Neurocognition and Cognitive Biases in Schizophrenia

Cristina P. Garcia, BA, Stephanie A. Sacks, MS,*† and Amy G. Weisman de Mamani, PhD**

Abstract: Individuals with schizophrenia have been found to exhibit a number of information processing biases that may play a role in the development and exacerbation of symptoms and may impair overall functioning. However, little is known about the factors that are associated with these cognitive biases. Recently, researchers have begun to consider whether neurocognitive deficits, common in schizophrenia, may be risk factors for the development of cognitive biases. In the present study, we assessed neurocognition (verbal learning, delayed verbal recall memory, and verbal recognition memory) and cognitive biases (knowledge corruption and impaired cognitive insight) in 72 individuals with schizophrenia or schizoaffective disorder. As hypothesized, poorer delayed verbal recall memory was associated with increased knowledge corruption. Contrary to expectations, verbal learning and verbal memory were not associated with cognitive insight. These findings suggest that an inadequate recall memory system may put patients with schizophrenia at greater risk for cognitive distortions.

Key Words: Schizophrenia, neurocognition, cognitive biases.

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Individuals with schizophrenia exhibit biases in information processing such as knowledge corruption, a trait characteristic that refers to holding false information with a high degree of certainty (Moritz et al., 2006), and impaired cognitive insight, or difficulty acknowledging one's cognitive fallibility and integrating corrective feedback (Beck et al., 2004). Patients with schizophrenia display significantly higher rates of knowledge corruption and diminished cognitive insight when compared to healthy control subjects (Martin et al., 2010; Moritz et al., 2006).

Given the pervasiveness and the deleterious impact of knowledge corruption and impaired cognitive insight in individuals with schizophrenia (Moritz and Woodward, 2006), it is important to identify the factors that may be associated with these cognitive biases. Neurocognitive abilities have been considered as such factors (Menon et al., 2006). The current study examines the following three areas of neurocognition: verbal learning, or the ability to consolidate and retain auditory information; delayed verbal recall memory, or the ability to spontaneously remember auditory information; and verbal recognition memory, or the ability to distinguish between previously presented information and new auditory information (Peterson, 1977).

To date, no published studies have explored whether verbal learning, delayed verbal recall memory, and verbal recognition memory abilities (henceforth collectively referred to as *verbal learning and verbal memory*) are associated with knowledge corruption. This investigation is important because it may specify a distinct cognitive profile in patients that includes poor memory facilities and confidence in this flawed memory system. We postulated that false memories might lead patients to draw incorrect conclusions because of difficulty distinguishing real from unreal memories. Drawing from this, the current study evaluates the relationship between verbal learning, verbal memory, and knowledge corruption. Specifically, we hypothesized that poorer verbal learning and poorer verbal memory will be associated with increased knowledge corruption in individuals with schizophrenia.

Cognitive insight is composed of self-reflectiveness, or the ability to objectively evaluate the veracity of personal experiences, and self-certainty, or the tendency to resist feedback and to be overconfident in evaluations (Beck et al., 2004). Previously, researchers have found that greater verbal learning and verbal memory abilities are associated with increased cognitive insight in patients and outpatients with first-episode schizophrenia (Buchy et al., 2010; Lepage et al., 2008; Orfei et al., 2010). Given these findings, we aimed to replicate and extend the previously observed link between verbal learning, verbal memory, and cognitive insight and its two components, self-reflectiveness and self-certainty. We hypothesized that poorer verbal learning and poorer verbal memory will be associated with decreased cognitive insight, lower self-reflectiveness, and greater self-certainty.

METHODS

Participants

Seventy-two individuals (51 men; mean age 43.13 [SD = 9.78]) were drawn from a larger study examining psychosocial and cognitive correlates of schizophrenia (see Table 1 for demographics). We recruited through advertisements in public transportation vehicles, radio commercials, newspapers, Web sites, and hospital referrals in the greater Miami area. The participants who met the criteria for schizophrenia or schizoaffective disorder were at least 18 years of age, were proficient in English or Spanish, and had not been hospitalized within the 3 months before the research study.

Measures

The Structured Clinical Interview for *DSM-IV* Axis I Disorders (SCID)–patient edition Psychotic Screener (First et al., 1996) was used to confirm diagnoses of schizophrenia or schizoaffective disorder. To establish interrater reliability, all the interviewers and the principal investigator watched six videotaped interviews and independently rated each question to determine an overall diagnosis. The interrater agreement using Cohen's Kappa was 1.0.

The Hopkins Verbal Learning Test (HVLT; Brandt, 1991) was used to assess verbal learning and verbal memory. The participants listened to a list of 12 words and then recited as many words as possible during three trials. We subtracted the number of correct responses from trial 1 from the number of correct responses from trial 3 to produce the verbal learning index. Twenty minutes after the recitation, the participants were asked to recite as many words from the original list as possible (delayed verbal recall memory index). The participants were then asked to listen to a list of 24 words and to identify the words that they recognized from the original list (verbal recognition memory index). We chose the HVLT because of its high reliability and validity and because it was included in the Measurement and Treatment Research to Improve Cognition in Schizophrenia Consensus Cognitive Battery as an optimal outcome measure for the evaluation of verbal learning and verbal memory functioning in schizophrenia (Nuechterlein et al., 2008).

