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Language in schizophrenia and its relationship to formal thought disorder

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ABSTRACT

Background. Although poor language test performance has been documented in schizophrenia, its relationship to formal thought disorder remains unclear.

Method. Forty schizophrenic patients were administered eight language tests and, under blind conditions, rated for formal thought disorder. Measures of general intellectual function were also obtained.

Results. Performance on all language tests was significantly correlated with the general intellectual measures. Three language test scores also showed significant correlations with formal thought disorder scores. Multiple regression and analysis of intellectually preserved patients suggested particular associations of formal thought disorder with semantic comprehension and picture description.

Conclusions. General intellectual impairment is an important determinant of poor language test performance in schizophrenia, but presence of formal thought disorder may also contribute. A higher-order semantic deficit may be particularly relevant to both linguistic impairment and formal thought disorder.

INTRODUCTION

Formal thought disorder, the incoherent speech observed in approximately 20% of patients with schizophrenia, is perhaps the most extensively investigated symptom in the disorder. Nevertheless, whether it represents a disorder of thought or language or both remains uncertain. In one well-known review, Schwartz (1982) concluded that thought-disordered schizophrenic speech was probably secondary to information processing abnormalities and did not reflect a basic problem of language competence. More recently, McGrath (1991) has argued that many aspects of formal thought disorder could be due to an executive/frontal lobe dysfunction. Frith (1992) has proposed that an inability to take into account listeners' needs is the main reason that schizophrenic patients' speech is difficult to follow. Other authors, though, such as Cutting (1985), Chaika (1990) and Thomas & Fraser (1994) have argued that genuine linguistic abnormalities make an important contribution to formal thought disorder, albeit as part of a wider pattern of abnormalities affecting thinking, discourse, and social cognition.

Some of the support for this latter view derives from studies applying neurolinguistic tests – typically taken from aphasia test batteries – to groups of schizophrenic patients (e.g. DiSimoni *et al*. 1977; Faber & Reichstein, 1981; Silverberg-Shalev *et al*. 1981). Although these studies differed in the details of their design, they invariably found impairment on a range of language functions. Other studies have focused on expressed speech in schizophrenia. Analysing transcripts of speech with a computerized linguistic programme, Morice & Ingram (1982) and Fraser *et al*. (1986) found that schizophrenic patients showed decreased syntactic complexity, had fewer well formed sentences, and made

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more syntactic and semantic errors. These findings were replicated by Morice & McNicol (1986), and Thomas *et al.* (1987, 1990; King *et al.* 1990), and other studies have also found evidence of expressive syntactic and semantic abnormalities in schizophrenic speech (Hoffman *et al.* 1985; Hoffman & Sledge, 1988).

While these studies provide ample evidence that language is abnormal in schizophrenia, they are inconclusive on two important issues. The first of these concerns the neuropsychological specificity of the language abnormality. It is widely accepted that patients with schizophrenia tend to perform poorly on virtually all tests of cognitive function (Chapman & Chapman, 1973). This may in turn be related to the fact that there is commonly some degree of general intellectual impairment associated with the disorder, ranging from a minor lowering of IQ in acute patients to severe and wide-ranging deficits in chronically hospitalized patients (for reviews see McKenna, 1994; Goldberg & Gold, 1995). Such deficits are widely believed to be an intrinsic part of the disorder and they are not easily attributable to drug treatment (e.g. King, 1990; Mortimer, 1997) or poor attention, motivation and cooperation (e.g. Goldberg *et al.* 1987; Kenny & Meltzer, 1991; Duffy & O'Carroll, 1994). Since none of the above studies of language test performance in schizophrenia made any assessment of their patients' intellectual status, it follows that the poor linguistic test performance found might not have been due to a specific language deficit, but merely have been one aspect of general poor performance that would have shown itself on any test.

