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Cognitive Correlates of Schizophrenia Signs and Symptoms: III. Hallucinations and Delusions

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Abstract

We examined the cognitive correlates of hallucinations and delusions in 47 schizophrenia spectrum individuals. Hallucinations were significantly negatively correlated with performance on episodic memory tasks, and were not significantly associated with performance on tasks measuring fluency or concentration/attention. Although hallucinations were more strongly associated with performance on verbal than non-verbal memory tasks, the difference was not statistically significant. There was also a trend for hallucinations to be associated with poorer performance on working memory tasks, though this association was eliminated when episodic memory performance was taken into account. Delusions were not significantly associated with any of the cognitive measures.

Keywords

hallucinations; delusions; episodic memory; working memory

1. Introduction

Two important and very common symptoms of schizophrenia are delusions and hallucinations. Although both delusions and hallucinations are considered positive symptoms of schizophrenia, psychopathology researchers have often proposed very different mechanisms to explain them. For example, whereas hallucinations are often posited to be the result of disturbances in language processes and semantic memory (e.g., Hoffman and McGlashan, 1997; Hoffman et al., 1999), delusions are often posited to be the result of cognitive biases and misattributions (e.g., Garety and Freeman, 1999; Bentall et al., 2001).

Auditory hallucinations have often been hypothesized to be associated with disturbances in language processes and semantic memory (e.g., David, 1994; Hoffman et al., 1999; Kerns et al., 1999). To explore further the relation between hallucinations and memory, in the present study we examined the relation between hallucinations and episodic memory, working memory, and attention/concentration (in the form of immediate auditory memory). To explore whether hallucinations are associated specifically with semantic memory, we administered

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measures of both verbal and non-verbal memory. A growing body of theorizing and empirical research has begun to implicate several cognitive processes in the development of delusions. For example, there is evidence linking delusions to a “jumping to conclusions” reasoning bias and to a self-serving attributional bias (e.g., Garety and Freeman, 1999; Bentall et al., 2001). Although the present study was not designed to test hypotheses concerning the relations between delusions and cognitive biases and misattributions, we believe it can advance our understanding of delusions in at least two ways. First, to the degree that delusions turn out to have different cognitive correlates than do hallucinations, it provides support for the utility of developing separate models to explain delusions and hallucinations rather than merely searching for the cause of positive symptoms. Second, because cognitive disturbances, such as executive functioning and working memory deficits, are regularly found to be associated with schizophrenia (e.g., Park and Lee, 2003) as well as with some specific symptoms, such as formal thought disorder (e.g., Kerns and Berenbaum, 2002), it is important to explore whether such deficits also play a role in the development of delusions.

2. Method

2.1. Participants

The participants were the same 47 individuals with schizophrenia spectrum disorders (39 schizophrenia patients and 8 schizoaffective disorder patients) described in the accompanying reports (see Berenbaum et al., 2006 for additional information). All participants were receiving outpatient services at the time of their participation in the study. Psychiatric diagnoses were made using DSM-IV criteria following the administration of the psychotic and mood disorders sections of the Structured Clinical Interview for the DSM-IV (First et al., 1998) and a review of clinical records.

2.2. Measurements/Instruments

Additional information concerning all of the cognitive measures described below can be found in the accompanying paper by Berenbaum et al. Hallucinations and delusions were rated using the hallucinations and unusual thought content scales, respectively, of the Brief Psychiatric Rating Scale (BPRS; Lukoff et al., 1986). Ratings were made by the experimenter conducting the diagnostic interviews.

A total fluency score was computed by averaging across scores on verbal and design fluency tasks, which were first standardized (i.e., converted into z-scores). A total memory score was computed by averaging across scores on verbal and face memory tasks, which were first standardized. A total working memory score was computed by averaging across scores on reading span and A-X CPT tasks, which were first standardized. The Digits Forward subtest of the WAIS-R (Wechsler, 1981) was administered as a measure of attention/concentration.

2.3. Procedure

All participants were tested on the same day by the same two experimenters. One experimenter always administered the SCID, the arrangement tasks, and rated hallucinations and delusions using the BPRS, whereas the other experimenter always administered the remaining cognitive measures.

3. Results

Delusion ratings ranged from one to six ($M=2.2$; $SD=1.7$). Hallucination ratings ranged from one to seven ($M=2.1$; $SD=1.9$). Hallucinations and delusions were significantly correlated, $r = 0.62$, $P < 0.001$. Information concerning other symptoms can be found in the accompanying reports.

Associations were measured using Spearman rank order correlations since many of the score distributions were skewed. The associations between the symptom and cognitive measures are presented in Table 1. Hallucinations were significantly negatively correlated with performance on the episodic memory task, and there was a trend for hallucinations to also be negatively correlated with performance on the working memory task. Hallucinations were significantly more strongly correlated with episodic memory task performance than were delusions, $z=2.52$, $P<0.01$, and there was a trend for hallucinations to be more strongly correlated with working memory performance than were delusions, $z=1.38$, $P<0.09$. There were trends for hallucinations to be more strongly correlated with episodic memory performance than with fluency performance and digit span performance, $z=1.61$, $P<0.06$ and $z=1.33$, $P<0.10$, respectively.

