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Assessing declarative memory in schizophrenia using Wisconsin Card Sorting Test stimuli: the Paired Associate Recognition Test

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Abstract

The Paired Associate Recognition Test (PART) was developed to measure declarative memory using Wisconsin Card Sorting Test (WCST) stimuli, so that both tasks could be administered during functional neuroimaging to differentiate memory and executive function, and associated frontal and temporal lobe activation in schizophrenia. The current study was designed to compare PART and WCST performance in schizophrenic patients and to examine effects of medication and symptomatology. The PART, WCST, and standard declarative memory tasks were administered to 30 chronic schizophrenic patients and 30 matched healthy control subjects. Supporting task validity was the finding that patients were equally impaired on the PART and the WCST. Neuroleptics did not appear to affect performance. The effect of anticholinergic medication correlated negatively with WCST performance in a small subsample. Severity of schizophrenia-specific symptoms measured at intake on the Brief Psychiatric Rating Scale correlated negatively with performance on the WCST. These results support the application of the PART and WCST in future functional neuroimaging studies.

Keywords

Neuropsychology; Neuroleptic effects; Anticholinergic effects

1. Introduction

Schizophrenia is associated with neuropsychological impairments across cognitive domains (e.g., Malec, 1978; Goldstein, 1986; Goldberg et al., 1987). Within this context of diffuse dysfunction, there is evidence for selective impairment of declarative memory processes (i.e., retrieval of factual information; Squire, 1992). Memory studies of schizophrenia found impaired recall of word lists (Koh, 1978; Calev, 1984), rapid forgetting (Calev et al., 1983), and more pronounced impairment in new learning versus remote memory (Calev et al.,

1987). In a recent study of monozygotic twins discordant for schizophrenia, ill twins had preserved procedural memory but deficits in episodic processing, semantic encoding, and effortful retrieval (Goldberg et al., 1993b). Declarative memory functions appear more severely impaired than other cognitive domains in some samples (e.g., Goldberg et al., 1989; Saykin et al., 1991; Tamlyn et al., 1992).

Impaired declarative memory for words and faces in schizophrenia has been associated with the failure to activate hemispheric middle-temporal regions selectively in response to memory task demands (Gur et al., 1994a). Such findings have suggested temporal lobe dysfunction in schizophrenia that may underlie perceptual and thought disturbances such as hallucinations and delusions (e.g., Davidson, 1983; Frith and Done, 1988; Trimble, 1990). This is consistent with neuropathological findings of disturbed hippocampal cell orientation (Conrad et al., 1991), reduced intraneuronal structural proteins (Arnold et al., 1992), and magnetic resonance imaging evidence of abnormalities in mesial temporal lobe structures (e.g., Brown et al., 1986; Suddath et al., 1990).

Administration of neurobehavioral probes (Gur et al., 1992) during neuroimaging allows the direct linkage of brain physiology with behavior to test hypotheses about the topography of brain functions. The Paired Associate Recognition Test (PART; Ragland et al., 1995) was developed as a measure of declarative memory based on Wisconsin Card Sorting Test (WCST; Heaton, 1981) stimuli and response requirements, so that both tests could be used as comparable neurobehavioral probes during functional neuroimaging.

The WCST measures executive functions (concept formation, cognitive flexibility, and working memory). It is considered a frontal-lobe task because performance decrements are commonly linked to lesions of the frontal cortex (e.g., Milner, 1963; Heaton, 1981; for an exception, see Anderson et al., 1991). Application of the WCST as a neurobehavioral probe has suggested impairments in schizophrenia that have been associated with hypofrontal cerebral blood flow (CBF) (Weinberger et al., 1986). These findings have suggested the possibility of frontal-lobe impairment in the disorder.

Matching the stimulus and response characteristics of the PART and the WCST controls nontask-related perceptual and motor components as a means of better isolating specific task-related regional activity when both tests are used during neuroimaging. Administering the PART and the WCST during neuroimaging may make it possible to examine the relation between temporal and frontal lobe CBF with memory and executive function in schizophrenia. An important initial step, however, is to examine task performance in a patient sample (Gur et al., 1992).

The purpose of the present study was to examine performance on the PART and WCST in matched groups of healthy volunteers and patients with schizophrenia. Previous research on the PART has established its reliability and construct validity in a group of healthy volunteers (Ragland et al., 1995). Our goals were to establish whether patients would be impaired on the PART, compare relative performance on the PART and WCST, and examine whether clinical symptoms or medication correlated with either memory or executive performance.