The second issue is whether linguistic test impairment in schizophrenia is related to formal thought disorder. Most of the studies cited above failed to examine patients with, and without, this symptom separately. One study that did so (Faber & Reichstein, 1981) found that poor language test performance was more pronounced in patients with formal thought disorder than in those without; however, two other studies (Anand *et al.* 1994; Blakey *et al.* 1996) found that language test scores and formal thought disorder scores were uncorrelated. Only one study of expressed speech in schizophrenia examined patients' performance *vis à vis* presence of formal thought disorder (Allen, 1983, 1984; Allen & Allen, 1985); this found no differences in syntactic and semantic abnormality between 10 chronic schizophrenic patients with positive symptoms (seven of whom showed formal thought disorder) and nine with negative symptoms. However, in this study the schizophrenic patients also failed to show significant differences from normal controls.

Perhaps the strongest evidence that language deficits form an integral part of formal thought disorder comes from a small number of studies that have examined the similarities between this and fluent dysphasia. Traditionally the subject of conflicting views (e.g. Kleist, 1960; Critchley, 1964; Benson, 1973), this question was first investigated empirically by Chaika (1974) who analysed the speech of a 37-year-old thought-disordered schizophrenic patient. As well as noting many of the characteristic clinical features of formal thought disorder, such as loss of goal, derailment and clang associations, she found evidence of phonological, syntactic and semantic abnormalities suggesting difficulties at the level of language. Some, but not all further case studies have had supportive findings (Fromkin, 1975; Lecours & Vanier-Clément, 1976; see also Rochester & Martin, 1979). In a similar vein, Faber *et al.* (1983) presented transcripts of speech from 14 thought-disordered schizophrenic patients and 13 patients with dysphasia (fluent in 11 cases) to psychiatrists, neurologists and a speech pathologist under blind conditions. Only the speech pathologist came close to correctly classifying the transcripts, and even she was not completely successful. In a recent synthesis of her own and others' work, Chaika (1990) continues to adhere to the view that there is a language disorder in formal thought disorder with '… word finding difficulties revealed by gibberish, neologizing, opposite speech, and other erroneous word retrieval … [and] morphological and syntactic errors …'.

While some studies have examined language test performance in relation to general cognitive impairment in schizophrenia (Landre *et al.* 1992) or to formal thought disorder (Faber & Reichstein, 1981; Anand *et al.* 1994), as yet only one study (Blakey *et al.* 1996) has combined measures of both cognitive function and formal thought disorder. Accordingly, the aims of the present study were to re-examine the pattern of poor language test performance in schizophrenia, to determine whether it dissociates from

the general tendency to poor cognitive test performance in the disorder, and to establish to what extent it is related to the symptom of formal thought disorder.

METHOD

Patients

Forty patients (29 male and 11 female) who fulfilled Research Diagnostic Criteria (Spitzer *et al*. 1978) for schizophrenia made up the sample. The age range was 25–71 (mean 42·5). None had a history of head injury, neurological disorder, or alcohol or drug abuse. All the patients had chronic illnesses, but there was a wide range of severity: eight patients were able to live independently or with minimal support; 20 lived in sheltered accommodation or were on rehabilitation/resettlement units; and 12 were chronically hospitalized. The sample was deliberately chosen to include patients showing all degrees of formal thought disorder. Some of the patients also showed mild or moderate general intellectual impairment (see below). All patients were taking neuroleptic medication at the time of assessment.

Procedure

One of the authors (S.R.-F.) administered a series of language tests. These covered comprehension of syntax and semantics, naming and expressive speech. Where possible, tests with established normative data were used, but as the primary purpose of the study was to examine the relationship between language test scores and formal thought disorder scores, some tests without extensive norms were also included.

Syntactic tests

In the Modified Token Test (De Renzi & Faglioni, 1978), the subject has to carry out a series of increasingly complex instructions with geometrical shapes of different colour and size (e.g. *Touch a circle*; *Instead of the white square, touch the yellow circle*). This test has normative data on 224 adults.

