Cognitive Function and Symptoms in Adolescents with Schizotypal Personality Disorder

Hanan Trotman², Amanda McMillan², and Elaine Walker¹–²

¹Department of Psychology, Emory University

Cognitive deficits have been documented in schizophrenia and spectrum disorders. This study examines cognitive functioning and its relation to symptoms in adolescents with schizotypal personality disorder (SPD). Participants are 89 adolescents recruited for a study of youth at risk for Axis I disorders, especially psychosis. At intake, 34 met criteria for SPD, 38 for another Axis II disorder and/or conduct disorder (Other disorder—OD), and 17 did not currently meet criteria for any DSM-IV disorder (normal control—NC). At initial assessment, cognitive functioning was measured using subtests from the Wechsler Intelligence Scales and Wechsler Memory Scales (WMS), and symptoms were measured using the Structured Interview for Prodromal Symptoms (SIPS). At the time of this report, 50 were readministered the SIPS at 1-year follow-up (T2). The SPD group scored significantly below the NC group on the Arithmetic subtest of the Wechsler Intelligence Scales, but there was only limited evidence of group differences on the WMS. Poorer performance on the Wechsler Intelligence Scales was associated with greater severity of negative and disorganized symptoms. Deficits on the WMS were linked with more severe disorganized symptoms. The findings reported here are consistent with previous reports of limited cognitive deficits in adolescents with SPD, with the most marked deficits in mental arithmetic. The associations between symptoms and cognitive scores parallel those observed in adults with schizophrenia and spectrum disorder, and they are consistent with the notion that negative symptoms are more stable and partially reflect premorbid cognitive functions.

Key words: schizotypal/cognitive functioning/memory

Efforts to predict the development of schizophrenia and other psychoses have led investigators to focus on individuals who manifest behavioral signs of risk. Subclinical manifestations of psychosis, such as attenuated positive and negative symptoms, appear to be promising behavioral risk indicators.¹⁻⁵ These signs are observed in the prodrome to schizophrenia and are also key defining features of schizotypal personality disorder (SPD).

SPD is viewed by many as the prototype of the schizophrenia spectrum disorders.⁶ It is characterized by perceptual and ideational abnormalities, as well as interpersonal deficits.⁷ Numerous studies have demonstrated that SPD shares developmental, biological, and cognitive parallels with schizophrenia. SPD is often a developmental precursor of psychosis; during the prodromal period, typically in adolescence and early adulthood, schizophrenia patients often manifest a gradual decline in functioning that involves the development of SPD symptoms.⁸,⁹ It has been estimated that between 40 and 50% of those who meet SPD criteria in young adulthood, and show gradual functional decline, eventually develop an Axis I psychotic disorder.¹⁰,¹¹

The biological parallels between SPD and Axis I psychotic disorders extend to brain abnormalities and genetic vulnerabilities. For example, both schizophrenia and SPD patients have structural and functional abnormalities in frontal and temporal brain regions,⁷ evidence of dopamine dysregulation,⁷,¹² and dysregulation of the hypothalamic-pituitary-adrenal axis.¹³ With respect to genetic determinants, SPD is more common among first-degree biological relatives of schizophrenia patients, and the criteria for SPD were developed from characteristics of relatives of schizophrenia patients.¹⁴,¹⁵ It has been suggested that SPD is the most common phenotypic expression of the underlying genetic diathesis for schizophrenia-spectrum disorders.¹⁵ Finally, in the domain of cognition, research has shown that both SPD and schizophrenia are associated with deficits in a variety of functions, especially executive functions and memory.

It is now well established that schizophrenia is associated with generalized cognitive impairment, such that performance deficits have been detected on a range of cognitive tasks, including measures of general intelligence. However, some recent data indicate that deficits are more pronounced in certain areas,¹⁶ especially attention,¹⁶ verbal fluency,¹⁸ executive function,¹⁹ and memory.²⁰ Further, cognitive impairment in schizophrenia is...
not solely a consequence of the illness, as archival and prospective studies have revealed lower premorbid intellectual performance, as well as a decline in cognitive ability preceding clinical onset.1,21

