

## Cognitive Impairment Consistent with Left Fronto-Temporal Abnormality in Schizophrenic Patients

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*In an effort to explore further the nature of the cognitive impairment associated with schizophrenia, fourteen Patients who met either RDC or DSM III-R criteria for schizophrenia and ten control subjects were administered neuropsychological tests sensitive to specific domains of cognitive functioning. These included measures of general intelligence, attention, verbal and nonverbal episodic memory, semantic memory, word fluency, design fluency and cognitive flexibility (Wisconsin Card Sorting). Patients with schizophrenia, although impaired on the measure of general intelligence, were found to have unimpaired attention. These patients were impaired on all four measures of verbal memory but not on measures of nonverbal memory or semantic memory. The schizophrenic group also showed impairment in word fluency and on the Wisconsin Card Sorting Test but not on design fluency. Taken together, these findings represent a Pattern of cognitive impairment consistent with the presence of left fronto-temporal abnormality.*

### Introduction

During recent years various attempts have been made to approach the problem of the neurobiological basis of schizophrenia through the study of the performance of patients with this disorder on neuropsychological tests. This work has yielded data consistent with a number of hypotheses regarding the biological basis of schizophrenia. It has been conceptualized as a frontal-lobe disorder (Franzen & Ingvar, 1975), a temporal limbic disorder (Alpert & Martz, 1977), a disorder of left hemisphere function (Berman & Weinberger, 1986) and as a disorder of brain-stem function (Meltzer, 1987). However, the interpretation of these studies has been complicated by many methodological problems (Seidman, 1983). In particular, many of these studies have failed to establish rigorous criteria for subject selection. Furthermore, many of the tests utilized have lacked specificity both in terms of the cognitive processes which they tap and the locus of brain dysfunction to which they are sensitive, thus limiting the extent to which inferences regarding cognitive processing and brain function may be drawn on the basis of their results. The present study seeks to overcome these problems through the use of highly reliable diagnostic measures and through the utilization of neuropsychological tests which have been demonstrated to reveal specific impairments in patients with well localized cortical lesions (Milner, 1975).

### Method

#### Subjects

A total of 14 patients who met either the DSM-III-R criteria or the Research Diagnostic Criteria (RDC) for Schizophrenia and 10 control subjects without a psychiatric disorder and matched with the patient group for age and education were studied. Because of unavoidable logistical factors, not all subjects were tested on every measure (see Table 1). All subjects in the

Schizophrenic group were psychiatric inpatients admitted to an acute-care private psychiatric hospital. None of the patients had any history of neurological illness, head trauma or substance abuse, and none had clinically obvious signs of neurological disease at the time of testing. All patients were taking neuroleptic medication at the time of testing. None of the patients had received electroconvulsive therapy within the previous twelve months. All testing was done individually during sessions that did not exceed one hour.

**Materials**

The tests employed were measures of general intelligence, immediate memory (attention), verbal and non-verbal episodic memory, semantic memory and frontal-lobe function. Unless otherwise specified, these tests are described in Milner (1975). General -Intelligence. Subjects were administered the Wechsler Adult Intelligence Scale-Revised (WAIS-R). -Immediate Memory, The Digit Scan Subtest from the WAIS-R was administered as a measure of attention. The score was the raw score for that subtest. Delayed Story Recall. Each subject heard the first story from the Wechsler Memory Scale (Story A) and a meaningful narrative story (Story C) played on a tape recorder. After a fifty-minute delay and without warning they were required to recall as much of the contents of each story as possible. Their recall was recorded on a tape recorder, transcribed and scored in terms of "idea units". The maximum scores for Stories A and C were 24 and 18 respectively. Paired-Associate learning and Delayed Recall. The paired associate subtest from the Wechsler Memory Scale was administered (maximum score = 21). Forty minutes later, and without warning the delay condition was administered (maximum score = 10). Delayed Recall of Rey-Osterrieth Complex Figure. Subjects were given five minutes to copy the Rey-Osterrieth Figure. Forty minutes later, and without warning, they were given a recall test. Recall was scored according to standard procedures (Lezak, 1976), with a maximum score of 36. Face Recognition. Subjects were given a forced-choice face recognition test comprised of fifty items (Warrington and James, 1967). Semantic Memory. A Semantic Fluency Test which required subjects to produce as many exemplars from each of three categories (Newcombe, 1959) was administered. The three categories were objects, animals, and birds alternating with colors. Subjects were given one minute for each category. The score was the total number of names correctly produced. -Frontal-Lobe Function. Subjects were given the Wisconsin Card Sorting Test. The score for this test was the total number of categories sorted, using 128 cards. The maximum score was 11. The Chicago Word Fluency Test, which requires subjects to write down as many words as they can beginning with the letter 'IS" in five minutes (S-5 condition) and as many four-letter words beginning with 'IC" (C-4 condition), was administered. The score for each condition was the number of words written. A Design Fluency Test Uones-Gotman & Milner, 1977), which required subjects to produce as many line figures as possible without constraints (free condition) and as many as possible using four lines (fixed condition), was administered. The score for each condition was the number of designs produced.

