Journal of Psycholinguistic Research, Vol. 26, No. 4, 1997

Language Generation in Schizophrenia and Mania: The Relationships Among Verbosity, Syntactic Complexity, and Pausing

Deanna M. Barch[1,2] and Howard Berenbaum[1]

Accepted July 19, 1996

We examined the relationships among verbosity, syntactic complexity, and pausing in the speech of 21 Diagnostic and Statistical Manual *of Mental Disorders (3rd ed., rev.) (DSM-III-R) diagnosed schizophrenic participants and 19 DSM-III-R diagnosed manic participants. We found that less verbosity was associated with both less syntactic complexity and greater pausing. In addition, less syntactic complexity was associated with greater pausing. The strength of these associations did not differ significantly between the two diagnostic groups. We propose that deficits in verbosity, syntactic complexity, and pausing are all related to a disturbance in message generation. We discuss the consistency of this hypothesis with previous research linking information processing and frontal lobe deficits to disturbances in verbosity, syntactic complexity, and pausing.*

Psychopathologists have long noted the enormous heterogeneity in symptom manifestation that characterizes schizophrenia. For example, although poverty of speech is considered a primary symptom of schizophrenia (e.g., Strauss, 1993), not all schizophrenic patients display poverty of speech. Furthermore, even among patients categorized as displaying poverty of speech,

Preparation of this article was supported in part by a NARSAD Young Investigators Award to Deanna M. Barch and by a National Institute of Mental Health Grant (MH50531-01A2) to Howard Berenbaum. Deanna M. Barch is currently at Western Psychiatric Institute and Clinic, University of Pittsburgh Medical School.

[1] University of Illinois at Urbana-Champaign, Urbana, Illinois.

[2] All correspondence concerning this article should be addressed to Deanna M. Barch, Western Psychiatric Institute and Clinic, 3811 O'Hara Street, Pittsburgh, Pennsylvania 15213.

0090-6905/97/0400-0401$12.50/0

different patients manifest this language disturbance to varying degrees. Unfortunately, this symptom heterogeneity has made it difficult to clarify the mechanisms underlying poverty of speech. As of yet, it is not clear whether poverty of speech reflects a cognitive dysfunction (e.g., Barch & Berenbaum, 1994; Liddle & Morris, 1991) or a social-interpersonal dysfunction (e.g., Alpert, Pouget, Welkowitz, & Cohen, 1993).

The fact that not all schizophrenic patients display the same symptoms has highlighted the potential usefulness of utilizing a dimensional approach when examining schizophrenic symptomatology (e.g., Costello, 1992). Such a strategy may help elucidate the mechanisms underlying poverty of speech, as well as other symptoms, in the following way. A dimensional approach can help clarify the association between individual differences in verbosity and individual differences in other cognitive and symptom disturbances. Clarification of the variables associated with verbosity variations among schizophrenic patients may then provide clues about the mechanisms underlying these phenomena.

Among schizophrenic patients, preliminary evidence suggests that individual differences in verbosity are linked to individual differences in both syntactic complexity (Morice & Ingram, 1983) and pausing (Alpert, Clark, & Pouget, 1994; Alpert et al., 1993; Resnick & Oltmanns, 1984). Syntactic complexity and pausing are both influenced by processes operating during language production (e.g., Levelt, 1989). In addition, both are associated with working memory function. Specifically, manipulations of working memory capacity, such as the use of dual-task paradigms, decrease syntactic complexity and increase pausing in nonpsychiatric individuals (Barch & Berenbaum, 1994; Jou & Harris, 1992). Further, increased syntactic complexity is associated with increased information processing load (e.g., Ford & Holmes, 1978; Power, 1986).

Thus, it is possible that reductions in syntactic complexity and increases in pausing among schizophrenic patients are related to language production disturbances that may be associated with working memory disturbances. If less verbosity is related to less syntactic complexity and greater pausing, it would suggest that less verbosity among schizophrenic patients may also be influenced by disturbances in language production and working memory.