2. Methods

2.1. Subjects

The subjects were 30 chronically ill right-handed patients with a *DSM-III-R* (American Psychiatric Association, 1987) diagnosis of schizophrenia (17 men and 13 women) and 30 healthy right-handed volunteers (16 men and 14 women). Hand, eye, and foot dominance was assessed following standard procedures (Raczkowski et al., 1974). Patients were matched to volunteers on age (patients: mean = 31 years, SD = 6.26; volunteers: mean = 28.4 years, SD = 6.89) and parental education (patients: mean = 12.52 years, SD = 1.75; volunteers: mean = 13.7 years, SD = 2.75). Matching was done on the basis of parent's rather than subject's years of education because illness disrupts educational attainment in schizophrenia (Resnick, 1992). Verbal intelligence (estimated from the Vocabulary subtest of the Wechsler Adult Intelligence Scale-Revised [WAIS-R]; Wechsler, 1981) was in the average range (scaled score: mean = 10.89, SD = 2.17) for the volunteers and in the average to low-average range for the patients (scaled score: mean = 7.96, SD = 3.23). Vocabulary data were not obtained for four patients and one volunteer.

Subjects were recruited and evaluated by members of the assessment team of the Mental Health Clinical Research Center (MHCRC) for Schizophrenia. They underwent comprehensive medical, neurological, neuropsychological, and psychiatric evaluations following previously described procedures (Shtasel et al., 1991, 1992a, 1992b). Subjects had no history of any present or past medical or neurological disorder or event that might affect central nervous system (CNS) function, except for schizophrenia in the patient group. Subjects had no history of other Axis I disorder including substance abuse. The normal comparison subjects had no known first-degree relatives with schizophrenia or affective illness as determined by a review of family history.

Five patients were not taking neuroleptic medication at the time of evaluation, and the remaining 25 were receiving an average chlorpromazine equivalent dose (Kaplan and Sadock, 1988) of 420 mg (range = 25–1200 mg). Eight neuroleptic-treated patients were also receiving bantzopine (mean dose = 1.56 mg, range = 0.5–2 mg). In addition, 12 patients were receiving anxiolytic medication, antidepressant medication or both. All patients were chronically ill, with mean age of onset of 21.7 years (mean $\pm$ SD; men: 20.3 $\pm$ 4.31; women: 23.5 $\pm$ 5.91), duration of illness of 9.3 years (men: 10.4 $\pm$ 5.98; women: 7.8 $\pm$ 5.62), and 1.1 ($\pm$ 1.2) hospitalizations before intake. Subtype diagnoses were as follows: 13 paranoid, 6 disorganized, 6 simple, 1 hebephrenic, and 4 mixed.

Patients had been previously enrolled in the MHCRC for an average of 3.23 years (range = 0–7.98 years) before the study began. Although no patient had previously performed the PART, seven of the patients had performed the WCST an average of 1.9 years before the current study as part of previous neuropsychological research (Saykin et al., 1991, 1994). Data for the 30 control subjects were drawn from a larger normative sample of 56 subjects (Ragland et al., 1995). This subsample of volunteers was selected on the basis of demographic characteristics without knowledge of task performance.

2.2. Clinical assessment

Clinical symptomatology was assessed with the Brief Psychiatric Rating Scale (BPRS; Overall and Gorham, 1980), the Scale for the Assessment of Negative Symptoms (SANS), and the Scale for the Assessment of Positive Symptoms (SAPS) (Andreasen, 1982a, 1982b) by investigators trained to a criterion reliability of 0.90 (intraclass correlation). These scales were administered both at intake and at repeated intervals in longitudinal follow-up, one of which coincided with the present study. Intake values were examined in addition to values at time of testing because they represent the patient's level of symptomatology during the acute phase of illness before stabilization on medication and have a greater range since they are not attenuated by treatment.

Measures on BPRS included a specific (e.g., conceptual disorganization, hallucinatory behavior, unusual thought content, and blunted affect) versus nonspecific (e.g., somatic concerns, anxiety, tension, and motor retardation) symptomatology index calculated by summing the respective BPRS items following previously described procedures (Gur et al., 1989). Mean Jres from the SANS included affect, avolition, anhedonia, and attention. The SAPS provided ratings of hallucinations, delusions, bizarre behavior, and positive formal thought disorder. Data from the BPRS, SANS, and SAPS were also combined using a procedure described by Gur et al. (1994b) that was designed to examine four statistically independent symptom dimensions: scale 1, negative symptoms; scale 2, disorganization; scale 3, Schneiderian delusions and hallucinations; and scale 4, suspicion-hostility.

