Psychiatry Research 230 (2015) 511–516

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Metamemory in patients with schizophrenia measured by the feeling of knowing

Chien-Yeh Chiu [a,1], Chen-Chung Liu [b,1], Tzung-Jeng Hwang [b], Hai-Gwo Hwu [b], Mau-Sun Hua [a,*]

[a] Department of Psychology, College of Science, National Taiwan University, Taipei, Taiwan
[b] Department of Psychiatry, National Taiwan University Hospital and College of Medicine, National Taiwan University, Taipei, Taiwan

ARTICLE INFO

Article history:
Received 2 April 2015
Received in revised form
19 August 2015
Accepted 30 September 2015
Available online 3 October 2015

Keywords:
Feeling-of-knowing
Insight
Metacognition
Metamemory
Neurocognition
Schizophrenia

ABSTRACT

Cognitive awareness in patients with schizophrenia is crucial for clinical management of cognitive deficits. Traditional approaches using self-report inventories have questionable validity and reliability. Using the Feeling-of-Knowing (FOK) procedure to measure metamemory might overcome such weakness. A cross-sectional study comparing 40 patients and 40 demographically matched normal controls, using a recall-judgment-recognition (RJR) procedure and the Hamann coefficient was conducted to examine whether patients with schizophrenia have FOK deficits and what neurocognitive mechanism might account for these deficits. General IQ, executive function, and memory tests were also assessed. The results show that as a group, patients with schizophrenia had impaired FOK ability and evidenced a disposition to underestimate their memory performance. However, patient's FOK ability was variable, with 42.5% of patients exhibited a below chance level performance. There were marked relationships between FOK and set formation and visual recognition abilities in healthy controls, while such feature was not evident in patient group. These findings are in line with the prefrontal cortex dysfunction, reduced intrapsychic monitoring ability, and impaired utilization of mental resources noticed in patients with schizophrenia. A routine evaluation of metamemory function by FOK might be helpful for designing customized cognitive rehabilitation programs considering their missed estimation of memory capacity.

1. Introduction

Neurocognitive deficits appear in about 80% of patients with schizophrenia (Palmer et al., 2009). These deficits impact patients' social-occupational functioning and quality of life (Green et al., 2000; Green et al., 2004; Mohamed et al., 2008). The effectiveness of intervention to improve patient's functioning depends on patient's awareness of their neurocognitive problems and willingness to comply with treatment (Quiles et al., 2013; Lysaker and Dimaggio, 2014). How well the patients judge their own neurocognitive function has been determined by the degree of concordance between the patient's self-report inventory and objective neuropsychological test performance, while current evidence suggests poor correlation between these two measurements (Medalia and Lim, 2004; Prouteau et al., 2004; Ehmann et al., 2007; Medalia et al., 2008). Patients with objective cognitive deficits may have limited appreciation of their own problems (Medalia et al., 2008), particularly prominent episodic memory impairment that may hamper the ability to provide accurate self-reports (Dickinson et al., 2007; Mesholam-Gately et al,. 2009; Fridberg et al., 2010). In addition to the memory problem, the validity and reliability of self-report measures are easily compromised by response bias and some transient factors, such as patient's mood or current stress (Hanita, 2000).

An alternative to examine a patient's awareness of individual's own cognitive function is the experimental metacognitive approach, which has been intensively investigated in cognitive psychology since the 1970s (Dunlosky and Metcalfe, 2009). Metacognition refers to the ability to monitor and control one's own cognitive processes (Nelson and Narens, 1990, 1994). Metamemory, a key element of metacognition, can be measured by experimental tasks to evaluate the monitoring aspect of metacognition (Pannu and Kaszniak, 2005) The feeling of knowing (FOK) paradigm using tasks which have no demands on recollecting previous instances of cognitive failure, can efficiently combine subjective appraisal of cognitive status and objective cognitive performance into a single task to provide an easy-to-understand index (Hart, 1965). In theory, during a memory search process, the initial FOK may affect the choice of search strategy

* Correspondence to: Department of Psychology, National Taiwan University, No. 1, Sec. 4, Roosevelt Road, Taipei 10617, Taiwan. Fax: +886 2 23629909.
E-mail address: huams@ntu.edu.tw (M.-S. Hua).
[1] Equally contributing co-first authors.

http://dx.doi.org/10.1016/j.psychres.2015.09.046
0165-1781/

(Janowsky et al., 1989) and persistence of the search process (Schnyer et al., 2004), which in turn may affect memory performance. Thus, a better understanding of FOK may contribute to the development of more effective cognitive remediation methods.

Previous studies in patients with neurological diseases have indicated that the prefrontal cortex may play an important role in FOK judgments (Janowsky et al., 1989; Kikyo et al., 2002; Schnyer et al., 2004; Chua et al., 2009). As patients with schizophrenia also have been demonstrated with structural and functional abnormalities in the prefrontal cortex (Buchanan et al., 1998; Davidson and Heinrichs, 2003; Hill et al., 2004; Harrison et al., 2006; Harms et al., 2010), they are also likely to have impaired FOK abilities but existing data focusing on patients with schizophrenia are limited and inconclusive. One study analyzing data using semantic FOK paradigm suggests that patients tend to underestimate their memory performance with similar levels of correct recognition but lower FOK ratings than normal controls (Bacon et al., 2001). Two studies using the episodic FOK paradigm failed to show a significant difference in FOK accuracy between patients and controls (Souchay et al., 2006; Bacon and Izaute, 2009), while one study found that patients' FOK accuracy was not reliably higher than chance level, suggesting very poor FOK accuracy (Souchay et al., 2006).

