Language Comprehension in Schizophrenics and Their Brothers

Ruth Condray, Stuart R. Steinhauer, and Gerald Goldstein

Disturbances in language functioning may be associated with familial vulnerability to schizophrenia. Language comprehension, measured by the Luria-Nebraska Relational Concepts Factor Scale, was evaluated in 36 schizophrenic probands and their nonschizophrenic adult brothers (n = 41), and in 18 normal controls. Language comprehension performance was a function of psychiatric diagnosis in the brothers. Brothers who met criteria for schizophrenia-spectrum disorders showed significantly reduced language performance compared with unaffected brothers and normal controls. Moreover, abnormal language performance was exhibited by significantly more probands and spectrum-disordered brothers than by the normal controls and the brothers without schizophrenia-spectrum disorders. Finally, language performance was not significantly different for 31 pairs of schizophrenic probands and their brothers. Impaired language comprehension appeared comparatively specific in this sample of relatives, as groups were not significantly different on measures of nonlinguistic concept formation (Wisconsin Card Sorting Test) and general intellectual functioning (WAIS-R Information and Block design). Results suggest that impaired language comprehension is associated with familial vulnerability to schizophrenia, and that this disturbance may be most severe in relatives diagnosed with schizophrenia-spectrum disorders.

Introduction

Disordered language has long been considered a diagnostic indicator of schizophrenia (American Psychiatric Association 1987; Bleuler 1911/1950; Kraepelin 1919), though the mechanisms underlying this symptom remain unclear and controversial (Maher 1991; Schwartz 1982). Some have suggested that the language disturbances of schizophrenics are likely due to nonlinguistic factors, such as abnormalities of thought (Brown 1973; Fromkin 1975) or deficits in information processing (Frith 1987; Schwartz 1982). Others have argued that the disturbances involve dysfunctions of basic linguistic systems (Chalk 1974; Faber and Reichstein 1981). Despite the theoretical debate, there is general agreement that the language functioning of many schizophrenics is characterized by difficulties, such as reductions in the cohesion (Rochester and Martin 1979; Wykes and Leff 1982) and syntactic complexity (Morice and Ingram 1983; Morice and McNicol 1986) of speech production.
An important component of general linguistic functioning is language comprehension, which includes the ability to understand relationships expressed in logical and complex grammatical constructions. Impaired language comprehension, which often characterizes aphasic patients (Goodglass and Kaplan 1983), has also been observed in schizophrenics (Faber and Reichstein 1981; Green et al 1979; Kugler 1983; Morice and McNicol 1985; Purisch et al 1978; Shelly and Goldstein 1983) and their children (Hallett and Green 1983). This language capacity may be particularly relevant to the neuropathology of schizophrenia because of its association with the functional integrity of the anterior language area, which includes portions of the temporal lobe (Benson and Geschwind 1985; Luria 1980). Both frontal and temporal brain systems have been implicated in recent models of the neuropathology of schizophrenia (Cohen and Servan-Schreiber 1992; Gray et al 1991; Gruzelier et al 1988; Levin 1984; Morice 1986; Seidman 1983; Weinberger 1987).

Disordered language may represent a “mediating vulnerability marker,” which refers to characteristics that typically depict from normal levels, but which vary with state fluctuations, such as exacerbations in symptomatology or changes in medication status (Nuechterlein and Dawson 1984). For example, clinical thought disorder shows the characteristics of such a “mediating vulnerability marker” in that while thought disorder persists in schizophrenic patients during periods of remission, the severity varies with clinical and medication status (Andreasen and Grove 1986; Harrow and Marengo 1986; Spohn et al 1986). Moreover, Morice and Ingram (1983) observed an association between schizophrenics’ age of onset and reductions in the syntactic complexity of their speech, and suggested that reduced linguistic complexity may reflect risk for schizophrenia.