As of yet, no study has examined the associations among verbosity, syntactic complexity, and pausing in the same sample of schizophrenic patients. However, preliminary evidence from several sources is consistent with the hypotheses that (1) variations in verbosity, syntactic complexity, and pausing among schizophrenic patients are interrelated; and (2) all three may be associated with disturbances in language production and working memory. First, as described previously, preliminary data suggest that ver-

bosity is positively correlated with syntactic complexity (Morice & Ingram, 1983) and negatively correlated with pausing among schizophrenic patients (Alpert et al., 1993; Alpert et al., 1994; Resnick & Oltmanns, 1984). These findings are consistent with research on nonpsychiatric individuals demonstrating that individual differences in all three are strongly associated (Barch & Berenbaum, 1994). Second, information processing deficits that may reflect working memory dysfunction have also been linked to both reduced verbosity (e.g., Strauss, 1993) and increased pausing among schizophrenic patients (Alpert et al., 1994; Rochester, Thurston, & Rupp, 1977). Again, these findings are consistent with research demonstrating that, among nonpsychiatric individuals, manipulations that decrease working memory capacity, reduce verbosity and syntactic complexity, and increase pausing (e.g., Barch & Berenbaum, 1994).

As a first step in addressing the previously discussed issues, we explored two questions not examined in previous research. First, we examined whether verbosity, syntactic complexity, and pausing are related in the same sample of psychiatric participants. Second, we examined whether the relationships among these three aspects of language are similar across diagnostic groups.

METHODS

Participants

The participants were 19 individuals with bipolar disorder who were in manic episodes at the time of the study, and 21 individuals with schizophrenia.[3] All participants were hospitalized at the time of their participation. Psychiatric diagnoses were made using *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed., rev. DSM-III-R; American Psychological Association, 1987) criteria following the administration of the psychotic and mood disorders sections of the Structured Clinical Interview for the DSM-III-R (SCID; Spitzer, Williams, Gibbons, & First, 1992) and a review of clinical records. Severity of current clinical state was assessed using the Brief Psychiatric Rating Scale (BPRS; Lukoff, 1986). The interviews and clinical ratings were completed by one or the other investigator, both of whom have had extensive experience using a variety of different structured clinical interviews and ratings scales. Sociodemographic, clinical, and med-

[3] The data for this paper were derived from new ratings of speech samples used in a previous study (Berenbaum & Barch, 1995).

Table I. Sociodemographic Characteristics, Clinical Data, and Medication Status[a]

Variable	Schizophrenic	Manic
Age (years)		
M	35.1	31.3
SD	11.4	13.9
Education (years)		
M	13.4	13.1
SD	3.6	2.0
Race (% white)	96	68
Gender (% male)	68	53
Total BPRS		
M	40.6	36.2
SD	10.2	7.6
BPRS negative symptoms[b]		
M	4.45	4.16
SD	1.74	1.80
BPRS Excitement		
M	2.09	3.00
SD	1.34	1.33
Medications taken (%)		
Neuroleptics	100	79
Lithium	36	68
Anticonvulsants	19	32
Antiparkinsonian	50	42
Length of current hospitalization (days)		
M	7.0	5.0
SD	5.8	3.1

[a]BPRS = Brief Psychiatric Rating Scale.
[b]Sum of Emotional Withdrawal, Blunted Affect, and Motor Retardation.

ication data for the participants are provided in Table I.[4] Independent sample *t*-tests indicated that the schizophrenic and manic participants did not differ significantly in age, education, or total BPRS score. In addition, chi-square analyses indicated that the two groups did not differ in sex or race composition.

[4] Medication dosage, in chlorpromazine equivalents, was not significantly correlated with any of the language measures, either in the total sample, or among either the schizophrenic or manic patients alone. However, given the problems associated with the use of correlational analyses with medication dosage levels to examine medication effects on dependent variables (e.g., Blanchard & Neale, 1992), these analyses do not rule out the possibility that antipsychotic medications influence verbosity, syntactic complexity, or pausing.

