Preserved Strategic Grain-Size Regulation in Memory Reporting in Patients with Schizophrenia

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Background: Cognitive and introspection disturbances are considered core features of schizophrenia. In real life, people are usually free to choose which aspects of an event they recall, how much detail to volunteer, and what degree of confidence to impart. Their decision will depend on various situational and personal goals. The authors explored whether schizophrenia patients are able to achieve a compromise between accuracy and informativeness when reporting semantic information.

Methods: Twenty-five patients and 23 healthy matched control subjects answered general knowledge questions requiring numerical answers (how high is the Eiffel tower?), freely at first and then through a metamemory-based control. In the second phase, they answered with respect to two predefined intervals, one narrow and one broad; attributed a confidence judgment to both answers; and afterward selected one of the two answers. Data were analyzed using analyses of variance with group as the between-subjects factor.

Results: Patients reported information at a self-paced level of precision less accurately than healthy participants. However, they benefited remarkably from the framing of the response and from the metamemory processes of monitoring and control to the point of improving their memory reporting and matching healthy subjects' accuracy.

Conclusions: In spite of their memory deficit during free reporting, after accuracy monitoring, patients strategically regulated the grain size of their memory reporting and proved able to manage the competing goals of accuracy and informativeness. These results give some cause for optimism as to the possibility for patients to adapt to everyday life situations.

Key Words: Cognition, grain-size, memory, metacognition, metamemory, schizophrenia

Traditionally, laboratory tasks that explore memory have focused on the quantity of information retrieved. In real-life situations, however, the processes involved in answering a question are subtle, not just a case of volunteering or withholding an answer. Answers that are volunteered are usually the result of regulating of the preciseness or coarseness (grain size) of the information. In the case of an accident witness testifying when a crash occurred, "between 3:00 and 3:06 PM" would be a fine-grained and thus highly informative answer, but the probability of its accuracy is quite poor. "Between 1:00 and 5:00 PM" would be a coarse-grained answer, more likely to be correct but not very informative or useful. The volunteered answer is mediated by a decision process aimed at avoiding incorrect responses (1). Accordingly, only information believed to be correct is proffered. Achieving this involves monitoring the accuracy of the information retrieved and deciding which information to report and in how much detail. The strategic regulation of memory accuracy therefore depends on how confident we are in the correctness of our answers and on the situational demands and incentives, and metamemory processes are involved (1–4). Metamemory plays an important role in planning, cognitive resources allocation, strategy selection, comprehension monitoring, and the cognitive performance evaluation. As a concept, it is the ability both to monitor and control one's own memory behavior. Monitoring is the ability to assess our own memory in a memory task and is expressed as metamemory judgments. Control is the ability to use the monitoring output to adapt our cognitive behavior, for example, by allocating a given time to study, answering a question or refraining from answering, continuing an action, or spending more time searching for known information, etc. (5,6).

Memory is recognized as being one of the cognitive functions worst affected in schizophrenia (7,8), and cognitive disturbances are seen as better predictors of patients' low social outcome than clinical symptoms (9–11). Accordingly, enhancing patients' memory abilities should improve their social outcome. More specifically, semantic knowledge impairments have been reported, and according to the conclusion of a systematic review, performance in semantic tests is influenced by an executive dysfunction (12). Moreover, several authors suggest that executive functions are closely related to metacognition (12–14). Previous studies about metamemory and schizophrenia patients have shown how some of their monitoring abilities are impaired, whereas others are preserved (15–17). Relative monitoring accuracy usually remains high, insofar as patients were repeatedly shown to be more confident of their correct answers than of their incorrect answers, particularly for semantic memory (15,16). In keeping with the previously described realistic approach, some studies have examined whether schizophrenia patients' strategic control over memory reporting is determined by their monitoring abilities (16,18). In particular, Danion *et al.* (16) observed that patients were able to take account of an external incentive to achieve better accuracy. They grounded their decisions to withhold or volunteer answers in their previous monitoring and improved their memory performance.

In near real-life situations, regulation of the volunteered answer has to accommodate the competing goals of accuracy and informativeness. Goldsmith *et al.* (3) addressed this question in their study with healthy participants who had to answer general knowledge questions, all requiring numerical answers

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Received May 16, 2013; revised Sep 2, 2013; accepted Sep 4, 2013.