Language dysfunction observed in the non schizophrenic adult relatives of patients may reflect familial vulnerability to schizophrenia (Zubin and Spring 1977; Zubin and Steinhauser 1983). More importantly, the specificity of this potential trait can be evaluated by examining language performance as a function of the psychiatric diagnosis of nonschizophrenic relatives. If language difficulties are observed in relatives with psychiatric disorder, in general, then the dysfunction may be associated with nonspecific psychiatric disturbance. However, if language impairment is restricted to those relatives with schizophrenia-spectrum disorders, then this dysfunction may be associated primarily with the schizophrenia-spectrum.

The present study addressed the following questions: (1) Will the nonschizophrenic relatives of schizophrenic probands exhibit impaired language comprehension, thereby suggesting a general association of language dysfunction and familial vulnerability to schizophrenia? (2) Will impaired language comprehension be observed as a function of psychiatric disorder in the relatives? Specifically, will language performance be more impaired in relatives with psychiatric disorders, in general, than in unaffected relatives, thus reflecting an association with nonspecific psychiatric disturbance; or will language functioning be more impaired in relatives diagnosed with schizophrenia-spectrum disorders, thereby suggesting an impairment specific to type of psychiatric disturbance?

These issues were examined by measuring language comprehension in clinically stable schizophrenic outpatients and their nonschizophrenic adult brothers, and in normal controls. The test of language comprehension used was the Luria-Nebraska Relational Concepts Factor Scale, which has been successful in discriminating the relatives of schizophrenics from controls in previous studies in our laboratory with smaller samples (Condray and Steinhauser 1992; Watson 1988). Additional measures were included to test the comparative specificity of language dysfunction, namely, measures of nonlinguistic con-
Table 1. Characteristics of Sample^a

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Schizophrenia</th>
<th>Schizophrenia-</th>
<th>Nonspectrum</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 36)</td>
<td>spectrum disorder</td>
<td>disorder</td>
<td>disorder</td>
</tr>
<tr>
<td>Age</td>
<td>36.7</td>
<td>35.9</td>
<td>39.5</td>
<td>35.7</td>
</tr>
<tr>
<td>(6.6)</td>
<td>(6.5)</td>
<td>(6.6)</td>
<td>(10.1)</td>
<td>(5.8)</td>
</tr>
<tr>
<td>Education (yr)</td>
<td>12.7</td>
<td>12.4</td>
<td>13.4</td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td>(1.8)</td>
<td>(0.9)</td>
<td>(2.4)</td>
<td>(1.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1.8)</td>
</tr>
</tbody>
</table>

^aMean (SD).

cept formation (Wisconsin Card Sorting Test), and general intellectual functioning (WAIS-R Information and Block design subtests).

Methods

Subjects

Subjects included 36 male schizophrenic probands, 41 brothers of patient probands, and 18 normal male controls with no lifetime diagnosis of psychiatric disorder who were recruited from the general population. All subjects participated in the ongoing Pittsburgh Vulnerability Study, which includes a protocol of behavioral, neuropsychological, and psychophysiological measures that are administered to schizophrenic probands and their family members. The data reported in the present study were drawn from that protocol.

Table 1 presents the characteristics of the sample. In the larger Vulnerability Study, only brothers and normal controls were matched on age and education. For the primary analyses in the present study, however, all groups were matched on age and education due to the well-documented association between these demographic variables and the neuropsychological measures of interest (Heaton et al 1991). Matching in the present study was accomplished by excluding those cases with extreme values for age and education until group differences were not statistically significant for these variables. In contrast, all available proband-sibling pairs were used in the analysis of matched pairs. As anticipated, the majority of probands were unemployed, whereas nonpatient subjects were employed in a variety of positions that ranged across semiskilled and skilled manual, clerical, sales, and technical occupations.

Schizophrenic probands were identified through the Highland Drive VA Medical Center in Pittsburgh. Probands did not participate in the neurocognitive testing if they had conditions that fell under the general exclusion criteria described below. This resulted in a slight increase in the sample size of the sibling group over that of the proband group.