There is evidence that cognitive deficits are part of the heritable diathesis for schizophrenia. The nonpsychotic, first-degree relatives of schizophrenia patients exhibit deficits in verbal working memory.2,21 Taken together, these findings indicate that cognitive deficit is a core feature of schizophrenia, rather than a secondary effect of medication, institutionalization, or symptoms.20,23,24

Cognitive deficits may be differentially correlated with various symptom dimensions of psychosis.17,25 Increased negative and disorganized symptoms in schizophrenia are associated with general intellectual impairment,26-28 as well as attention deficits29 and memory impairment.30 In a recent meta-analytic review, it was concluded that both the negative and disorganization dimensions of psychosis, but not positive symptoms, are associated with deficits in cognitive functioning.29

**Cognitive Deficits in Schizotypal Personality Disorder**

When compared with schizophrenia patients, individuals with SPD have similar, though less severe, cognitive deficits. They typically exhibit task performance between normal controls and schizophrenia patients.31 As with schizophrenia, there is some evidence of specificity in the cognitive impairments associated with SPD.

Most findings indicate that SPD in adults is characterized by relatively intact general intellectual functioning, with isolated domains of significant impairment.31-34 The cognitive domains that appear to be characterized by the greatest impairment in SPD are executive functions and verbal and spatial memory.7,33-35,38 Specifically, using the Wechsler Memory Scales (WMS), schizotypy in young adults is associated with deficits on immediate and delayed recall of the Logical Memory subtest and immediate and delayed recall of the Visual Reproduction subtest.22,33,39

Only a few studies have focused on cognitive performance in adolescents with SPD. Roitman et al.37 found that SPD adolescents showed deficits on the Arithmetic subtest of the Wechsler Intelligence Scales, but that they were not significantly different from normal controls on other subtests. Partially replicating these findings, a study of adolescents screened for military induction revealed that SPD was associated with generalized performance deficits, although the impairment was most pronounced for the Arithmetic test.40 Another study of SPD adolescents showed that, like adults with spectrum disorders, these patients showed significant deficits in executive function.41

Although there are relatively few published reports on the relation between cognition and symptom dimensions in SPD, there is some evidence that, as with schizophrenia, positive and negative symptom severity is differentially associated with cognitive performance. DiFrancesco, Walker, and Kestler41 found that more severe negative symptoms, but not positive symptoms, were linked with greater impairments in executive abilities and verbal fluency in SPD adolescents. A similar pattern was observed in a recent study of schizotypal symptoms in a community sample of adolescents.32 In contrast, Trestman et al.32 found that negative symptoms were associated with executive function, whereas positive schizotypy symptoms in adults were linked with poorer verbal fluency. Finally, Mitropoulou et al.33 reported that verbal working memory was inversely related to a measure of interpersonal deficit symptoms, a component of negative symptoms, in young adult patients with SPD. Thus, the general pattern of findings for SPD parallels those reported for schizophrenia, in that the negative symptoms of SPD show a stronger relation with cognitive deficits.

In summary, the etiologic and functional similarities between SPD and schizophrenia are well documented, and there is considerable evidence that some individuals with SPD are at heightened risk for developing Axis I psychotic disorders. Investigators are now focusing more attention on refining the prediction of risk for psychosis in individuals with SPD and other prodromal syndromes. Enhancing predictive power is, ultimately, a prerequisite for embarking on preventive intervention. At the same time, researchers are beginning to shift their focus to adolescence, the developmental period when prodromal signs often emerge and when opportunities for preventive intervention may be optimal.

Cognitive functions constitute a domain that holds promise for elucidating the trajectory that leads to the progression of more severe psychiatric symptoms in individuals with SPD. Of particular interest is determining whether cognitive factors are linked with specific symptom dimensions, both cross-sectionally and longitudinally.