In the Test for the Reception of Grammar (TROG) (Bishop, 1989), the investigator reads out increasingly grammatically complex sentences (e.g. *The boy is not running*; *The cat the cow chases is big*) and the subject has to choose which of four pictures match what is being said. This test has not been extensively standardized on adults, but data on 24 normal individuals aged 53–85 have given an approximate normal score range (Hodges *et al*. 1992).

Semantic tests

In the Pyramids and Palm Trees Test (Howard & Patterson, 1992), the subject is shown the written name of an object (e.g. *Egyptian pyramid*) and then has to decide which of two other written words it is most closely related to (*palm tree* or *pine tree*). Normative data on an unspecified number of normal adults are available.

Naming

The Boston Naming Test (Goodglass & Kaplan, 1983) requires identification and naming of 60 increasingly difficult pictures of animals and objects (e.g. *bed*, *scroll*). One of the pictures is a pretzel, which would not be known to many British individuals, and so for the purposes of the present study this was automatically scored as correct. Norms for this test are based on data from 84 normal adults.

Expressive tests

Three tests from the Minnesota Aphasia Battery (Schuell & Sefer, 1973) were used: Answering Simple Questions (e.g. *What do you do with a hammer?*, *What do you do with money*?); Producing Sentences (where subjects have to make up a sentence incorporating a given word); and Picture Description. In this last test, subjects are shown a picture of a complex scene and asked to describe it. Answers are tape recorded and scored according to a seven point scheme (0, normal performance – uses sentences, integrates people and action; 1, Same as above but with slurring or mild articulatory defect – sounds almost normal but not quite; 2, uses some phrases and sentences and names at least ten objects correctly but occasional breakdowns in communication occur – difficulty in thinking of a word, use of a wrong word, approximation of a word or difficulty in expressing a complete idea; 3, chiefly enumeration of objects – names eight to ten objects intelligibly and correctly; 4, names five to seven objects intelligibly and correctly; 5, names three to four objects intelligibly and correctly; 6, unable to name three objects intelligibly and correctly). These three

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tests have been standardized on 50 normal adults.

One test from another aphasia battery, the Western Aphasia Battery (Shewan & Kertesz, 1980; Kertesz, 1982) was also used: Repetition of Words requires subjects to repeat increasingly complex phrases, from single words to sentences like *Pack my box with five dozen jugs of liquid veneer*. No norms are available for this test.

The other investigator (P.J.M.) rated the patients for presence of formal thought disorder. This was done on the same day, immediately before or after neuropsychological testing, using the Thought, Language and Communication Scale of Andreasen (1979, 1987). Clinical ratings were made without knowledge of the neuropsychological test results. The 'positive formal thought disorder' items but not those for 'alogia' were summed to give an overall rating of formal thought disorder.

Measures of general intellectual function were also obtained. The Mini-Mental State Examination (MMSE) (Folstein *et al*. 1975) provides a global measure of cognitive function, with a cut-off of 23/24 out of 30 having been established as a threshold for presence of mild dementia (Anthony *et al*. 1982). Estimated pre-morbid IQ was measured using the National Adult Reading Test (NART) (Nelson, 1982) and a current IQ figure was obtained using the WAIS. Following common practice, a NART-WAIS discrepancy of > 15 points was taken as an index of significant intellectual decline.

RESULTS

The patients showed wide range of formal thought disorder, as measured by global ratings on the Thought, Language and Communication Scale: 0 (not present) $N = 9$; 1 (minimal) $N = 7$; 2 (mild) $N = 9$; 3 (moderate) $N = 7$; 4 (severe) $N = 6$; and 5 (very severe) $N = 2$. In terms of intellectual function the sample included 19 patients with NART-WAIS discrepancies of > 15 points and three with MMSE scores < 24 (two of whom also had NART-WAIS discrepancies of > 15 points).