Language Generation Ratings

To obtain speech samples for language ratings, participants completed a 10- to 15-min semistructured interview. This interview consisted of open-ended questions regarding interests and activities. Each interview was conducted by a research assistant who was blind to the participant's diagnosis and current level of symptomatology. The interviews were transcribed by one research assistant and checked for accuracy by two additional research assistants.

Verbosity. Verbosity was measured by counting the number of words per interview for each participant. The results presented below were similar when the average number of words per question was used as the measure of verbosity instead of total words per interview.

Syntactic Complexity. An advanced linguistics graduate student coded the number of independent and dependent clauses in each participant's transcribed speech sample. A Master's level linguist coded a subset of 12 speech samples. Interrater reliability, measured using an intraclass correlation coefficient with the raters treated as random effects and the individual rater as the unit of reliability, was .96 for independent clauses and .92 for dependent clauses. Syntactic complexity was measured by the average number of dependent clauses per T-unit. A T-unit is a single independent clause with all of its modifying subordinate clauses (Hunt, 1965).

Filled Pauses. Pauses, filled and unfilled, are influenced by both social and cognitive factors (e.g., Butterworth, 1980; Ford & Holmes, 1978). We utilized the number of filled pauses (e.g., "um," "ah") in each interview as our measure of pausing. The number of filled pauses was coded by two research assistants. Interrater reliability, measured using an intraclass correlation coefficient treating raters as random effects and the mean of the raters as the unit of reliability, was .99. A greater amount of speech is associated with more opportunities to produce pauses (Alpert et al., 1994). However, our interest was in determining whether decreased verbosity is associated with an increased likelihood of pausing in the same amount of speech. Thus, to correct for the number of opportunities, the number of filled pauses was divided by the number of words.

RESULTS

We began by examining the correlations among the various language measures in the combined sample of schizophrenic and manic participants. Less verbosity was strongly associated with less syntactic complexity ($r = .83, p < .05$) and moderately associated with greater pausing ($r = -.32, p$

Table II. Correlations and Descriptive Statistics Reported Separately for Schizophrenic and Manic Participants

	Schizophrenic participants			Manic participants		
	Verbosity	Syntactic complexity	Pausing	Verbosity	Syntactic complexity	Pausing
Verbosity	—	.80[c]	−.30[a]	—	.89[c]	−.36[a]
Syntactic complexity	—	—	−.14	—	—	−.44[b]
M	955.6	.16	.03	1,020.3	.22	.03
SD	583.7	.11	.02	654.1	.15	.02

[a] $p<.10$, one-tailed.
[b] $p<.05$, one-tailed.
[c] $p<.001$, one-tailed.

$< .05$). In addition, pausing was negatively correlated with syntactic complexity ($r = -.25$, $p < .07$).

Next we examined the similarity of the relationships among the language measures across diagnostic groups. Table II shows the correlations among the language measures calculated separately for schizophrenic and manic participants. As can be seen in Table II, the correlations within each group were similar to those for the total sample. Fisher's *Z*-tests indicated that none of the correlations among the language measures differed significantly between the two groups.[5]

We also examined whether schizophrenic and manic participants differed in syntactic complexity, verbosity, and pausing. As can be seen in Table II, there was a weak trend for schizophrenic participants to display less verbosity and syntactic complexity than manic participants. Independent sample *t*-tests did not reveal significant group differences on any of the language variables.

We were surprised by the absence of diagnostic group differences, and wondered whether the language measures might be related to different aspects of psychopathology among the two groups. Specifically, we hypothesized that verbosity, syntactic complexity, and filled pauses would be more strongly associated with negative symptoms than with excitement among schizophrenic patients, whereas we hypothesized that these language measures would be more strongly associated with excitement than with negative symptoms among manic patients. As can be seen in Table III, the pattern

[5] Although the correlation between pausing and syntactic complexity was not statistically significant in this sample of schizophrenic participants, we have found a stronger association between these two variables ($r = -.29$, $p < .05$; $N = 37$) in a different sample of schizophrenic participants (Barch & Berenbaum, 1996).