In the present study we examine cognitive functions, especially memory, in SPD adolescents. As noted, adolescence is a critical developmental period for the onset and exacerbation of the prodromal signs of schizophrenia, but only a few studies have examined cognition in this group.41 Based on past reports, generalized intellectual deficit in SPD adolescents is not predicted, but it is hypothesized that they will manifest significant memory impairment. We target memory because of evidence that verbal and spatial working memory functions are areas of more pronounced impairment in both SPD and schizophrenia. Given theories linking memory substrates with vulnerability to psychotic symptoms,43 it is predicted that individuals with SPD will show deficits in immediate and delayed recall when compared with age-matched normal controls. Further, it is predicted that memory deficits will be linked with more severe negative and disorganized symptoms.
Methods

Participants

The present sample was drawn from a larger sample of adolescents participating in a longitudinal study of youth at risk for serious mental disorder: the Emory University Adolescent Development Project. The total study sample consists of 130 participants. Included in the present study are those participants who, at the initial assessment, met diagnostic criteria for SPD, another personality or conduct disorder (OD—other disorder), or no Axis II disorder (NC—normal control). Excluded from the normal comparison group were those who had a personal history of treatment (medication or consultation) for adjustment problems or a first-degree relative with a disorder. Clinical and demographic characteristics (means and standard deviations) for each diagnostic group are listed in Table 1. One year following the initial assessment, 50 of these participants (11 SPD, 24 OD, and 15 NC) underwent a follow-up assessment.

Consistent with previous reports, the rate of comorbidity was high, with 71% of the SPD participants also meeting criteria for another personality disorder, especially the Cluster A disorders, schizoid and paranoid. Among the OD group were children with the following diagnoses: schizoid, paranoid, antisocial, avoidant, histrionic, obsessive-compulsive, and narcissistic personality disorders, and conduct disorder.

Participants were recruited through announcements directed at parents of youth with adjustment problems. The announcement included a lay description of diagnostic criteria for SPD, although, as expected, the announcement elicited responses from parents whose children manifested a range of problems and met criteria for a variety of Axis II disorders. Healthy participants were recruited primarily through the Emory University registry of prospective research participants in the Atlanta area.

Parents of all prospective participants underwent telephone-screening interviews, and those likely to meet the study criteria were scheduled for assessment. Exclusion criteria were neurological disorder, mental retardation, an Axis I disorder, and current substance abuse/addiction. Written consent was obtained from all participants and a parent, in accordance with the guidelines of the Emory University Human Subjects Review Committee.

Measures

The assessment included the following battery of diagnostic measures: the Structured Interview for DSM-IV Personality Disorders (SIDP-IV), the Structured Interview for Prodromal Syndromes (SIPS), and the Structured Clinical Interview for Axis I DSM-IV Disorders (SCID). The SIDP was used to obtain Axis II diagnoses, and the SIPS was used to derive positive, negative, and disorganized symptom ratings.

The SIPS yields ratings of symptoms using a 6-point scale that ranges from 0 (asymptomatic) to 6 (severe, psychotic). Thus, the items on the prodromal symptom scale are on a continuum that includes frankly psychotic symptoms. The 3 SIPS symptoms scales used in the present study are positive (unusual thoughts/ideas, suspiciousness, grandiosity, perceptual abnormalities, conceptual disorganization), negative (social isolation, avolition, decreased expression of emotion, decreased experience of emotion, decreased ideational richness, deteriorated role function), and disorganized (odd behavior, bizarre thinking, trouble with focus and attention, impairment in personal hygiene or social attention). The scores for these 3 symptom dimensions were derived by averaging the scores received on each individual’s symptoms under that dimension. The alpha values for the positive, negative, and disorganized symptom composites were .84, .82, and .77, respectively. Training of raters on the SIPS yielded interrater reliabilities on these symptom scales that ranged from .78 to .86, with a mean of .83.

All structured diagnostic interviews were conducted by graduate-level psychologist examiners who underwent training to meet interrater reliability criteria. Research staff, including a licensed clinical psychologist and psychiatrist, then reviewed the videotaped interviews, as well as medical records and parents reports, to determine diagnostic status.

Wechsler Intelligence Scales

Intellectual ability was assessed with subtests from the Wechsler Intelligence Scales for Children, third edition (WISC-III, ages 11–15) or the Wechsler Adult Intelligence Scales, third edition (WAIS-III; ages 16–18), depending on the age of the participant. The subtests

Table 1. Subject Demographic Information

<table>
<thead>
<tr>
<th>Personality Disorder</th>
<th>Schizotypal Personality Disorder (SPD)</th>
<th>Other Personality Disorder (OD)</th>
<th>No Personality Disorder (NC)</th>
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<td>11</td>
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<td>Asian</td>
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<tr>
<td>Personality Disorder Comorbidity (%)</td>
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</table>
that were administered were Vocabulary, Similarities, Picture Completion, Arithmetic, and Block Design. These subtests were selected because they represent the range of functional domains tapped by the Wechsler Intelligence Scales.