Informed consent was obtained from probands to contact their first-degree family members, and brothers were selected randomly within each family for recruitment contact. Random selection of brothers within each family was accomplished to control for potential selection biases.

Normal controls (no Lifetime Diagnosis of Psychiatric Disorder-Axis I or Axis II) were selected from among individuals who responded to an advertisement that stated an interest in testing the information processing capacities of normal, healthy adult males.

Exclusion Criteria. General exclusion criteria included a history of chronic major
intellectual functioning

Table 2. DSM-III AXIS I Diagnoses of Male Siblings of Schizophrenic Probands

<table>
<thead>
<tr>
<th></th>
<th>Affected siblings</th>
<th>Unaffected siblings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Schizophrenia-spectrum disorder (n = 12)</td>
<td>Nonspectrum disorder (n = 11)</td>
</tr>
<tr>
<td>No Axis I disorder</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>Mood disorders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major depression</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Atypical bipolar</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Hypomania</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>Substance use disorders</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Anxiety disorders</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>Co-morbid Axis I conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mood + Substance use</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Anxiety + Substance use</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>Mood + Anxiety + Substance use</td>
<td></td>
<td>—</td>
</tr>
</tbody>
</table>

Medical disease (e.g., diabetes, heart disease), and neurological injury or disorder (e.g., incidents of loss of consciousness, epilepsy). Subjects diagnosed with current substance use disorders were not tested until their reported substance use was in remission for a minimum of 30 days. As reflected in Table 2, sixteen brothers had lifetime diagnoses of substance use disorders, but none were current at the time of testing. Brothers were excluded if they met diagnostic criteria for schizophrenia, or if they had ever received antipsychotic medication. Normal controls were excluded if they reported a family history of schizophrenia.

Medication Status. At the time of study participation, schizophrenic probands were clinically stable outpatients, and all but two probands were receiving antipsychotic medication. Thirty probands were receiving daily oral antipsychotic medication (mean dose in chlorpromazine equivalents 537.3 ± 529.7 mg; range 80–2500 mg chlorpromazine equivalents) (Davis 1976). Three probands were receiving fluphenazine decanoate: two probands were receiving injections biweekly (50 mg), and one proband was receiving injections every 3 weeks (5 mg). Information regarding the medication status of one proband was unavailable. Eleven probands were receiving daily anticholinergic medication (benztropine mesylate) in addition to antipsychotic medication.

As noted, none of the brothers or normal controls had ever received antipsychotic medication.

Procedures

Informed consent following explanation of procedures was obtained for all subjects. Subjects were paid $50 for completion of the entire protocol.

Psychiatric Assessment. DSM-III Axis I and Axis II diagnoses (American Psychiatric Association 1980) were determined in case conferences which included a psychiatrist, psychologist, and research staff. Diagnoses were based on the results of semistructured
clinical interviews: Axis I—Schedule for Affective Disorders and Schizophrenia-Lifetime (SADS-L) (Spitzer and Endicott 1979), and Alcohol & Drug sections, Diagnostic Interview Schedule (DIS) (Robins et al 1981); and Axis II—Structured Interview for DSM-III Personality (SIDP) (Pfohl et al 1983), and Schedule for Schizotypal Personalities (SSP) from the Schedule for Interviewing Borderlines (SIB) (Baron 1980). Family history of psychiatric disorder was determined using the Family History Research Diagnostic Criteria (Andreasen et al 1977). Interrater reliability for the Axis II diagnosis of interest (schizophrenia-spectrum disorders) was 0.81, p < 0.01 (kappa statistic), as assessed by two independent raters (n = 11 cases from the Vulnerability Study protocol).