Table III. Correlations Between Clinical Symptoms and Language Measures

	Schizophrenic participants		Manic participants	
	Negative symptoms	Excitement	Negative symptoms	Excitement
Verbosity	−.39[b]	.06	−.20	.33[a]
Syntactic complexity	−.27	.04	.05	.29
Filled pauses	.04	.004	.14	−.34[a]

[a] $p<.10$, one-tailed.
[b] $p<.05$, one-tailed.

of correlations supports both of these hypotheses. One can view Table III as consisting of six pairs of correlations, three for the schizophrenic patients and three for the manic patients. For example, the correlation between verbosity and negative symptoms and the correlation between verbosity and excitement make up one pair of correlations for each of the two diagnostic groups. For each of the three pairs of correlations for schizophrenic patients, we predicted that the magnitude of the correlation with negative symptoms would be larger than the magnitude of the correlation with excitement. In contrast, for each of the three correlation pairs for manic patients, we predicted that the magnitude of the correlation with excitement would be larger than the magnitude of the correlation with negative symptoms. Our predictions were correct for all six pairs of correlations. The likelihood of our being correct in all six cases is .0156 (tested using the binomial probability table, with an expected probability of .5 for being correct by chance in each case). Thus, this pattern of correlations is unlikely to be the result of chance alone.

DISCUSSION

We found that, among both schizophrenic and manic participants, less verbosity was strongly related to less syntactic complexity, and moderately related to greater pausing. In addition, greater pausing was associated with less syntactic complexity. The finding that verbosity, syntactic complexity, and pausing are all interrelated is important because it provides guidance for theories of reduced verbosity in schizophrenia. These results are consistent with the hypothesis that deficits in verbosity, syntactic complexity, and pausing are influenced by a common etiological factor. The relationship of less verbosity to both less syntactic complexity and greater pausing is also consistent with the hypothesis that all three may be related to language production difficulties. We also found that the relationships among these

three aspects of language in both schizophrenic and manic participants were similar to those found in nonpsychiatric participants, using similar methods and dependent variables (Barch & Berenbaum, 1994).

We believe that research regarding normal language production can help us understand the results of this study and can contribute to the development of theoretically driven accounts of disturbances in verbosity, syntactic complexity and pausing. This belief is based on the assumption that the same processes determine verbosity, syntactic complexity, and pausing among both normal and schizophrenic individuals. The validity of this assumption is supported by our finding that the relationships among verbosity, syntactic complexity, and pausing are similar among individuals with schizophrenia and individuals with other or no psychiatric disorders.

We hypothesize that disturbances in the message generation component of language production contribute to deficits in verbosity, syntactic complexity, and pausing. Message generation involves planning and elaborating the conceptual content of speech. Language production theorists argue that, during message generation, a discourse plan is created which includes the topic of the discourse and the goals concerning the information one wishes to convey (Levelt, 1989). The development of such a discourse plan is thought to precede and/or guide the lexical, syntactic, and phonological formulation of speech (e.g., Levelt, 1989). Previous research in normals has demonstrated that pausing increases as the difficulty of message generation increases (Ford & Holmes, 1978; Lay & Paivio, 1970). We believe that message generation deficits could also affect verbosity because difficulty generating goals or accessing conceptual content may lead to less speech. Syntactic complexity may also reflect, at least partially, the complexity of ideas and connections between thoughts to be expressed. Therefore, we believe that difficulty generating a message and connecting concepts could also lead to less complex speech.