Wechsler Memory Scales

The Wechsler Memory Scales, third edition (WMS-III) was used to measure immediate and delayed memory with both verbal and spatial material. The WMS-III subtests that were administered were Logical Memory I and II, Family Pictures I and II, and Letter-Number Sequencing. The selection of these subtests was based on past findings indicating that they are sensitive to deficits in individuals with schizophrenia and SPD.22,33,39

The Logical Memory subtest, a measure of verbal memory, has both an immediate (I) and delayed (II) component. Participants are initially asked to retell 2 orally presented short stories from memory to assess immediate recall, and following a time lapse of 15 to 25 minutes, participants retell both stories to assess delayed recall. Similarly, the Family Pictures subtest, a measure of spatial memory, also includes immediate (I) and delayed (II) components. Participants are exposed to a family photograph and various scenes depicting the family engaging in various activities. They are asked to recall details about the scene such as who was in the scene, where they were located, and what they were doing. In the Letter-Number Sequencing subtest, participants are presented with a string of alternating letters and numbers that gradually increase in length. They must repeat the numbers first in ascending order followed by the letters in alphabetical order, a task that is intended to assess working memory.47

Results

Preliminary analyses were conducted to test for the effect of demographics (sex, race, and age) on cognitive performance. These analyses revealed no significant relations between these factors and performance on any of the cognitive measures. There was also no evidence of an adverse medication effect on cognitive performance.

Analyses were also conducted to compare the subjects who underwent the Time 2 (T2) assessment with those who did not. The results revealed no differences for any cognitive or symptoms score, with the exception of Positive symptoms at baseline, which were marginally higher in those who did not participate in the second assessment, t(87) = 1.97, p = .05.

Finally, comparisons were conducted to determine whether there were any diagnostic group differences in age, gender ratio, or an index of socioeconomic status (maternal and paternal education). These comparisons yielded no trends toward significant differences. For all of the analyses described below, there was no significant main or interactive effect of sex when it was included as an independent variable. Thus, we report here on the analyses without sex as a predictor.

Diagnostic Group Differences in Symptoms

Multivariate analysis of variance (MANOVA) was conducted to compare the diagnostic groups on the 3 symptom scores. This analytic procedure is most appropriate for testing group differences in sets of correlated dependent measures. Symptom scores, by diagnostic group, are illustrated in the bar graph in Figure 1. As would be expected, there was a robust difference among the groups, F(Wilke’s Lambda) (6, 168) = 20.30, p < .001. The univariate tests for positive symptoms, F(2, 86) = 31.52, p < .001, negative symptoms, F(2, 86) = 31.41, MSE < 12.559, p = .001, and disorganized symptoms, F(2, 86) = 62.72, p < .001, were all highly statistically significant. T-test comparisons among the pairs of groups revealed that the SPD group scored significantly higher than the NC and OD groups on all 3 symptom dimensions, with all p-values < .001. The OD group scored above the NC groups on all 3 symptom dimensions, with all p-values < .01.

Diagnostic Group Differences in Intellectual Performance

Wechsler intellectual subtest scores by diagnostic group are presented in Figure 2. A MANOVA conducted on the scores yielded a significant effect of diagnostic group, F(Wilke’s Lambda) (10, 162) = 2.35, p = .02. Univariate ANOVAs indicated diagnostic group differences in performance on the Arithmetic subtest, F(2, 85) = 4.35, p = .02, with the SPD group scoring below the NC group (p < .05), but no other significant group differences. The univariate tests revealed no significant differences among the groups in performance on the Vocabulary, Similarities, Picture Completion, or Block Design subtests.

Wechsler Memory Scales

MANOVA revealed no significant difference among the diagnostic groups in performance on the WMS subtests; however, as Figure 3 illustrates, there was a consistent trend toward poorer performance by both the SPD and OD groups on many of the subtests. Comparison
of the SPD and NC groups did show a significant deficit in the SPD group, \( t(48) = 1.81, p < .05 \), on delayed recall on the Family Pictures subtest. No other paired group comparison was statistically significant.