Because hallucinations have been hypothesized to be associated with semantic memory, we explored whether the association we found between hallucinations and episodic memory functioning was specific to verbal memory. Although hallucinations were more strongly associated with performance on the verbal memory task ($r = -0.42$, $P < 0.01$) than with performance on the non-verbal memory task ($r = -0.20$, *NS*), both correlations were in the same direction and they did not differ significantly ($z = 1.26$, *NS*). We also explored whether the association between hallucinations and episodic memory performance would be eliminated when removing shared variance with working memory; the partial correlation was $r = -0.31$ ($P<0.05$), indicating that the association between episodic memory functioning and hallucinations were not an artifact of the association between working memory and hallucinations. In contrast, when removing shared variance with episodic memory functioning, the partial correlation between hallucinations and working memory was reduced to $r = -0.03$, *NS*.

Hallucinations were not associated with fluency or digit span performance. In contrast to hallucinations, delusions were not significantly associated with any of the cognitive scores.

4. Discussion

We found that hallucinations were significantly associated with performance on memory tasks, but were not associated with performance on fluency tasks or a digit span task. Delusions were not associated with performance on any of the cognitive tasks. The absence of significant correlations with fluency and digit span performance cannot be explained by psychometric shortcomings of these tasks, since in the same sample of individuals, these same tasks were significantly associated with verbal communication disturbances (see accompanying paper by Berenbaum et al.). The associations we found between symptoms and performance on cognitive tasks are extremely unlikely to be accounted for by generalized cognitive deficits since the different symptoms were differentially associated with different cognitive skills.

We found that hallucinations were not significantly associated with performance on the digit span task, which measures immediate auditory memory. We also found that although hallucinations were significantly associated with working memory, this association was eliminated when taking into account episodic memory. Thus, our results suggest that episodic memory may play a particularly important and perhaps specific role in the development of hallucinations. The results of the present study raise the possibility that the link between episodic memory and hallucinations may not be specific to verbal memory since hallucinations were not significantly more strongly correlated with the measure of verbal episodic memory than with the measure of nonverbal episodic memory. We recommend that future research administer multiple measures of verbal and nonverbal episodic memory to explore further the potential specificity of verbal memory to hallucinations. It will also be important to explore whether the associations between hallucinations and performance on episodic memory tasks

are a function of memory per se or are instead the result of disturbances in how information is encoded.

Despite being significantly associated with hallucinations, delusions were not significantly associated with any of the cognitive measures. We believe this has at least two important implications. First, these findings suggest it will be important to develop separate, specific, theory-driven models to explain delusions and hallucinations rather than developing broader, less specific models of positive symptoms. Second, these findings suggest that the cognitive biases that may contribute to delusions (e.g., jumping to conclusions bias) are not mere artifacts of cognitive deficits (e.g., working memory deficit). In fact, the results of this study raise the distinct possibility that cognitive biases may play a more important role than cognitive deficits in the development of delusions. Of course, it is possible that cognitive deficits not examined in the present study may prove to play an important role in the formation of delusions.

That delusions were not significantly associated with any of the cognitive measures may seem somewhat surprising given that delusions are such a central feature of schizophrenia, and cognitive deficits, such as disturbances in working memory, also appear to be an integral aspect of the disorder. However, when one considers that conviction in delusions waxes and wanes significantly over time, even over relatively brief periods of time, and cognitive deficits are more stable and may even be present prior to the onset of overt psychosis (e.g., Erlenmeyer-Kimling, et al., 1993), our finding that variations in the severity of delusions were not associated with cognitive functioning no longer seems so odd. Although we believe that cognitive deficits play an important role in influencing vulnerability to schizophrenia (and hence vulnerability to having delusions), we believe that cognitive factors are less likely to play as central a role in delusions as they are for other symptoms of schizophrenia, such as verbal communication disturbances. Although the results of the present study are clearly not sufficient to call off the search for cognitive deficits that may contribute to delusions, we believe our results suggest that it is likely to be fruitful to also look elsewhere, with emotional factors, particularly emotional awareness (Berenbaum et al., 2003), being a likely candidate contributing to delusions (Winters and Neale, 1983; Ciompi, 1997; Kerns and Berenbaum, 2000; Freeman and Garety, 2003; Berenbaum et al., in press).

The results of the research described in this and the accompanying two papers were consistent with our hypothesis that the different signs and symptoms of schizophrenia are differentially associated with different cognitive disturbances, and that the heterogeneity of schizophrenia signs and symptoms might be explained by heterogeneity in cognitive disturbances. For example, as expected, we found that working memory and planning ability were associated with disturbances in discourse coherence, whereas episodic memory was associated with hallucinations. We believe these findings highlight the need to develop and test specific hypotheses concerning individual signs and symptoms of schizophrenia rather than, or at least in addition to, developing and testing hypotheses concerning broad types of symptoms (e.g., positive symptoms) or schizophrenia as a whole.

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Table 1

Associations Between Hallucinations and Delusions Scores and Cognitive Variables

<u>Cognitive Variable</u>	<u>Hallucinations</u>	<u>Delusions</u>
Fluency	-0.04	-0.03
Episodic Memory	-0.34 *	-0.01
Working Memory	-0.27 †	-0.09
Digit Span	-0.10	-0.02
† $P < 0.09$		
* $P < 0.05$ (2-tailed)		