2.3. Neuropsychological tasks

Data were obtained on four tasks in a single session: the PART, the WCST, and the Logical Memory and Visual Recall subtests of the Wechsler Memory Scale (WMS; Wechsler, 1945).

2.3.1. PART—Information about task construction, psychometric evaluation, and normative data on the PART are available elsewhere (Ragland et al., 1995). In brief, the PART contains six trials of four items each, in which subjects are first required to learn and then correctly recognize pairs of WCST stimuli after a delay. After a practice session, subjects are presented with four paired associates at a rate of 5 s each and, after a 2-min delay, are presented with four recognition probes in the same order. Paired associate stimuli consist of one of 64 WCST target cards arranged below one of four WCST 'key cards'. Recognition probes consist of one previously administered WCST target card presented under the array of four key cards. The subject's task for each recognition probe is to choose which of four key cards was previously paired with the target. Subject responses are recorded, scored as either true or false, and summed to obtain a total score out of a possible 24 correct responses. To ensure compatibility across tests, the total score was rescaled to standard equivalents (i.e., *z* score) with mean = 0 and SD = 1.

2.3.2. WCST—Subjects were administered a two-deck version of the WCST following standard administration and scoring procedures (Heaton, 1981). Number of categories and number of perseverative errors were calculated as dependent measures. Because larger values on WCST categories indicate better performance, and larger values on WCST

perseverative errors reflect worse performance, the latter measure was multiplied by (-1) to equate the meaning of task variables (i.e., larger values = better performance). Category and perseverative error scores were then rescaled to standard equivalents (i.e., z score) with mean = 0 and SD = 1. Standardized PART and WCST variables were used for data analysis, and raw variables were presented in text and figures to ease interpretation of results.

2.3.3. WMS Logical Memory and Visual Recall subtests—Declarative memory for auditorily presented stories and for visually presented geometric designs was assessed with the WMS Logical Memory and Visual Recall subtests (Wechsler, 1945). In addition to the standard immediate recall condition, recall after a 30-min delay was calculated according to the procedure established by Russell (1975). All the volunteers and 26 patients received the same (1945) WMS subtests. Because of an update of neuropsychological procedures in our laboratory, four of the patients received the WMS-Revised (Wechsler, 1987) subtests and were therefore not included in the examinations of correlations between PART and WMS variables (see data analysis).

2.4. Data analysis

Since there are gender differences in neuropsychological performance (e.g., Wiederholt et al., 1993) and in schizophrenia (e.g., Flor-Henry, 1990; Shtasel et al., 1992a), the comparison of patients and volunteers was accomplished by entering gender and diagnosis as class variables in a two (male, female) $\times$ two (patient, volunteer) $\times$ three (PART total score, WCST categories, WCST perseverative errors) multivariate analysis of variance (PROC OLM [General Linear Models Procedure], SAS Institute, 1987), with repeated measures for the third factor. Results were examined for main effects of gender and subject diagnosis, as well as for interactions between these two factors with test variable. Any main effects or interactions were decomposed with post hoc oneway analysis of variance. The significance criterion was set at $\alpha = 0.05$, two-tailed, for these and remaining tests unless otherwise specified.

Effects of neuroleptic or anticholinergic medication on executive and memory performance were examined by calculating correlations between PART and WCST task variables with neuroleptic and anticholinergic dose for medicated patients. Where distributions were normal, productmoment correlations were used for these and remaining correlations. Where distributions were not normal, Spearman's ρ was substituted. Correlation coefficients were also used to examine the effects of chronicity of illness by correlating age of onset, current age, and duration of illness with the PART and WCST variables.

Clinical improvement in the patients was examined by subtracting total BPRS, SAPS, and SANS scores at the time of testing from respective scores obtained at intake, dividing this difference by the intake score, and multiplying the result by 100. This % change score has an advantage over the conceptually simpler subtraction method (i.e., time 1 – time 2) because it compensates for extreme values at intake that could cause spurious regression to the mean effects. The % change scores were tested against the null hypothesis that they would equal zero by one-tailed t tests. The clinical indices obtained from the BPRS, SANS, and SAPS were then correlated with PART and WCST scores to examine clinical/

neuropsychological relationships. Finally, correlations between the PART and the WMS Logical Memory and Visual Recall subtests were calculated for patients to test if correlations previously obtained in the normative control sample could be duplicated in the current patient sample.