We used confidence ratings from the source monitoring task (Vinogradov et al., 1997) to measure knowledge corruption. The

*Deparment of Psychology, University of Miami, Coral Gables, FL; and †Veterans Affairs Medical Center, Washington, DC.

Send reprint requests to Cristina P. Garcia, BA, Department of Psychology, University of Miami, 5665 Ponce de Leon Blvd, Coral Gables, FL 33146. E-mail: CristinaG@miami.edu.

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TABLE 1. Descriptive Statistics for Demographic and Study Variables

	Frequency, *n* (%)	Mean (SD)	Range
Language			
English	71 (98.6)		
Diagnosis			
Schizophrenia	29 (40.3)		
Schizoaffective disorder	43 (59.7)		
Ethnicity			
White	15 (20.8)		
African-American	40 (55.6)		
Hispanic	17 (23.6)		
Education			
Advanced degree	3 (4.2)		
College degree	5 (6.9)		
Some college	28 (38.9)		
High school graduate	19 (26.4)		
Some high school	14 (19.4)		
Never entered high school	3 (4.2)		
Medication type			
Typical antipsychotics	15 (20.8)		
Atypical antipsychotics	29 (40.3)		
Typical and atypical	8 (11)		
No medication	20 (27.8)		
Verbal learning		2.31 (1.82)	−2–7
Delayed verbal recall memory		5.72 (2.63)	0–11
Verbal recognition memory		10.07 (1.76)	4–12
Knowledge corruption		0.24 (0.16)	0–0.64
Cognitive insight		6.20 (7.04)	−8–23
Self-reflectiveness		13.87 (5.76)	3–25
Self-certainty		7.68 (4.18)	0–15

participants read 20 fill-in-the-blank sentences and made up a word (target) for each blank. The experimenter then created a test list of 20 word pairs using the noun from each sentence and the corresponding target word plus 10 new word pairs. For each pair, the subject determined whether the second word was previously unseen, a word that he/she made up, or a word from the original list. The subjects indicated the confidence in their response on a scale from 1 (not at all confident) to 5 (very confident; see Vinogradov et al. [1997] for a full description of the task). We derived the knowledge corruption index (Moritz and Woodward, 2002) from these confidence ratings; specifically, we divided the number of incorrect high-confidence responses (rated as 5) by the number of total high-confidence responses. No psychometric properties have been published for this task.

To assess cognitive insight, we used the Beck Cognitive Insight Scale (Beck et al., 2004), a 15-item self-report measure that assesses how individuals evaluate their judgments. Items were rated on a scale from 0 (do not agree at all) to 3 (agree completely). The responses were summed, yielding separate scores for each component (self-reflectiveness and self-certainty). We calculated the cognitive insight score by subtracting the self-certainty score from the self-reflectiveness score. Cronbach's alpha scores for self-reflectiveness and self-certainty were 0.81 and 0.75, respectively.

Procedures

After obtaining the informed consent, a trained doctoral student administered the SCID (First et al., 1996), and then a trained undergraduate research assistant administered the remaining measures.

RESULTS

Tests of kurtosis and skewness revealed normal distributions for all variables. Because 2% of the data were missing at random, multiple imputation was used based on individual functions from each participant's data (see Table 1 for mean scores, standard deviations, and ranges for the primary variables of study).

Preliminary Analyses

Associations between primary variables and potential demographic covariates are listed in Table 2. During the primary analyses, we controlled for age, sex, and atypical medication using partial correlations because these variables were associated with self-certainty, self-reflectiveness, and cognitive insight.

Primary Analyses

Delayed verbal recall memory and knowledge corruption formed the only significant relationship ($r = -0.24$, $p = 0.04$). Specifically, poorer delayed verbal recall memory was associated with increased knowledge corruption. Verbal learning and verbal recognition memory were not significantly associated with knowledge corruption ($r = -0.09$, $p = 0.47$; $r = -0.12$, $p = 0.35$, respectively). Verbal learning, delayed verbal recall memory, and verbal recognition memory were not significantly associated with cognitive insight (partial correlations controlling for atypical medication, $r = 0.09$, $p = 0.48$; $r = 0.09$, $p = 0.50$; $r = 0.15$, $p = 0.23$, respectively), self-reflectiveness (partial correlations controlling for sex and atypical medication, $r = -0.01$, $p = 0.93$; $r = 0.12$, $p = 0.35$; $r = 0.03$, $p = 0.79$, respectively), or self-certainty (partial correlations controlling for age, $r = -0.10$, $p = 0.42$; $r = -0.01$, $p = 0.93$; $r = -0.08$, $p = 0.55$, respectively).