Test performance

The proportions of patients failing the linguistic tests are shown in Table 1. High rates of failure were found on the test of semantic comprehension, the Pyramids and Palm Trees Test (40% outside the normal range), and one of the expressive tests, Picture Description (40·5% outside the normal range). None of the patients fell outside the normal range on another expressive test, Answering Simple Questions, and the failure rate was also zero on one of the tests of syntactic comprehension, the Modified Token Test. On the other syntactic comprehension test, the TROG, 17·5% of the patients were outside the normal range. Intermediate failure rates were also evident on the Boston Naming Test (12·5% outside the normal range) and Producing Sentences (21·6% outside the normal range).

The verbatim responses of the five lowest scoring patients on picture description (who all scored 3 or 4) are shown in Table 2. From this it can be seen that they tended to merely list objects and actions rather than provide a narrative account of the events taking place.

The patients who made errors on the Producing Sentences test most often merely failed to produce a full sentence, generating a meaningful phrase instead, e.g. *after* → 'After the gold rush'; *new* → 'New dresses, suits'. Such productions were on the whole grammatically and semantically correct. However, a small number of responses were grammatically imperfect, e.g. *belongs* → 'Belongs in the history'; *after* → 'After my breakfast bed to sleep'; *new* → 'The world new is complete'.

Rates of impairment for the 19 patients with well preserved overall intellectual function are also shown in Table 1. The failure rate remained substantial on the Pyramids and Palm Trees Test (26·3%) and Picture Description (31·6%). However, failures fell to zero on the Boston Naming Test and to nearly zero on the syntactic comprehension test, the TROG (5·3%). This figure reflects failure by only one of 19 patients and, since none of these patients (or the group as a whole) failed the other syntactic test, the Token Test, comprehension of syntax thus appeared to be largely intact in this group.

Correlations with intellectual impairment and formal thought disorder

As all the patients performed perfectly on Answering Simple Questions, this test was excluded from the correlational analysis. Spearman correlations between performance on the

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Table 1. *Rates of impairment on language tests*

Test	Normal score range	Patient score range	Number* (%)	Number† (%)
Syntactic				
Modified Token Test	21–36	31–36	0/40 (0)	0/19 (0)
TROG	73–80	56–80	7/40 (17·5)	1/19 (5·3)
Semantic				
Pyramids and Palm Trees Test	49–52	34–52	16/40 (40)	5/19 (26·3)
Naming				
Boston Naming Test	42–60	31–59	5/40 (12·5)	0/19 (0)
Expressive				
Picture description	All scored 0	4–0	15/37 (40·5)‡	6/19 (31·6)
Producing sentences	All scored 6	3–6	8/37 (21·6)	4/19 (21·0)
Answering simple questions	All scored 8	All scored 8	0/40 (0)	0/19 (0)

* Number outside normal range/whole group.
† Number outside normal range/intellectually preserved patients.
‡ Based on scores of $\geqslant 2$, i.e. excluding rating 1, which refers only to artriculatory deficits and slurring.

Table 2. *Examples of picture description by schizophrenic patients who performed poorly*

Kite flying … people … pointing … smoke … chimney … man … tree … searching. (Score 3)
Well there's either a boy, a country boy, or a girl looking up into a tree, and a dog watching them. Ducks on pond. (Score 3)
House … dog … man with a kite … J Smith … duck on the pond. That's all I can think of. (Score 4)
There's a tree, a kite, a house … flowers. What's that? … Duck … a pond … some vegetation in the pond. What's that called? Hills … a path … steps. (Score 3)
A tree … kite in the air … smoke out of the chimney … house … J Smith sign … dogs … a dog … car waving … duck in the pond … the countryside and the tree. That's the lot. (Score 3)

Table 3. *Correlations between linguistic test scores, intellectual test scores and formal thought disorder scores*