3. Results

3.1. PART and WCST performance

There was no main effect of gender, gender $\times$ diagnosis, or gender $\times$ test variable interaction (all $F < 1$, $df = 1,56$). Fig. 1 illustrates the performance of patients and volunteers on the PART and the WCST.

As can be seen, there was a main effect of diagnosis ($F = 11.05$, $df = 1,56$, $P = 0.0016$), with patients performing worse on PART total correct ($F = 11.60$, $P = 0.0012$); WCST categories ($F = 4.61$, $df = 1,56$, $P = 0.036$); and WCST perseverative errors ($F = 5.15$, $df = 1,56$, $P = 0.027$). Although the magnitude of patient impairment appeared greatest for PART (see Fig. 1), there was not a diagnosis $\times$ test variable interaction, indicating no difference in level of patient impairment between PART and WCST measures.

Because patients had lower WAIS-R Vocabulary subtest scores ($t = -3.9$, $P = 0.0003$), this measure was used as a covariate in a multivariate analysis with one classification (diagnosis) and three repeated dependent measures (PART total score, WCST categories, WCST perseverative errors). Patients remained impaired as assessed by the PART total score ($F = 4.64$, $df = 1,54$, $P = 0.035$), but not by WCST categories ($F = 0.23$, $df = 1,54$, $P = 0.6320$) or perseverative errors ($F = 0.37$, $df = 1,54$, $P = 0.54$) variables, suggesting that patient impairment on the WCST was related to more general differences in verbal intellectual abilities.

3.2. Medication effects

For the 25 patients who were receiving neuroleptic medications at time of testing, there were no significant correlations between medication dose and WCST or PART performance. In contrast, for the eight patients who were receiving anticholinergic medication, benztropine dose correlated with WCST number of categories ($r = -0.70$, $P = 0.049$) and, at a trend level, with WCST perseverative errors ($r = 0.68$, $P = 0.06$). Thus, in this small subgroup of eight patients, anti-cholinergic medication was associated with fewer categories (mean $\pm$ SD = 4.5 ± 3.9 vs. 5.04 ± 3.8) and more perseverative errors on the WCST (mean $\pm$ SD = 39.7 ± 28.1 vs. 21.0 ± 11.6).

3.3. Relationship with clinical symptomatology

In analyses of the effects of chronicity, there were no significant correlations between patient age, age of onset, or duration of illness with PART or WCST variables. As expected, patients improved clinically between intake and time of current testing. Whereas patients had been classified as mildly ill on total BPRS, SAPS, and SANS measures at intake (mean $\pm$ SD = 49 ± 8.6 , 45 ± 17.4 , and 58 ± 23.7 , respectively), they were not judged as ill on the same measures at time of testing. The % change score in total BPRS, SANS, and SAPS from

intake to time of testing was > 0 for all three measures ($t = 6.81$, $t = 5.26$, and $t = 6.88$, respectively, all $P < 0.0001$). Clinical indices at each time point were therefore examined separately.

Correlations between PART and WCST variables and the BPRS, SANS, and SAPS clinical indices were first calculated for intake data. BPRS symptoms specific to schizophrenia (BPSP) correlated negatively with numbers of categories on the WCST ($r = -0.38$, $P = 0.04$) and positively with WCST perseverative errors ($r = 0.41$, $P = 0.026$). Thus, greater severity of symptoms specific to schizophrenia was associated with lower category attainment and higher rates of perseverative responding. No other significant correlations were obtained for intake data (see Table 1). The same analyses for indices obtained at the time of testing revealed no significant correlations.

3.4. Relationship between PART and WMS

Because scores on immediate and delayed recall of both the Logical Memory and Visual Recall subtests were strongly correlated ($r = 0.93$ and $r = 0.87$, respectively; both $P = 0.0001$), scores from immediate and delayed conditions were averaged for subsequent analyses. In contrast to previous findings with a normative sample (Ragland et al., 1995), for the 26 patients with WMS data, PART performance did not correlate with the WMS Visual Recall score ($r = 0.20$, $P = 0.33$). In accord with earlier normative findings, the PART total score also did not correlate with Logical Memory subtest performance for the patient sample ($r = 0.43$, $P = 0.0007$).

4. Discussion

The purpose of this study was to examine performance of a matched sample of healthy volunteers and patients with fSchizophrenia on the PART and WCST before administering these tasks as neurobehavioral probes during physiologic neuroimaging studies designed to differentiate memory and executive function and associated frontal and temporal lobe activation in schizophrenia.