For brothers, the diagnostic distinctions of a priori theoretical interest included the general categories of affected (presence of Lifetime Diagnosis of Psychiatric Disorder-Axis I or Axis II) versus unaffected (no Lifetime Diagnosis of Psychiatric Disorder-Axis I or Axis II). Affected brothers were further distinguished as having been diagnosed with nonspectrum disorders, which included Axis I disorders other than schizophrenia and/or any of the nonspectrum personality disorders, or schizophrenia-spectrum disorders, which included schizotypal and paranoid personality disorders (probable = within 1 symptom of diagnostic threshold, and definite = met or exceeded diagnostic threshold). At the time of testing, 31 brothers were 30 years of age or older. Thus, 75% of this sample of brothers of schizophrenic probands had passed through the greatest risk period for onset of schizophrenia (Gottesman and Shields 1982).

Language Comprehension and General Cognitive Functioning. Language comprehension was evaluated using the Relational Concepts Factor Scale (R2) from the Luria-Nebraska Neuropsychological Battery (Golden et al 1985). This scale is presented orally, and includes items that measure the understanding of relationships expressed with prepositions, and in comparative and complex grammatical constructions. Item 132 from this scale is presented as an example (Factor Scale R2: Golden et al 1985): “The woman who worked at the store came to the school where Mary studied to give a talk. Tell me, who gave a talk? (Pause for a response.) Tell me, what was Mary doing?”

Additional measures were used to test the relative specificity of language performance: a measure of nonlinguistic concept formation that may be sensitive to anterior brain dysfunction (the number of categories completed and number of perseverative errors made on the original 128-card Wisconsin Card Sorting Test) (Heaton 1981) (Levin et al 1989; Weinberger 1987); a visuo-constructional test traditionally associated with right-hemisphere parietal dysfunction (WAIS-R Block design) (Lezak 1983); and a test of general knowledge (WAIS-R Information).

Results

Data Analysis

Matched pair t-test and analysis of variance (ANOVA) were used to test research questions. Due to the number of measures (n = 5), the standard significance level of p = 0.05 was adjusted using the modified Bonferroni test (Keppel 1982), which resulted in significance set at p = 0.04 and a trend considered present if p = 0.08. ANOVA multiple comparisons were tested using Newman-Keuls range test with significance set at p = 0.05. Several measures showed unequal group variances, and nonparametric tests were conducted to check the robustness of parametric analyses. Results were not altered by application of the nonparametric statistics.
and Schizophrenia-Lifetime sections, Diagnostic Interview for DSM-II-R (1980). Family history of psychiatric disorders (Axis 1) was assessed as well (McGlashan, 1976).

Table 3. DSM-III AXIS II Diagnoses of Male Siblings of Schizophrenic Proband

<table>
<thead>
<tr>
<th></th>
<th>Affected siblings</th>
<th>Unaffected siblings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Schizophrenia-spectrum disorder (n = 12)</td>
<td>Nonspectrum disorder (n = 11)</td>
</tr>
<tr>
<td>No Axis II disorder</td>
<td>—</td>
<td>7</td>
</tr>
<tr>
<td>Axis II personality disorders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schizotypal</td>
<td>6</td>
<td>—</td>
</tr>
<tr>
<td>Paranoid</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td>Histrionic</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>Antisocial</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>Comorbid Axis II conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schizotypal + Compulsive + Dependent</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Paranoid + Compulsive</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Paranoid + Borderline + Antisocial</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Paranoid + Borderline + Histrionic</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Borderline + Antisocial</td>
<td>—</td>
<td>1</td>
</tr>
</tbody>
</table>