We believe that an association between verbosity and syntactic complexity is consistent with the hypothesis that reductions in both could be influenced by a disturbance in message generation. However, one might argue that an association between verbosity and syntactic complexity is not particularly surprising. Thus, it is worth pointing out that greater verbosity need not necessarily correspond to greater syntactic complexity. For example, we would have found that verbosity and syntactic complexity were *not* associated if some speakers said "John, who likes hotdogs, went to the grocery store" and some speakers said "John went to the grocery store. He likes hotdogs." Both speech samples are equally verbose (nine words) and express the same number of ideas, but one is more syntactically complex than the other. Instead, we found that some individuals tended to produce more words and ideas using more syntactically complex speech (e.g., "John,

who liked hotdogs, went to the grocery store''), whereas other individuals tended to produce fewer words and ideas using less syntactically complex speech (e.g., ''John went to the grocery store''), leading to a positive correlation between verbosity and syntactic complexity.

The hypothesis that message generation deficits contribute to disturbances in verbosity, syntactic complexity, and pausing may help explain how and why disturbances in strategic or capacity-demanding information processing, which may reflect working memory function, are linked to these language disturbances (e.g., Barch & Berenbaum, 1994; Cornblatt, Lenzenweger, Dworkin, & Erlenmeyer-Kimling, 1985; Neuctilerlein, Edell, Norris, & Dawson, 1986; Serper, 1993). Both theory and research suggest that message generation relies on working memory function and is more strategic or capacity demanding than other aspects of language production, such as phonological formulation (e.g., Ford & Holmes, 1978; Levelt, 1989; Power, 1986). Strategic information-processing disturbances among schizophrenic participants may be linked to greater pausing and lower verbosity and syntactic complexity because such disturbances impair message generation. Impairments in message generation may then lead to language deficits such as reduced verbosity.

Our message generation hypothesis is also consistent with research and theory regarding the role of the frontal cortex in deficits in verbosity, syntactic complexity, and pausing (Katsanis & Iacono, 1991; Morice, 1986; Stolar, Berenbaum, Banich, & Barch, 1994). Reduced verbosity has been attributed to disturbances in the ability to ''access or utilize abstract representations in the absence of external cues'' in both schizophrenia (Stolar et al., 1994) and frontal lobe lesion patients (Goldman-Rakic, 1987). It is likely that this ability, thought to be supported by the prefrontal cortex (Goldman-Rakic, 1987), is needed during message generation to develop and maintain a discourse plan that will guide language production. In addition, Morice (1986) has claimed that deficits in the ''executive'' coordination of language, presumably supported by the frontal cortex, underlie decreased syntactic complexity in schizophrenia. We believe that message generation is an integral part of language coordination because the development of a discourse plan helps guide and coordinate the conceptual, syntactic, lexical, and phonological aspects of speech. Thus, our message generation hypothesis may help clarify the mechanisms by which frontal lobe dysfunction, via disturbances in the ability to utilize abstract representations and/or language coordination, could lead to reduced syntactic complexity and verbosity. Both research and theory (e.g., Liddle, & Morris, 1991; Stolar et al., 1994) have also linked frontal deficits to other symptoms of schizophrenia, such as blunted affect, motor retardation, and social withdrawal, that are often referred to as ''negative'' symptoms. Thus, additional indirect support for the hypothesis that frontal deficits are associated with reductions in verbosity

and syntactic complexity is provided by our finding that, among schizophrenic patients, these aspects of language are associated with BPRS-rated negative symptoms.

In this study, we found that less verbosity was associated with a greater number of filled pauses. This result is compatible with previous findings of an association between less verbosity and longer unfilled pause durations (Alpert et al., 1993; Alpert et al., 1994; Resnick & Oltmanns, 1984). However, Alpert et al. (1994) found that more verbosity was associated with a greater number of between-clause filled pauses. The apparent discrepancy between our results and those of Alpert et al. (1994) may be due to methodological differences. Alpert et al. (1994) examined the frequency of pauses per minute of interview time (which does not control for number of words produced), whereas we examined the frequency of pauses corrected for the number of words produced. To determine whether this methodological difference explains the discrepancy between our results and those of Alpert et al. (1994), we examined the relationship between verbosity and the number of pauses uncorrected for the number of words. Similar to Alpert et al. (1994), we found that greater verbosity was associated with more (uncorrected) filled pauses ($r = .49$, $p < .01$). Because individuals who produce more speech have more opportunities to produce pauses (Alpert et al., 1994), we believe the critical issue is whether lower verbosity is associated with a higher likelihood of pausing given the same amount of speech. Although both we and Alpert et al. (1994) found that more verbosity is associated with a greater absolute number of filled pauses, our results indicate that less verbosity is associated with a higher likelihood of pausing in a given amount of speech. It is likely that examining unfilled pauses would provide additional evidence for an association between pausing, verbosity, and syntactic complexity. At a minimum, our results provide preliminary evidence that a greater likelihood of producing filled pauses is associated with reduced verbosity and syntactic complexity.