	Spearman correlation			
Test	MMSE	NART IQ	WAIS IQ	FTD score
Syntactic				
Modified Token Test	0·47**	0·12	0·46**	−0·11
TROG	0·48**	0·20	0·56***	−0·36*
Semantic				
Pyramids and Palm Trees Test	0·54***	0·09	0·47**	−0·48**
Naming				
Boston Naming Test	0·42**	0·44**	0·50**	−0·11
Expressive				
Picture description	−0·46**	−0·18	−0·37*	0·44**
Producing sentences	0·32	0·09	0·38**	−0·32
Repetition	0·31	0·08	0·45**	−0·19

*$P < 0{\cdot}05$; **$P < 0{\cdot}01$; ***$P < 0{\cdot}001$.

seven remaining language tests and scores on tests of intellectual function are shown in Table 3. From this it can be seen that performance on all of the linguistic tests was significantly correlated with current intellectual function as measured by WAIS IQ and, with two exceptions, was also correlated with MMSE score. Only one test showed a significant association with estimated pre-morbid IQ; this was the Boston Naming Test.

Also shown in Table 2 are the correlations between performance on the seven language tests and formal thought disorder scores. Three tests correlated significantly with measures of

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formal thought disorder: the Pyramids and Palm Trees Test ($r = -0{\cdot}48$; $P < 0{\cdot}01$), Picture Description ($r = 0{\cdot}44$; $P < 0{\cdot}01$) and the TROG ($r = -0{\cdot}36$; $P = 0{\cdot}03$). It should be noted that ratings of formal thought disorder showed no significant correlation with any of the three measures of general intellectual function (MMSE: $r = -0{\cdot}02$, NS; NART: $r = 0{\cdot}08$, NS; WAIS: $r = -0{\cdot}15$, NS).

These findings suggest that poor performance on the above three language tests is associated with independent contributions from intellectual function and formal thought disorder. To examine this further, multiple regression was carried out using IQ and language test scores as predictor variables for formal thought disorder scores. In separate analyses this revealed: (*i*) that Pyramids and Palm Trees Test significantly predicted FTD score independent of IQ ($t = -2{\cdot}9$, $P = 0{\cdot}006$), but IQ was not a predictor of FTD independently of Pyramids and Palm Trees score ($t = 0{\cdot}96$, NS); (*ii*) that Picture Description also significantly predicted FTD score independent of IQ ($t = -2{\cdot}3$, $P = 0{\cdot}03$), but IQ was not independently predictive of scores on this language test ($t = 0{\cdot}34$, NS); and (*iii*) that neither TROG nor IQ were significantly associated with formal thought disorder independently of each other (TROG: $t = -1{\cdot}7$, $P = 0{\cdot}9$; IQ: $t = 0{\cdot}95$, NS). The findings were generally similar when MMSE was used as a predictor variable instead of IQ, except that TROG was found to be significantly associated with FTD score independent of MMSE score ($t = -2{\cdot}1$, $P = 0{\cdot}04$).

When the correlations between these three tests and formal thought disorder were re-examined in the subgroup of 19 intellectually preserved patients, the correlation with the Pyramids and Palm Trees Test remained largely unchanged ($r = -0{\cdot}42$; $P = 0{\cdot}07$), as did that with picture description ($r = -0{\cdot}47$; $P = 0{\cdot}04$). However, the correlation previously found with the syntactic test, the TROG fell somewhat and no longer reached significance ($r = -0{\cdot}28$; NS).

Other findings

A more detailed breakdown of performance on the Boston Naming Test was made by classifying errors as semantic or perceptual. Semantic errors were conceptually related to the target item but visually dissimilar (e.g. *harmonica* → 'harpsichord'; *funnel* → 'flask'); superordinate responses (e.g. *pelican* → 'bird') were also included. Perceptual errors were visually confusable (e.g. *acorn* → 'thimble'; *doorknocker* → 'lantern'). A third class of errors, circumlocutions, (e.g. *hammock* → 'seaman's sleeping bunk') were also scored. 'Don't know' responses and errors that were ambiguous (e.g. *pelican* → 'parrot') were not counted. Semantic errors ranged from 0–11/patient (mean 3·60), perceptual errors ranged from 0–3/patient (mean 0·62) and circumlocutions ranged from 0–5/patient (mean 1·08).