**Psychiatric Diagnoses**

Tables 2 and 3 present DSM-III Axis I and Axis II diagnoses for the brothers. As noted, the diagnostic distinctions of interest for the sibling group included unaffected (no Lifetime Psychiatric Disorder) versus affected (Lifetime Psychiatric Disorder), and within the affected category, schizophrenia-spectrum versus non spectrum disorders. The rate of schizophrenia-spectrum disorders observed in the brothers (n = 12/41, 29.3%) is comparable to the rate of spectrum-disorders reported in earlier family studies (Baron et al, 1985a; Baron et al, 1985b). The greater absolute frequency of Axis I disorders in the brothers with non spectrum disorders only reached trend significance (Fisher’s exact test, p = 0.07). Furthermore, spectrum-disordered brothers and non spectrum disordered brothers were not significantly different with respect to frequency of diagnosed mood disorders (Fisher’s exact test, p = 0.39) or diagnosed substance use disorders (Fisher’s exact test, p = 0.22).

Schizotypal personality disorder in isolation was infrequent among the brothers as a whole (n = 3/41, 7%) with the majority of schizotypal brothers showing coexisting Axis I and Axis II disorders (n = 4/7, 57%). This finding is consistent with previous studies (Schulz et al, 1986; Siever et al, 1991). In addition, diagnostic overlap between the spectrum disorders and borderline personality disorder was observed in a small proportion of cases (n = 2/12, 17%), which is also consistent with earlier work (George and Soloff, 1986; Pfohl et al, 1986; Schulz et al, 1986; Serban et al, 1987; Siever et al, 1991).

**Language Comprehension and General Cognitive Functioning**

Table 4 presents the performance of the groups on the language comprehension and cognitive measures. The association of language impairment with familial vulnerability to schizophrenia was evaluated by comparing the comprehension performance of matched
Table 4. Language Comprehension and General Cognitive Functioning in Schizophrenic Probands, their Male Siblings, and Normal Controls

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Probands</th>
<th>Schizophrenia-spectrum disorder</th>
<th>Non-spectrum disorder</th>
<th>No disorder</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luria-Relational Concepts Factor Scale (R2) (errors)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Categories</td>
<td>4.9</td>
<td>4.9</td>
<td>5.4</td>
<td>5.3</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>(1.7/33)</td>
<td>(1.5/12)</td>
<td>(0.9/10)</td>
<td>(1.5/18)</td>
<td>(0.3/14)</td>
</tr>
<tr>
<td>Perseverative errors</td>
<td>20.2</td>
<td>21.3</td>
<td>18.2</td>
<td>14.4</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>(13.7/33)</td>
<td>(16.8/12)</td>
<td>(11.3/10)</td>
<td>(16.0/18)</td>
<td>(7.5/14)</td>
</tr>
<tr>
<td>WAIS-R information</td>
<td>10.3</td>
<td>9.3</td>
<td>10.6</td>
<td>10.5</td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>(3.1/34)</td>
<td>(2.4/12)</td>
<td>(2.4/11)</td>
<td>(2.3/17)</td>
<td>(2.2/14)</td>
</tr>
<tr>
<td>WAIS-R block design</td>
<td>9.1</td>
<td>10.4</td>
<td>9.9</td>
<td>10.1</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td>(2.7/33)</td>
<td>(3.1/12)</td>
<td>(2.1/11)</td>
<td>(2.4/17)</td>
<td>(2.4/14)</td>
</tr>
</tbody>
</table>

*Mean (SD/N).

*p < 0.01.

Adjusted alpha (p = 0.05); p = 0.04.

proband-sibling pairs. The matched-pair t test provides a test of the difference between members in a pair, which in this case involved pairing each schizophrenic proband with his male sibling (n = 31 pairs). The three diagnostic distinctions for the brothers were distributed across these 31 pairs: schizophrenia-spectrum disorders (8/31, 26%); nonspectrum disorders (11/31, 35%); and unaffected (12/31, 39%). Number of errors on the Relational Concepts Factor Scale was not significantly different for these 31 matched pairs (t(30) = 0.21, p = 0.78). Moreover, these paired data were not significantly correlated (r = 0.24, p = 0.19) indicating that the performance of these proband-sibling pairs was not associated in a linear fashion.