Our results indicated that the schizophrenic participants displayed slightly, but not significantly, less syntactic complexity and verbosity than the manic participants. This finding is inconsistent with previous research demonstrating significant group differences between manic and schizophrenic individuals in verbosity (e.g., Andreasen, 1979). Our failure to find significant group differences in verbosity and syntactic complexity may be related to the composition of our manic and schizophrenic groups. Our manic participants were tested after an average of 5 days in the hospital. All had been treated pharmacologically immediately upon admission and were no longer acutely manic, as indicated by their modest BPRS excitement scores. Furthermore, a fairly large percentage of our schizophrenic participants had primarily positive symptoms. Inspection of the raw data revealed

that only 27% were rated as displaying significant levels of negative symptoms on the BPRS (a rating of 3 or higher on either the blunted affect or motor retardation item). Thus, we may not have found significantly lower levels of verbosity and syntactic complexity among schizophrenic patients compared to manic patients because of the relatively low level of negative symptoms among our schizophrenic patients and because many of our manic patients were no longer acutely manic. This possibility is made more plausible by our finding that, among schizophrenic patients, *reduced* verbosity and syntactic complexity were associated with the presence of negative symptoms. Further, among manic patients, *increased* verbosity and syntactic complexity, as well as fewer filled pauses, were associated with increased excitement. Thus, had we examined a sample of schizophrenic patients with more negative symptoms and a sample of manic patients with more excitement, we might have found larger group differences in verbosity and syntactic complexity. These observations are consistent with previous research demonstrating heterogeneity of symptom expression and cognitive deficits among schizophrenic patients (Strauss, 1993) and again highlights the importance of utilizing a dimensional approach (e.g., Costello, 1992). Such a dimensional approach may be particularly useful for examining the relationships between deficits in verbosity, syntactic complexity, and pausing and potential etiological factors such as disturbances in message generation, information processing, and frontal functioning.

REFERENCES

Alpert, M., Clark, A., & Pouget, E. R. (1994). The syntactic role of pauses in the speech of schizophrenic patients with alogia. *Journal of Abnormal Psychology, 103*, 750–757.

Alpert, M., Pouget, E. R., Welkowitz, J., & Cohen, J. M. (1993). Mapping schizophrenic negative symptoms onto measures of the patient's speech: Set correlational analysis *Psychiatry Research, 48*, 181–190.

American Psychological Association. *Diagnostic and statistical manual of mental disorders* (3rd ed., rev.). Washington, DC: Author.

Andreasen, N. (1979). Thought, language, and communication disorders: II. Diagnostic significance. *Archives of General Psychiatry, 36*, 1325–1330.

Barch, D. M., & Berenbaum, H. (1994). The relationship between information processing and language production. *Journal of Abnormal Psychology, 103*, 241–250.

Barch, D. M., & Berenbaum, H. (1996). [Verbosity, pausing, and syntactic complexity among schizophrenic patients]. Unpublished raw data.

Berenbaum, H., & Barch, D. M. (1995). The categorization of thought disorder. *Journal of Psycholinguistic Research, 24*, 349–376.

Blanchard, J. J., & Neale, J. M. (1992). Medication effects; Conceptual and methodological issues in schizophrenia research. *Clinical Psychology Review, 12*, 345–361.

Butterworth, B. (1980). Evidence from pauses in speech. In B. Butterworth (Ed.), *Language production* (pp. 155–176). London, England: Academic Press.