DISCUSSION

As hypothesized, we found a significant relationship between poorer delayed verbal recall memory and increased knowledge corruption in individuals with schizophrenia. This relationship may exist because diminished memory capacity might increase susceptibility to false memory formation (Moritz and Woodward, 2006). Although it is understood that a poor memory base may produce false memories, it is not clear why patients would strongly believe false memories. One explanation comes from Moritz and Woodward's (2006) liberal acceptance theory, which claims that persons with schizophrenia make hurried decisions. This decision-making style is based on insufficient evidence, possibly because of a limited memory system, and may lead to overconfidence. Because the current study is the first to find an association between delayed verbal recall memory and knowledge corruption, replication studies are needed to confirm this relationship. If the finding is indeed robust, additional research will be necessary to clarify the mechanisms that link poorer delayed verbal recall memory in patients with schizophrenia with a bias toward having high confidence in false information.

Unexpectedly, we did not find associations between verbal learning, verbal memory, and overall cognitive insight or its component indices. Significant associations between these measures of neurocognition and cognitive insight have been found using the Rey Auditory Verbal Learning Test (Orfei et al., 2010), which includes 15 words, but have not been found using the HVLT (Cooke et al., 2010), which includes 12 words. Thus, it is possible that our null findings may be caused by the lack of sensitivity of the HVLT. Moreover, the most complete account of associations between neurocognition and cognitive insight is shown in patients experiencing first-episode psychosis (Lepage et al., 2008). Hence, the stage of psychotic illness may have a differential effect on the relationship of interest. We also note that differences in sample composition may account for the conflicting study results because the current study included subjects

TABLE 2. Pearson's and Spearman's Correlations, *t*-Tests, and One-Way ANOVA for Primary Variables and Potential Covariates

	Verbal Learning	Recall Memory	Recognition Memory	Knowledge Corruption	Cognitive Insight	Self−reflectiveness	Self-certainty
Age[a]	−0.13, $p = 0.28$	−0.30, $p = 0.01$	−0.17, $p = 0.17$	0.07, $p = 0.54$	0.16, $p = 0.18$	−0.01, $p = 0.93$	−0.29, $p = 0.02$
Sex[b]	−1.52 (70), $p = 0.13$	−1.17 (69), $p = 0.25$	−2.95 (67), $p < 0.01$	0.34 (70), $p = 0.73$	−1.47 (67), $p = 0.15$	−2.77 (68), $p = 0.01$	−1.30 (67), $p = 0.20$
Ethnicity[c]	0.11 (3, 68), $p = 0.90$	7.72 (3,67), $p < 0.01$	4.10 (3,65), $p = 0.02$	0.91 (3,68), $p = 0.41$	0.97 (3,65), $p = 0.39$	2.19 (3,66), $p = 0.39$	0.09 (3,65), $p = 0.94$
Education[d]	0.09, $p = 0.44$	0.31, $p = 0.01$	0.20, $p = 0.11$	0.15, $p = 0.21$	0.05, $p = 0.67$	−0.02, $p = 0.90$	−0.12, $p = 0.31$
Typical medication[a]	−0.13, $p = 0.27$	−0.13, $p = 0.27$	−0.08, $p = 0.51$	−0.14, $p = 0.23$	−0.05, $p = 0.70$	−0.01, $p = 0.96$	0.07, $p = 0.58$
Atypical medication[a]	0.07, $p = 0.55$	0.03, $p = 0.78$	0.04, $p = 0.75$	−0.02, $p = 0.88$	0.24, $p = 0.05$	0.28, $p = 0.02$	−0.01, $p = 0.96$

ANOVA indicates analysis of variance.
[a]Pearson's correlations.
[b]*t*-Tests; *df* reported in parentheses.
[c]One-way ANOVA; *df* reported in parentheses.
[d]Spearman's correlations.

with chronic psychosis and patients with first-episode psychosis, whereas earlier studies assessed only patients experiencing first-episode psychosis.

The current study is not without limitations. Our use of cross-sectional data prohibits conclusions of causation. Studies exploring the nature and correlates of neurocognition and cognitive biases longitudinally will be instrumental in assessing whether impaired delayed verbal recall memory precedes the development of knowledge corruption. Another limitation was our small, heterogeneous sample; a larger, more homogenous sample may better reveal associations between neurocognition and cognitive biases. It is possible that type II error or lack of power may account for the absence of associations between neurocognitive variables and cognitive insight. Other limitations of this study include the absence of patient symptom assessment and the absence of a comparison group. Future research might examine relationships among a range of neurocognitive deficits (Nuechterlein et al., 2004), cognitive biases, and symptoms in patients with schizophrenia compared with healthy controls.

CONCLUSIONS

The current study reveals an association between delayed verbal recall memory and knowledge corruption, which may provide evidence of a distinct cognitive profile with high confidence in a poor memory system. In accord with Moritz and Woodward (2006), we suggest that future research examine the effects of cognitive remediation on knowledge corruption to understand whether changes in neurocognition drive changes in knowledge corruption.

DISCLOSURE

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