The relationship between language dysfunction and the psychiatric diagnosis of relatives was evaluated by comparing comprehension performance across diagnostic groups (namely, schizophrenic probands, brothers with schizophrenia-spectrum disorders, brothers with nonspectrum disorders, brothers without any psychiatric disorder, and normal controls). Number of errors on the Luria-Nebraska Relational Concepts Factor Scale was significantly different between diagnostic groups (F(4,94) = 3.71, p < 0.01). Brothers with schizophrenia-spectrum disorders showed the worst mean score. Newman-Keuls tests (p = 0.05) determined that spectrum-disordered brothers made significantly more errors than unaffected brothers and normal controls. Although not significantly different, probands and the nonspectrum disordered brothers performed at an intermediate level between spectrum-disordered brothers, and the unaffected brothers and normal controls.

Though group differences on the Relational Concepts Scale were highly significant, none of the group means represented abnormal T-scores (Golden et al 1985). However, groups differed significantly with respect to the proportion of individuals within each group who performed in the abnormal range, as defined psychometrically using T ≥ 60 as the cutoff. Abnormal performance was exhibited by 25% of the probands and 33% of the brothers with schizophrenia-spectrum disorders. In contrast, abnormal comprehension
Language in Schizophrenia

was exhibited by only 9% of the brothers with nonspectrum disorders, 6% of the unaffected brothers, and 6% of the normal controls. Thus, severity of language comprehension difficulty was a function of the presence of schizophrenia-spectrum disorder. Abnormal language performance was exhibited by significantly more individuals with schizophrenia-spectrum disorders (proband and spectrum-disordered brothers) than by individuals without spectrum disorders (brothers with nonspectrum disorders, unaffected brothers, and normal controls) (Fisher’s exact test, \( p = 0.007 \)). In contrast, severity of language difficulty was not a function of the severity of schizophrenia-spectrum disorder. The number of probands who performed abnormally did not differ significantly from the number of spectrum-disordered brothers who had abnormal scores (Fisher’s exact test, \( p = 0.41 \)).

Groups did not differ significantly on the measures of general cognitive functioning: the WAIS-R Information or Block design subtests, or the Wisconsin Card Sorting Test categories. However, group differences reached trend significance for Wisconsin Card Sorting Test-Perseverative Errors (\( F(4,86) = 2.25, p = 0.07 \)).

Discussion

This study provided a comparison of the comprehension of complex grammatical constructions in individuals who differed with respect to familial vulnerability to schizophrenia. In addition, language comprehension was examined as a function of psychiatric diagnosis in the nonschizophrenic adult brothers of schizophrenic probands. The results indicated that impaired language comprehension occurred in the adult family members of schizophrenic probands, and that this dysfunction was most severe in association with schizophrenia-spectrum disorders. Language comprehension was not significantly different for matched pairs of schizophrenic probands and their brothers. Spectrum-disordered brothers showed significantly reduced language performance compared with unaffected brothers and normal controls. Moreover, abnormal language performance was exhibited by significantly more individuals with schizophrenia-spectrum disorders than by subjects without schizophrenia-spectrum disorders. Thus, results suggest that individuals at risk for schizophrenia are characterized by a continuum of language impairment rather than by a categorical marker with distinct boundaries (i.e., normal versus abnormal). Such a continuum of language dysfunction is consistent with an earlier observation made by Morice (1986) regarding the language functioning of schizophrenic patients.