**Table 1**

<b>Test</b>	<b>N</b>	<b>Schizophrenic</b>	<b>N</b>	<b>Control</b>	<b>T-Value</b>	<b>DF</b>	<b>P-Value</b>
<b>General Function</b>							

Full-Scale 10	9	85.11	3	114.00	5.93	10	0.001
WAIS-R Digit Span	14	13.36	10	14.80	1.06	22	NS
<b>Temporal Function</b>							
Story A-Delay	10	3.70	10	10.50	3.98	18	0.001
Story C-Delay	13	7.00	8	14.13	4.53	19	0.001
Paired Assoc. Learning	11	11.91	10	15.60	2.21	19	0.039
Paired Assoc.-Delay	10	7.5	10	9.10	2.36	18	0.030
Rey-Delayed	13	14.69	10	16.30	0.26	21	NS
Face Recognition	8	36.50	9	39.11	0.97	15	NS
Newcombe Fluency	11	52.55	8	63.75	1.53	17	NS
<b>Frontal Lobe Function</b>							
Chicago Word S-5	10	29.30	10	42.10	2.61	18	0.018
Chicago Word C-4	10	7.00	10	14.00	3.55	18	0.002
Gotman Design-Free	7	14.71	10	22.60	1.46	15	NS
Gotman Design-Fixed	7	8.14	10	17.00	1.99	15	NS
Wisconsin Card Sorting	14	2.86	9	7.55	5.31	21	0.001

### Procedure

Testing sessions lasted a maximum of one hour for the patients and up to two hours for the control subjects.

### Results

Table I shows the mean scores for the schizophrenic group and the control group on each of the tests administered. Statistical analysis was by independent group t-tests and the results of these tests, together with their respective significance levels, are also shown in Table 1. As may be seen, the schizophrenic group has a significantly lower Full Scale IQ than the control group, but the two groups did not differ on the Digit Span Subtest of the WAIS-R. In addition, the schizophrenic group was impaired in the delayed recall of both stories as well in the learning and delayed recall of paired associates. In contrast, the schizophrenic group was not significantly different from controls on the Rey-Osterrieth Delayed Recall and on Face Recognition. Turning to tests sensitive to frontal-lobe abnormality, the schizophrenic group was impaired on both conditions of the Chicago Word Fluency Test and on the Wisconsin Card Sorting Test. There was no difference between the patient group and the control group on either condition of the Design Fluency Test.

## Discussion

The present findings indicate that whereas patients with schizophrenia exhibit a lower IQ than control subjects, their attentional processes, as measured by the WAIS-R Digit Span, are unimpaired. Within the domain of memory, patients with schizophrenia were impaired on measures of recent verbal memory, including the delayed recall of two prose stories and the learning and delayed recall of verbal paired associates. In contrast, face recognition and the delayed recall of the Rey-Osterrieth Complex Figure were unimpaired. These findings are consistent with the presence of left, but not right temporal-lobe abnormality. When tests sensitive to frontal-lobe abnormality are considered, the schizophrenic group was found to be impaired on the Wisconsin Card Sorting Test and the Chicago Word Fluency Test, but not the Jones-Gotman Design Fluency Test, suggesting the presence of left frontal lobe abnormality. Taken together, these findings suggest that at least some patients with schizophrenia exhibit a pattern of cognitive impairment which is consistent with left fronto-temporal abnormality and thus lend support to the hypothesis that a disruption of processing within these structures is associated with this disorder (Berman, Zec & Weinberger, 1986). Further study is required to determine the generality of these findings and the extent to which these impairments in cognition reflect the presence of primary factors in the etiology of schizophrenia as opposed to secondary effects of the psychiatric disorder.

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