Cornblatt, B. A., Lenzenweger, M. F., Dworkin, R. H., & Erlenmeyer-Kimling, L. (1985).

Positive and negative symptoms, attention, and information processing. *Schizophrenia Bulletin, 11*, 397–407.

Costello, C. G. (1992). Research on symptoms versus research on syndromes: Arguments in favor of allocating more research time to the study of symptoms. *British Journal of Psychiatry, 160*, 304–308.

Ford, M., & Holmes, V. M. (1978). Planning units and syntax in sentence production. *Cognition, 6*, 35–53.

Goldman-Rakic, P. S. (1987). Circuitry of primate prefrontal cortex and regulation of behavior by representational memory. In F. Plum & V. Mountcastle (Eds.), *Handbook of physiology* (Vol. 5, pp. 373–417). Bethesda, MD: American Physiological Society.

Hunt, K. (1965). *Grammar structures written at three grade levels* (Research Report 3). Urbana, IL: NCTE.

Jou, J., & Harris, R. J. (1992). The effect of divided attention on speech production. *Bulletin of the Psychonomic Society, 30*, 301–304.

Katsanis, J., & Iacono, W. G. (1991). Clinical, neuropsychological, and brain structural correlates of smooth-pursuit eye tracking performance in chronic schizophrenia. *Journal of Abnormal Psychology, 100*, 526–534.

Lay, C. H., & Paivio, A. (1970). The effects of task difficulty and anxiety on hesitations in speech. *Canadian Journal of Behavioral Science, 1*, 25–37.

Levelt, W. J. M. (1989). *Speaking: From intention to articulation*. Cambridge, MA: MIT Press.

Liddle, P. F., & Morris, D. L. (1991). Schizophrenic syndromes and frontal lobe performance. *British Journal of Psychiatry, 158*, 340–345.

Lukoff, D. (1986). Symptom monitoring in the rehabilitation of schizophrenic patients. Special issue: Psychiatric rehabilitation. *Schizophrenia Bulletin, 12*, 578–593.

Morice, R. D. (1986). Beyond language—speculations on the prefrontal cortex and schizophrenia. *Australian and New Zealand Journal of Psychiatry, 20*, 7–10.

Morice, R. D., & Ingram, J. C. L. (1983). Language complexity and age of onset of schizophrenia. *Psychiatry Research, 9*, 233–242.

Nuechterlein, K. H., Edell, W. S., Norris, M., & Dawson, M. E. (1986). Attentional vulnerability indicators, thought disorder, and negative symptoms. *Schizophrenia Bulletin, 12*, 408–426.

Power, M. J. (1986) A technique for measuring processing load during speech production. *Journal of Psycholinguistic Research, 15*, 371–382.

Resnick, H. S., & Oltmanns, T. F. (1984). Hesitation patterns in the speech of thought-disordered schizophrenic and manic patients. *Journal of Psycholinguistic Research, 93*, 80–86.

Rochester, S. R., Thurston, S., & Rupp, J. (1977). Hesitations as clues to failures in coherence: Studies of the thought-disordered speaker. In S. Rosenberg (Ed.), *Sentence production: A handbook of theory and practice*. New York: Erlbaum.

Serper, M. R. (1993). Visual controlled information processing resources and formal thought disorder in schizophrenia and mania. *Schizophrenia Research, 9*, 59–66.

Spitzer, R. L., Williams, J. B. W., Gibbon, M., & First, M. B. (1992). The structured clinical interview for DSM-III-R (SCID): I. History, rationale, and description. *Archives of General Psychiatry, 49*, 624–629.

Stolar, N., Berenbaum, H., Banich, M. T., & Barch, D. M. (1994). Neuropsychological correlates of alogia and affective flattening in schizophrenia. *Biological Psychiatry, 35*, 164–172.

Strauss, M. (1993). Relations of symptoms to cognitive deficits in schizophrenia. *Schizophrenia Bulletin, 19*, 215–232.