It is interesting to note that probands showed less impairment than spectrum-disordered brothers. A primary methodological feature of the ongoing vulnerability protocol involves the selection of patient probands who are clinically stable outpatients at the time of testing. Thus, at the time of study participation, schizophrenic probands were clinically stable outpatients and the majority were receiving antipsychotic medication. In contrast, the spectrum-disordered brothers had never received antipsychotic medication. It is therefore possible that probands’ language performance was influenced by antipsychotic medication. Thus, performance on the Relational Concepts Scale may have the characteristic of a “mediating vulnerability marker,” which refers to performance that typically departs from normal levels, but that varies with state conditions, such as differences in clinical presentation or medication status (Nuechterlein and Dawson 1984). However, it is important to emphasize that this reasoning is highly speculative because the present study was not designed to evaluate language performance as a function of medication status.
Language comprehension dysfunction appears to have been a comparatively specific difficulty for this sample of individuals with schizophrenia-spectrum disorders. Groups were not significantly different on the measures of general intellectual functioning and nonlinguistic concept formation. Although group differences were in the expected direction on the Wisconsin Card Sorting Test, these differences failed to reach statistical significance. Severe deficits on this task have been observed in schizophrenic inpatients (Weinberger et al. 1986) and a mixed group of schizophrenic inpatients and outpatients (Morice 1990). In contrast, in the present study, neither the clinically stable medicated outpatient probands nor their spectrum-disordered brothers exhibited impairment on the Wisconsin Card Sorting Test. This finding for the probands is highly consistent with a recent study of clinically stable, medicated schizophrenic outpatients (Braff et al. 1991).

Comprehension of grammatical constructions may be particularly relevant to current discussions regarding the neuropathology of schizophrenia. This capacity is functionally associated with the integrity of the anterior language area, which incorporates portions of the temporal lobe (Benson and Geschwind 1985; Luria 1980). Both frontal and dominant temporal systems have been implicated in recent models of schizophrenia (Cohen and Servan-Schreiber 1992; Gray et al. 1991; Gruzelier et al. 1988; Levin 1984; Morice 1986; Seidman 1983; Weinberger 1987). Although the following comments are necessarily qualified by the lack of concurrent measures of cerebral activity, the general pattern of results observed in the present study is consistent with the argument that the schizophrenia disorders are likely associated with disruption in the functional integrity of frontal and dominant temporal systems. Though language comprehension was significantly reduced in spectrum-disordered brothers, and significantly more probands and spectrum-disordered brothers showed abnormal comprehension performance, groups were not significantly different on a measure traditionally associated with right-hemisphere parietal dysfunction (WAIS-R Block design) (Lezak 1983). It is important to note, however, that individuals with schizophrenia-spectrum disorders did not show impairment on all measures with demonstrated sensitivity to frontal lobe dysfunction. Specifically, groups were not significantly different on the Wisconsin Card Sorting Test, and mean scores were all within the normal range for this test (Heaton et al. 1991). Deficient performance on the Wisconsin Card Sorting Test has been previously associated with anterior system dysfunction (Levin et al. 1989), particularly the dorsolateral prefrontal cortex in schizophrenia (Weinberger 1987; Weinberger et al. 1986). Thus, the probands and the spectrum-disordered brothers in the present study showed impaired performance on a measure associated with the functional integrity of frontal-temporal systems, but only marginal reductions in performance were observed on a task previously associated with dorsolateral prefrontal cortex functioning.

Luria (1970) proposed that the ability to understand complex grammatical constructions is minimally dependent on an adequate processing of words in sequence and an understanding of syntactical relationships. The semantic integration deficit hypothesis, advanced to account for the linguistic disturbance in schizophrenia, reflects similar assumptions. The integration deficit hypothesis predicts that encoding of simple lexical items is generally intact in schizophrenia, but that integration of simple ideas units into connected, complex wholes may be deficient (Knight and Sims-Knight 1979; Traupmann 1975; Traupmann et al. 1976).