Supporting future application of this paradigm was the finding that patients showed impaired performance on both the PART and the WCST. Although there was no initial difference in patient impairment on the two tasks, when patient/volunteer differences in WAIS-R vocabulary performance were controlled, patients were no longer impaired on the WCST. This suggested that WCST impairment may have reflected more general differences in estimated verbal intellectual abilities. In accord with previous studies documenting minimal impact of neuroleptic medication on cognition (e.g., Spohn and Strauss, 1989), presence and dose of neuroleptic medication did not relate to either PART or WCST performance. However, anticholinergic medication dose correlated negatively with WCST performance. Indices of clinical symptomatology bore little relationship to PART or WCST performance, except that higher levels of schizophrenia-specific symptomatology at intake correlated with fewer categories and more perseverative errors on the WCST.

Patient impairment on the PART is consistent with previous research both within (Saykin et al., 1991, 1994) and outside of our laboratory (Goldberg et al., 1989, 1993b) in documenting

impaired declarative memory in schizophrenia. As a paired associate task, the PART uses a recognition format. Several investigators (e.g., Calev, 1984) have stressed that recognition memory is relatively spared by schizophrenia. However, others have attributed this result to issues of task difficulty, arguing that patients perform better on recognition tasks because this format is typically less difficult than free-recall conditions (Gold et al., 1992). Even though the PART uses a recognition format, it was designed to be moderately difficult (76% correct in the normative sample) to avoid possible ceiling effects or confounds with task difficulty. The level of performance on the PART (66.6% vs. 73.8% correct for patients and volunteers, respectively) argues that our effort to optimize the difficulty of the recognition format was successful.

Although the finding of WCST impairment in schizophrenia is consistent with other studies (e.g., Weinberger et al., 1986), it conflicts with previous research in our laboratory which indicated relatively normal performance on the WCST and differential impairment on learning and memory measures (Saykin et al., 1991, 1994). The current group of patients had a similar age of onset (21.0 vs. 20.76 years) and duration of illness (10.2 vs. 7.86 years) to those of the earlier patients described by Saykin et al. However, in contrast to the earlier patients, who were either neuroleptic naive or medication free for a period of at least 2 weeks, the current patients were receiving neuroleptics and, in a subgroup, anticholinergic medication. This difference in medication status may account for the discrepancy.

Although anticholinergic medications are typically associated with disruption of memory functions (Drachman, 1977), there is some evidence supporting our finding that cholinergic imbalance contributed to executive impairments. In a study of three psychiatric patients who had experienced toxic effects from anticholinergic medication, Galdi (1993) proposed that medication was interfering with performance on executive tasks by disrupting inhibition of previously learned sets, thus resulting in high levels of perseverative responding. A linkage between Alzheimer's dementia, which involves a putative decrease in cholinergic function (Coyle et al., 1983), and executive impairment (e.g., Fuld et al., 1981) also supports the explanation that patients receiving benztropine were particularly impaired on the WCST because of disrupted cholinergic function. However, the subgroup of patients receiving benztropine was very small, and this finding requires replication.

In examinations of the relationships between symptomatology and cognition, executive deficits have been more frequently associated with negative symptoms such as anhedonia and anergia than with positive symptoms such as hallucinations and delusions (see Breier et al., 1991). However, the opposite was found in one study (Morrison-Stewart et al., 1992), while others have linked reductions in WCST performance to nonparanoid subtypes (e.g., Rosse et al., 1991), to severity of Kraepelinian symptoms (e.g., Braff et al., 1991), or to overall clinical severity regardless of subtype (Bornstein et al., 1990). The results of the present investigation are more consistent with the report of Bornstein et al. (1990), in suggesting that worse executive performance was related to overall severity of symptoms specific to schizophrenia regardless of subtype. However, a longitudinal study of 13 patients with schizophrenia (Goldberg et al., 1993a) found that improvements in psychiatric symptoms bore little relation to WCST or other task performance, suggesting that cognitive deficits are relatively independent of symptomatology. Future longitudinal studies that

correlate performance on psychometrically matched neuropsychological tasks with treatment effects and clinical outcome measures are clearly needed to determine the functional significance of psychiatric symptoms and to identify any neuropsychological function $\times$ symptom $\times$ subtype interactions.

Several possible methodological limitations of this study should be considered. As described in the Methods section, although the normal volunteers had not been exposed to the neuropsychologic tests, seven of the patients had performed the WCST during a previous evaluation. It is therefore possible that practice effects could have improved patients' WCST performance, thereby obscuring or reducing group differences. However, since patients remained impaired on the WCST, it does not appear that significant practice effects occurred. This finding is consistent with evidence that prior exposure, and even specific training, does little to improve WCST performance in schizophrenia (Goldberg et al., 1987).

