event-based prospective memory in schizophrenia. J Clin Exp Neuropsychol 2005; 27(7): 867-72.
27. Wang Y, Chan RC, Hong X, Ma Z, Yang T, Guo L, et al. Prospective memory in schizophrenia: further clarification of nature of impairment. Schizophr Res 2008; 105(1-3): 114-24.
28. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed. Washington, DC: American Psychiatric Association; 2000.
29. Kay SR, Fiszbein A, Opler LA. The positive and negative syndrome scale (PANSS) for schizophrenia. Schizophr Bull 1987; 13(2): 261-76.
30. Crawford JR, Smith G, Maylor EA, Della SS, Logie RH. The Prospective and Retrospective Memory Questionnaire (PRMQ): Normative data and latent structure in a large non-clinical sample . Memory 2003; 11(3): 261-75.
31. Crawford JR, Henry JD, Ward AL, Blake J. The Prospective and Retrospective Memory Questionnaire (PRMQ): latent structure, normative data and discrepancy analysis for proxy-ratings. Br J Clin Psychol 2006; 45(Pt 1): 83-104.
32. Rendell PG, Craik FI. Virtual week and actual week: Age-related differences in prospective memory. Appl Cognitive Psych 2000; 14(7): S43-62.
33. Overall JE, Gorham DR. The brief psychiatric rating scale. Psychol Rep 1962; 10: 799-812.
34. Singh MM, Kay SR. A comparative study of haloperidol and chlorpromazine in terms of clinical effects and therapeutic reversal with benztropine in schizophrenia. Theoretical implications for potency differences among neuroleptics. Psychopharmacologia 1975; 43(2): 103-13.
35. Chan RC, Wang Y, Ma Z, Hong XH, Yuan Y, Yu X, et al. Objective measures of prospective memory do not correlate with subjective complaints in schizophrenia. Schizophr Res 2008; 103(1-3): 229-39.
36. Elvevag B, Maylor EA, Gilbert AL. Habitual prospective memory in schizophrenia. BMC Psychiatry 2003; 3: 9.
37. Kumar D, Nizamie SH, Jahan M. Activity-based prospective memory in schizophrenia. Clin Neuropsychol 2008; 22(3): 497-506.
38. Burgess PW, Scott SK, Frith CD. The role of the rostral frontal cortex (area 10) in prospective memory: a lateral versus medial dissociation. Neuropsychologia 2003; 41(8): 906-18.
39. Ungvari GS, Xiang YT, Tang WK, Shum D. Prospective memory and its correlates and predictors in schizophrenia: an extension of previous findings. Arch Clin Neuropsychol 2008; 23(5): 613-22.