Semantic errors, perceptual errors and circumlocutions were uncorrelated with FTD scores ($r = 0{\cdot}03$, $0{\cdot}08$ and $0{\cdot}00$ respectively, NS). With respect to general intellectual impairment, semantic errors were uncorrelated with both the intellectual test scores (MMSE: $r = -0{\cdot}15$, NS; WAIS: $r = -0{\cdot}18$, NS). Perceptual errors, however, were significantly correlated with MMSE score ($r = -0{\cdot}48$, $P = 0{\cdot}002$), and there was a trend for WAIS IQ ($r = -0{\cdot}28$, $P = 0{\cdot}07$). Circumlocutory errors were uncorrelated with MMSE score ($r = -0{\cdot}12$, NS) but showed a trend to correlation with WAIS IQ ($r = -0{\cdot}31$, $P = 0{\cdot}06$).

DISCUSSION

Poor performance on tests of language is by now a well documented finding in schizophrenia (e.g. see Cutting, 1985). It is also widely believed that this impairment is intrinsic and not due to extraneous factors, in particular drug treatment. Thus, although some of the studies described earlier were carried out on mainly drug-treated patients (e.g. DiSimoni *et al*. 1977; Silverberg-Shalev *et al*. 1981), one of them (Faber & Reichstein, 1981) used mainly drug-free patients. Poor linguistic performance has also been demonstrated in other studies on drug-free (Saykin *et al*. 1991; Blanchard & Neale, 1994) and drug-naive patients (Saykin *et al*. 1994).

The major finding of the present study is that language test impairment appears to be a function of the general intellectual impairment that also characterizes schizophrenia. Thus, scores on the different language tests correlated significantly with current IQ in all cases, and with MMSE score in most cases. This finding is closely similar to that of another study that

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examined the correlations between language and intellectual test scores (Blakey *et al.* 1996). It is also in keeping with other studies which have found linguistic impairment to be part of a pattern of generalized neuropsychological impairment (e.g. Braff *et al.* 1991; Saykin *et al.* 1991; Blanchard & Neale, 1994). Also supporting such a view are the findings of a single case study by Shallice *et al.* (1991) – these authors administered various neuropsychological tests to five chronically hospitalized patients and found that impairment on three language tests was only present when there was also evidence of general intellectual impairment.

Such a finding is, in itself, unsurprising; it seems unlikely that general intellectual impairment in schizophrenia would spare the specific area of language. Rather more unexpectedly, the pattern of impairment across different types of language function was found to be non-uniform, ranging from zero to around 40% across different tests. This might be considered evidence for a neuropsychologically specific language deficit in schizophrenia – i.e. one which shows dissociations. However, such an argument has at least two weaknesses. In the first place, the profile of impairment found did not follow any clear pattern of associations and dissociations. Thus, a zero failure rate on one test of syntactic comprehension, the Token Test, was coupled with a 20% failure rate on another similar test, the TROG, and similar variations were evident on the semantic and expressive tests. Secondly, while other studies also found a non-uniform pattern of impairment on different language tests in schizophrenia, these were comparable neither with the present study nor one another. For example, DiSimoni *et al.* (1977) found substantial rates of semantic and syntactic comprehension impairment, but a low rate of impairment on a naming test. Silverberg-Shalev *et al.* (1981) found schizophrenic patients to be impaired compared to controls only on naming and semantic comprehension (of words, sentences and paragraphs). Faber & Reichstein (1981) found impairment on repetition, naming and syntactic comprehension.