Such inconsistent findings are attributable to small sample sizes (most of the above-mentioned studies having fewer than 20 subjects in each group), only testing a restricted range of neuropsychological domains (only memory and general intelligence), using a less reliable indicator (the Goodman–Kruskal Gamma coefficient) (Schraw, 1995; Nietfeld et al., 2006), and mainly focusing on testing the group difference between patients and controls while ignoring the heterogeneity among patients with schizophrenia when a larger sample size was explored (Medalia and Thysen, 2008; Medalia et al., 2008).

In this study, we concurrently assessed their episodic memory and executive functions which were regarded as especially relevant to FOK (Souchay et al., 2000, 2002), and used the Hamann index as the indicator of FOK accuracy to investigate the neuropsychological processes underlying FOK judgment in 40 patients with schizophrenia and 40 normal controls. We tried to determine to what extent FOK judgment was impaired in patients with schizophrenia and whether certain neurocognitive mechanisms, such as impairment in episodic memory or executive function, might account for their FOK deficit.

2. Methods

2.1. Participants

Patients with a diagnosis of schizophrenia were recruited from the outpatient clinic at a university-based teaching hospital. Exclusions were those who had IQs below 70, a history of central nervous system illness, traumatic brain injury, substance abuse, or age below 16 years. Patients gave signed informed consents prior to participation, and eligible participants were paid after receiving assessment. The project protocol was approved by the institutional review board of the study hospital. In each case, the clinical diagnosis was made by a primary psychiatrist and based upon Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) criteria using information from clinical interviews and medical records. All patients were diagnosed as having schizophrenia except one with schizoaffective disorder. They were all outpatients with no hospitalization or changes of antipsychotic dose in recent 3 months; the majority of them (35/40) received second generation antipsychotic medication and overall with a relatively low dose, while two took no antipsychotic medication at the time of participation.

We also recruited 40 gender- and age-matched normal control participants via public posting. The control participants also signed informed consents and were interviewed to assure that they had no history of psychiatric or neurologic illnesses and were not taking any psychoactive drugs at the time of participation.

2.2. Measurements

2.2.1. Feeling-of-knowing task (recall-judgment-recognition paradigm)

FOK ability was assessed by the recall-judgment-recognition (RJR) task, a method of measuring episodic FOK with high sensitivity of metamemory deficit detection in patients with frontal lobe pathology (Janowsky et al., 1989). The RJR task consisted of three phases: learning, cue-recall/FOK judgment, and recognition. The learning list consisted of 26 cue-target pairs, including six fillers distributed in the beginning and the end of the list to minimize the serial position effect on recall in list learning tasks (Postman and Phillips, 1965). In this study, we used moderately associated common Chinese word pairs as the cue-target pairs selected from an associative norm (Chen, 1998). Instructions, stimuli presentation, and response collection were performed using E-Prime 2® on a laptop computer (Schneider et al., 2002a, 2002b).

In the learning phase, all the participants were presented with the 26 cue-target pairs and told that they would be asked to recall the target words later in response to corresponding cues. Subsequently, 10-min distracting tasks (the Arithmetic and Digit Span subtests from the Wechsler Adult Intelligence Scale-III) were performed to prevent rehearsal of the learning list.

In the second phase, the participants were asked to recall the target words and assess their FOK judgments on a 6-point Likert-like scale (0%, 20%, 40%, 60%, 80%, and 100% confidence in correctly recognizing the target word on the later recognition test) for all targets. We collapsed this 6-point scale into two categories: high FOK judgment (more than or equal to 60% confidence) and low FOK judgment (less than 60% confidence). Only the FOK judgments for non-recalled items in the recall phase were included in further data analysis.

In the third phase, after all the FOK predictions were made, participants completed a “Yes or No” forced-choice recognition task. The recognition list consisted of 20 targets and 20 distracters. Participants were asked to recognize whether each word has been learned in the learning phase.

FOK accuracy was measured by estimating the association between FOK judgment and correctness of recognition. As the Goodman–Kruskal Gamma coefficient ignores pairs tied on the predictor variable thus may result in an inflated estimation of monitoring ability (Pannu and Kaszniak, 2005), we used the Hamann coefficient as an index of FOK accuracy based on Schraw's recommendation (Schraw, 1995). The equation for calculating the Hamann index (a continuous variable ranging from -1 to $+1$) is provided in Table 2. A large positive value, zero, and negative value indicated a high degree of FOK accuracy, chance-level accuracy, and less than chance-level accuracy, respectively.

2.2.2. Neuropsychological assessment

We focused on the neuropsychological domains regarded as relevant to FOK ability, including general intelligence, episodic memory, and executive function. The full scale intellectual quotient (IQ) was estimated by the Similarities, Arithmetic, Block Design, and Digit Symbol Substitution tests from the Wechsler Adult Intelligence Scale – 3rd edition (WAIS-III), Taiwan version (Chen and Chen, 2002, Chen et al., 2008). Episodic memory was measured by the Logical Memory (LM) and Visual Reproduction (VR) tests from the Wechsler Memory Scale – 3rd edition (WMS–