Data from previous psycholinguistic studies are generally supportive of the integration deficit hypothesis. Results of studies employing the 'embedded click' paradigm, developed by Fodor and Bever (1965), suggest that processing of syntactical boundaries in schizo-
n a comparatively specific spectrum disorders. Groups
intellectual functioning and were in the expected direc-
failed to reach statistical in schizophrenic inpatients
inpatients and outpatients clinically stable medicated
hibited impairment on the is highly consistent with a
patients (Braff et al 1991).
icularly relevant to current his capacity is functionally
which incorporates portions
Both frontal and dominant schizophrenia (Cohen and
Levin 1984; Morice 1986; comments are necessarily
urity, the general pattern of
tent that the schizophreni
al integrity of frontal and
nificantly reduced and spectrum-disordered
ups were not significantly sphere parietal dysfunction
however, that individuals
ent on all measures with
ally, groups were not signi
ean scores were all within
formance on the Wisconsin
ystem dysfunction (Levin
 schizophrenia (Weinberger
ectrum-disordered brothers
ure associated with the
rginal reductions in perfor
olateral prefrontal cortex

grammatical constructions in
sequence and an under-
deficit hypothesis, advanced
fects similar assumptions.
ble lexical items is generally
into connected, complex
upmann 1975; Traupmann

supportive of the integration
click’ paradigm, developed
ntal boundaries in schizo-

phrenia is intact (Carpenter 1976; Grove and Andreasen 1985; Rochester et al 1973). In
this task, clicks are superimposed over tape-recorded sentences, and the placement of the
clicks varies across syntactical boundaries (e.g., before, during, and after clauses). Foll-
wing presentation, subjects are asked to reproduce both the sentence and the exact
position of the click. Normals and schizophrenics both erroneously displace the position
of the clicks to correspond to syntax boundaries, which suggests that both groups are
sensitive to grammatical structure during sentence processing. The association between
semantic integration deficits and schizophrenia has been addressed by studies using the
‘memory for gist’ paradigm developed by Bransford and Franks (1971). Subjects are
presented with sentences that vary in terms of the number of idea units expressed (1-3
ideas). A recognition test follows that includes the previously presented sentences (old
items), sentences never presented (distractors), and a never presented ‘prototype’ sentence
that integrates the previously presented simple ideas into a complex semantic unit. Normal
subjects erroneously recognize the prototype as a previously presented item. This suggests
that information presented in discrete exemplars is abstracted and stored in more complex,
integrated units. Knight and Sims-Knight (1979) found that chronic schizophrenics were
clearly deficient in semantic integration, but that good premorbid acute patients were
similar to normals, thus suggesting that semantic integration may be related to clinical
presentation. More recently, Grove and Andreasen (1985) found premorbid functioning
was unrelated to semantic integration performance. The inconsistency between those two
studies concerning clinical status may be due to differences in the gender composition of
the two samples. In the study by Knight and Sims-Knight (1979), only males were
tested. In the study by Grove and Andreasen (1985), each diagnostic subgroup included
both men and women. Differences in premorbid functioning have been reported for male
and female schizophrenics (Haas et al 1990), and these differences may have contributed
to the discrepant findings of the two studies. In general, however, the cumulative evidence
suggests that the semantic integration deficit hypothesis possesses heuristic value for
organizing our formulations regarding language comprehension difficulties associated with
the schizophrenia-spectrum disorders.

In summary, language comprehension was examined as a function of familial vul-
nearliness to schizophrenia, and of psychiatric diagnosis in the adult brothers of schizo-
phrenic probands. Language comprehension was not significantly different between
members of matched proband-sibling pairs. Moreover, language comprehension was
significantly reduced for brothers diagnosed with schizophrenia-spectrum disorders. Fi-
nally, significantly more probands and spectrum-disordered brothers showed abnormal
performance compared with individuals without spectrum disorders. Results suggest that
impaired language comprehension is associated with familial vulnerability to schizo-
phrenia, and that this dysfunction is most severe in individuals with schizophrenia-
spectrum disorders. Furthermore, this language capacity may be particularly relevant to
the neuropathology of schizophrenia because of its functional association with the in-
tegrity of the anterior language area in the dominant hemisphere, which includes por-
tions of the temporal lobe.

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