A stronger case for a specific pattern of language impairment can be made by considering only the intellectually well-preserved schizophrenic patients in the present study, in whom the 'noise' produced by the general tendency to poor performance would be expected to be at its lowest. In the patients with MMSE scores above the cut-off for mild dementia and WAIS-NART discrepancies of 15 points or less, syntactic function appeared to be largely spared: none failed the Token Test (as in the group as a whole) and only one failed the TROG. Also, most responses in the Producing Sentences test were syntactically correct. By contrast, the two highest rates of impairment were on the Pyramids and Palm Trees Test and Picture Description. The Pyramids and Palm Trees Test requires the subject to access higher-order associative semantic information, i.e. knowledge which goes beyond simple word meanings. On Picture Description, the patients' responses were characterized by an apparent inability to construct a narrative account of a scene, which might be considered to reflect an inability to draw on the higher-order semantic structures referred to as frames, scripts and schemes (e.g. Shallice, 1988; Baddeley, 1990).

These findings could suggest that schizophrenic language impairment is characterized by a pattern of relatively preserved syntax coupled with more obviously impaired semantics, particularly higher-order semantics. Anand *et al.* (1994) came to a similar conclusion, finding that while impairment was present across semantic, syntactic and other linguistic tests in a group of psychotic (mostly schizophrenic) patients, poor performance on a test of semantic comprehension was the variable that best distinguished the patients and controls. A further finding that can be marshalled to support this argument is the patients' pattern of predominant semantic errors on the naming test. These semantic errors did not seem to be a function of overall intellectual impairment, whereas there were strong suggestions of such an association in the case of perceptual errors. Any such conclusion, however, should be regarded as tentative: in the first place the impairment found on picture description is open to other interpretations besides a high level semantic deficit. Secondly, naming is obviously semantic, but this was found to be intact in the intellectually preserved patients.

Although it seems clear that general intellectual impairment is a major determinant of linguistic impairment in schizophrenia, this may not be the whole story. Formal thought disorder

also accounted for a significant proportion of the variance in language test scores. Here, the strongest correlations were with the Pyramids and Palm Trees test and Picture Description; there was also a somewhat lesser but still significant correlation with one of the two receptive syntactic tests, the TROG. Further analysis tended to strengthen the association with the first two tests. The correlation between impairment on the Pyramids and Palm Trees Test and Picture Description and formal thought disorder was maintained in the subgroup of intellectually preserved patients, but the significant correlation with the TROG was reduced to non-significance. Multiple regression suggested that intellectual impairment did not contribute to variability in scores on these two tests independently of formal thought disorder, but this was not clearly the case for the TROG.

This pattern, once again with the above qualifications, suggests that formal thought disorder is associated with a semantic linguistic impairment which, however, spares naming. This is similar to the conclusion of a recent study by Goldberg *et al.* (1998) who found that schizophrenic patients with high levels of formal thought disorder showed more impairment on semantic linguistic tests, but not non-linguistic tests, than those with low levels. Further analysis indicated that only some semantic measures were significantly associated with formal thought disorder. One of these was a measure of semantic category fluency which controlled for executive function (number of items named over one minute in semantic categories minus corresponding performance for words beginning with particular letters), and the other was a word-picture matching task (the Peabody Picture Vocabulary Test). Performance on a naming test did not, however, differentiate the two groups. The authors concluded that 'clinically rated thought disorder in schizophrenia is associated with and may result from semantic processing abnormalities'. In a study using the single case approach Oh *et al.* (2001) also argued that semantic, especially expressive semantic abnormalities distinguished thought-disordered from non-thought-disordered patients.

Combining all the present study's findings, there appears to be strong support for the view that neurolinguistic test performance in schizophrenia is affected by a general factor which can be identified with or is closely related to general intellectual impairment. There are also indications that some elements of language are affected to a greater extent than others, with certain deficits being found in otherwise cognitively intact patients. These deficits implicate semantic more than syntactic function, involve both receptive and expressive components of this, and affect the comprehension and construction of complex propositions while sparing lower-order or lexical semantic representations, in particular naming. Some language deficits are also associated with the clinical symptom of formal thought disorder. It is noteworthy that these are exactly the deficits which are also disproportionately impaired in schizophrenia, suggesting that the language disorders associated with schizophrenia are seen in a more exaggerated form in patients with FTD.

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