Another potential problem is that task difficulty was not strictly matched between PART and WCST tasks, or between different measures of WCST performance. Chapman and Chapman (1978, 1989) point out that to infer that a group's performance is more impaired on one task than another (differential deficit), it is essential that both tasks have similar reliability and true score variance because, if not, the group will appear more impaired on the task with higher reliability and variability regardless of the group's ability. It is therefore possible that group $\times$ test variable interactions were obscured because psychometric properties of the two tasks were not identical. To address issues of differential deficit, future studies may need to develop psychometrically equivalent measures of different cognitive domains instead of relying on combinations of existing clinical neuropsychological tests that were not developed with this issue in mind.

In summary, the current results for matched groups of healthy volunteers and patients with schizophrenia continue to support the validity of the PART as a measure of declarative memory. As is also true for the WCST, performance on this task is impaired in schizophrenia. The test is relatively insensitive to medication effects and differences in clinical symptomatology, and it correlates well with standard measures of declarative memory for verbal and visual-spatial information in a nonnative sample. These combined findings support the application of the PART and WCST as neurobehavioral probes in future functional neuroimaging studies.

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Fig. 1.

Mean ($\pm$ SE) performance of normal control subjects (gray bar) and schizophrenic patients (striped bar) on Paired Associate Recognition Test total correct (PARTOT), Wisconsin Card Sorting Test number of categories (WCSTCAT), and Wisconsin Card Sorting Test number of perseverative errors (WCSTPE). Significance levels of group differences are indicated by asterisks: ** $P < 0.0001$; * $P < 0.05$.

Table 1Correlations between PART and WCST with clinical scale variables measured at intake ($n = 30$)

Clinical scale variable	PARTOT	WCSTCAT	WCSTPE
BPRS	<i>r</i> -0.06938	-0.37735	0.40582
specific symptoms	<i>P</i> 0.7156	0.0398	0.0261
BPRS	<i>r</i> -0.22415	0.00000	-0.16992
non-specific symptoms	<i>P</i> 0.2337	1.0000	0.3693
SANS	<i>r</i> 0.19747	0.13585	-0.05372
affective flattening	<i>P</i> 0.2956	0.4741	0.7780
SANS	<i>r</i> -0.09945	-0.19415	0.31284
alogia	<i>P</i> 0.6011	0.3039	0.0923
SANS	<i>r</i> 0.17498	0.01007	0.18306
apathy	<i>P</i> 0.3550	0.9579	0.3329
SANS	<i>r</i> 0.34109	0.24107	-0.18308
anhedonia	<i>P</i> 0.0651	0.1994	0.3329
SANS	<i>r</i> -0.22814	-0.19815	0.12308
attention	<i>P</i> 0.2253	0.2939	0.5170
SAPS	<i>r</i> -0.19150	-0.10994	-0.06666
hallucinations	<i>P</i> 0.3107	0.5630	0.7264
SAPS	<i>r</i> -0.18854	-0.09407	0.12196
delusions	<i>P</i> 0.3184	0.6210	0.5209
SAPS	<i>r</i> 0.01383	-0.06385	0.27134
bizarre ideation	<i>P</i> 0.9422	0.7375	0.1469
SAPS	<i>r</i> -0.09299	-0.1384	0.32248
thought disorder	<i>P</i> 0.6250	0.4658	0.0822
Scale 1	<i>r</i> 0.08018	0.06043	0.02480
negative	<i>P</i> 0.6736	0.7511	0.8965
Scale 2	<i>r</i> -0.09156	-0.20281	0.35692
disorganized	<i>P</i> 0.6304	0.2824	0.35692
Scale 3	<i>r</i> -0.23494	-0.16318	0.05888
Schneiderian	<i>P</i> 0.2114	0.3889	0.7573
Scale 4	<i>r</i> -0.18801	0.03945	0.22413
paranoid	<i>P</i> 0.3198	0.8360	0.2338

Note. PARTOT, Paired Association Recognition Test total correct; WCSTCAT, Wisconsin Card Sorting Test number of categories; WCSTPE, Wisconsin Card Sorting Test number of perseverative errors; BPRS, Brief Psychiatric Rating Scale; SAPS, Scale for the Assessment of Positive Symptoms; SANS, Scale for the Assessment of Negative Symptoms. Significant correlations are in boldfaced type.