The Relation Between Cognitive Performance and Baseline Symptom Ratings

The correlations among the cognitive and symptom scores for the entire sample, including the NC group, are presented in Table 2. As illustrated, the strongest relations are between the cognitive measures and the rating of negative symptoms, with poorer performance associated with more severe symptoms.

Regression analyses were conducted to examine the relation between cognitive scores and the symptom dimension scores (described above) for the SPD and OD groups. (The normal comparison sample was excluded from these analyses due to the low rate of symptoms in this group.) The 3 symptom scores (positive, negative, and disorganized) served as dependent variables in separate regression analyses, and the cognitive scores from each measure were the predictors, entered in a block. Analyses were first conducted for the combined samples, then separately for the SPD and OD groups.

For the combined groups, Wechsler Intelligence Scale subtest scores significantly predicted baseline ratings for disorganized symptoms, \( R = .45 \) (adjusted \( R^2 = .14 \)), \( F(5, 65) = 3.24, p < .01 \), and negative symptoms, \( R = .45 \) (adjusted \( R^2 = .14 \)), \( F(5, 65) = 3.21, p < .01 \). Significant individual predictors for negative symptoms were Picture Completion, \( t = -2.45, p < .02 \), and Arithmetic, \( t = -2.06, p < .05 \). For disorganized symptoms the Arithmetic subtest was significant, \( t = -3.57, p < .01 \).

Regression analyses for the separate groups showed that the Wechsler Intelligence Scale subtest scores significantly predicted negative symptoms at baseline for the SPD group, \( R = .71 \) (adjusted \( R^2 = .35 \)), \( F(5, 27) = 5.40, p < .001 \). Among the individual predictors, lower scores on the Picture Completion, \( t = -2.74, p < .01 \), and Similarities, \( t = -2.56, p < .01 \), subtests were associated with more severe negative symptoms. Subtest scores did not predict positive or disorganized symptoms for the SPD group, and none of the regression analyses were significant for the OD group alone.

For the analyses of WMS scores, the Family Pictures I and II scores were averaged and used as a single predictor, due to their high intercorrelation. The same set of regression analyses was then conducted with the scores from the WMS, and no significant relation was observed for the combined SPD and OD groups. For the SPD group, however, the memory scores were significant predictors of disorganized symptoms ratings, \( R = .56 \) (adjusted \( R^2 = .28 \)), \( F(4, 27) = 2.58, p < .05 \). Among the individual predictors, lower Letter-Number Sequencing subtest scores were associated with higher ratings for disorganized symptoms, \( t = -2.67, p < .02 \). Subtest scores did not predict positive or negative symptoms for the SPD group, and none of the regression analyses were significant for the OD group.

The Relation Between Cognitive Performance and Follow-Up Symptom Ratings

At this writing, all follow-up assessments have not been completed, so the findings of these analyses should be considered tentative. In testing the prediction of follow-up symptom scores, regression analyses were conducted with statistical control for baseline symptom ratings. Thus, the T1 symptom score was entered first, then the cognitive scores.

For the combined SPD and OD groups, regression analyses showed that Wechsler Intelligence Scale subtest scores were significant predictors of positive symptoms, \( R = .58 \) (adjusted \( R^2 = .21 \)), \( F(6, 33) = 2.81, p < .03 \), and negative symptoms, \( R = .63 \) (adjusted \( R^2 = .29 \)), \( F(6, 33) = 3.66, p < .01 \), but not disorganized symptoms. Marginally significant individual predictors were Similarities for negative symptoms, \( t = -2.02, p = .05 \), and Arithmetic for positive symptoms, \( t = -2.03, p = .05 \). Wechsler subtest performance did not, however, predict symptom scores when regression analyses were conducted on the separate groups. It should be noted that the statistical power for these analyses of follow-up data was low due to the small samples when the groups were analyzed separately.