0006-3223/$36.00
http://dx.doi.org/10.1016/j.biopsych.2013.09.004

Table 1. Demographic, Clinical, and Cognitive Data

	Healthy ($n = 23$)	Patients ($n = 25$)	F	p Value
Men/Women	13/10	14/11		
Age	38 (8)	37.5 (7.2)	.10	.75
Years of Education	12.3 (1.3)	11.8 (2)	.32	.57
fNART	105 (7.7)	104.2 (9.4)	.08	.77
Phonemic Fluency	37.8 (9.1)	35.1 (12.1)	.77	.38
Categorical Fluency	77.3 (16.1)	67.5 (16.4)	4.26	.04[a]
Cognitive Estimations	23.6 (3.2)	25.9 (3.8)	4.77	.03[a]
PANSS Total		69 (27.8)		
Positive score		14.9 (5.6)		
Negative score		18.8 (10.5)		
General psychopathology		35.7 (14.8)		

Means and SDs in parentheses.

fNART, French adaptation of the National Adult Reading Test; PANSS, Positive and Negative Syndrome Scale.

[a]Significant difference between groups.

guided via a metamemory-based control. They answered at two predefined intervals, one narrow and one broad, and then attributed a retrospective judgment of confidence to each answer before selecting one of them, as if they were testifying as an expert witness. The results showed healthy participants achieved a good compromise between accuracy and informativeness. Their answers were neither exclusively fine-grained (which would mean sacrificing accuracy for informativeness) nor exclusively coarse-grained (i.e., informativeness sacrificed for accuracy). They regulated their answers' grain size strategically (control process) based on how confident they were in the correctness (monitoring process) of each answer given for each grain size. They achieved good memory reporting accuracy but not at the expense of informativeness.

To date, there is no information available about how schizophrenia patients cope with the accuracy-informativeness trade-off. The aim of this study was therefore twofold. First, it set out to determine, through a naturalistic approach [adapted from (3)], whether or not schizophrenia patients are able to cope with the accuracy-informativeness trade-off to regulate their control over the grain size of their memory reports and obtain better accuracy and to what extent they rely on monitoring to do so. Second, the study explored the differences between patients' spontaneous behavior and their behavior within a frame, operationalized here with two intervals**,** one narrow and one broad. The prerequisite for efficient control is that monitoring is able to assess accurately whether or not a putative answer is likely to be correct, a process shown to be relatively intact in schizophrenia, and particularly for semantic memory (15,16), whereas subsequent control of a memory task has been shown to be somewhat impaired (16,18). We hypothesize that patients are also less efficient at deciding what level of information to provide when they have to handle both accuracy and informativeness.

Methods and Materials

Participants

Twenty-five chronic, clinically stable outpatients with schizophrenia were recruited from the Psychiatric Department of Strasbourg University Hospital. According to the consensus opinion of their current psychiatrist and a senior psychiatrist on the research team, all the patients met the criteria for schizophrenia as set out in the DSM-IV-TR. Their psychiatric symptoms overall were assessed according to the Positive and Negative Syndrome Scale (19). Patients taking lithium were excluded from the study. Eight patients were being treated with typical neuroleptics, 12 with atypical neuroleptics, 2 with a mixture of typical and atypical, and 3 were neuroleptic-free. Twenty-three healthy participants matching 23 of the patients in terms of age, gender, and level of education were also recruited.

None of the 48 participants had a known neurological affection or a current or past alcohol or substance abuse.

Demographic, clinical, and cognitive data are presented in Table 1. The mean age of schizophrenia onset was 23.3 years (SD = 6.2). There was no difference between the groups in terms of their mean age, level of education, or French adaptation of the National Adult Reading Test premorbid IQ. Regarding cognitive skills, patients performed worse than the healthy participants with respect to categorical fluency and the Shallice and Evans Cognitive Estimation Test.

Material

Forty-five questions were selected from an initial list of 123 questions (20), all requiring numerical answers (heights, weights, ages, speeds, etc.). Examples are available in Table 2. The experimental design was computerized, and the data were collected automatically.

Procedure

The project was approved by the University Ethics Committee, and before the study, informed written consent was obtained from each participant in accordance with the recommendations of the Helsinki Declaration. Participants were tested individually in the presence of the experimenter.

The experiment consisted of two phases. Before each new task, instructions were given both orally and in writing, and examples were systematically given (Table 2).

Phase A: Free Grain Size Phase (Spontaneous Reporting Behavior). The questions appeared on a computer screen one by one, in random order. Participants had to respond aloud, giving the best answer they could for each question, even if it meant

Table 2. Examples of Questions, Correct Answers, and the Fixed Intervals

Question	Correct Answer	Fine-Grain Interval	Coarse-Grain Interval
What is the speed record of the French high speed train (TGV)?	575 km/h	Give the answer within 50 km/h	Give the answer in a 250 km/h interval
How old is the average expectancy of life of a man in France?	78 years old	Give the answer within 3 years	Give the answer within 20 years
How much is the minimum net salary in France?	1430 euros	Give the answer within 50 euros	Give the answer within 200 euros
How old is Catherine Deneuve?	70 years old	Give the answer within 2 years	Give the answer within 15 years

TGV, Train à Grande Vitesse.