Regression analyses using the WMS scores as predictors yielded no significant equations, indicating that
The present study of adolescents with SPD adds to the growing body of literature on cognitive functions and their symptom correlates in this disorder. Consistent with past reports, we find no pervasive intellectual deficits in adolescents with SPD, although Arithmetic subtest scores were significantly lower. But, contrary to prediction, we do not find marked deficits in memory performance. Instead, as documented in some previous reports, we observe selective impairments and associations with specific symptom dimensions.

Table 2. Correlations Among Cognitive Scores and Symptom Ratings

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<th>Vocabulary</th>
<th>Similarities</th>
<th>Arithmetic</th>
<th>Block Design</th>
<th>Logical Memory I</th>
<th>Family Pictures I</th>
<th>Letter-Number Sequencing</th>
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<th>Family Pictures II</th>
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<td>.117</td>
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*p = .05 (2-tailed); **p = .01 (2-tailed).
on the Letter-Number Sequencing task, which would also be expected to tap context-processing deficits.

In interpreting the pattern of differential group differences among the cognitive measures, it is important to keep in mind that the pattern may reflect differences among the measures in their discriminative power. It may be, for example, that certain tasks, such as arithmetic, are more sensitive to the deficits associated with SPD because of greater discriminative power. However, it is worth noting that the Wechsler IQ subtests are designed to be of comparable discriminative power with equal means and variances.

In contrast to some previous findings of memory deficits in SPD, we did not find a significant diagnostic group difference in performance on the Wechsler Memory Scales, although there were clear trends toward lower performance in both the OD and SPD youth. Also, the SPD group had significantly lower scores on delayed recall in the Family Pictures subtest. The absence of a diagnostic group difference in memory functions may indicate that the memory deficits associated with SPD in young adults are not yet apparent in adolescence. Nonetheless, we find that cognitive scores are associated with symptoms.

Cognitive Deficits and Symptom Dimensions in Schizotypal Personality Disorder

For the combined sample of SPD and OD adolescents, poorer performance on the Wechsler Intelligence Scales was linked with more severe negative and disorganized symptoms. The relation with negative symptoms was also apparent for the SPD group alone. This finding converges with the published reports on both schizophrenia and SPD. As noted above, general cognitive performance is typically found to be a stronger correlate of negative and disorganized symptoms than of positive symptoms. In a recent study of a community sample of adolescents found that those who scored lower on general cognitive ability, as measured with the WISC, had higher ratings on negative symptoms of schizotypy. In contrast, positive schizotypal symptoms were not associated with cognitive deficits in this study.

Taken together, the findings on the relations between intellectual performance and symptom dimensions have been interpreted to indicate that negative features of psychosis reflect more persistent phenomena that have continuity with premorbid functioning, especially cognitive functioning, while positive symptoms are more episodic in nature, waxing and waning in severity through the course of the illness. Our findings indicate that this extends to the negative dimensions of SPD.

In the present study the disorganized symptom dimension was also associated with cognitive performance in the SPD group. But the association only reached statistical significance for the WMS scores, especially on the Letter-Number Sequencing subtest, which is viewed as a measure of working memory that is sensitive to attentional deficits. Given that disorganized symptoms include ratings of "focus and attention," this finding indicates face validity of the symptom rating.

Analyses of the follow-up symptom data, available for a subgroup of participants, suggest that cognitive measures may predict the progression of symptoms. For the combined SPD and OD groups, poorer performance on the Wechsler Intelligence Scales was associated with more severe positive and negative symptoms at follow-up. This suggests that the SPD adolescents with the poorest cognitive performance may be at risk for worsening symptoms over time. Again, however, this must be considered tentative until follow-up assessments are completed. Nonetheless, the findings point to the potential utility of cognitive measures in the prediction of symptom progression in prodromal individuals. If subsequent follow-up data support and strengthen this finding, then cognitive measures may be included as part of a larger battery of measures aimed at identifying those at greatest risk for conversion to more serious psychopathology.

Conclusions

The present findings contribute to the growing body of literature that indicates that schizotypal symptoms can be reliably measured in adolescents and that the key symptom dimensions of SPD are differentially associated with cognitive functions in this group. As follow-up data accumulate, it will be possible to determine whether cognitive functions predict the longitudinal course of symptoms and, in particular, whether the combination of symptoms and cognitive measures predict conversion to Axis I psychotic disorders.

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References


