ELSEVIER

The effect of language production manipulations on negative thought disorder and discourse coherence disturbances in schizophrenia

Deanna M. Barch*, Howard Berenbaum

Department of Psychology, University of Illinois at Urbana-Champaign, 603 E. Daniel, Champaign, IL 61820, USA

Abstract

This study was designed to test the following hypotheses about the mechanisms underlying language disturbances in schizophrenia: (1) negative thought disorder (reduced verbosity and syntactic complexity, increased pausing) reflects a deficit generating a discourse plan; and (2) discourse coherence disturbances (tangential responses, loss of goal, derailment, non-sequiturs, distractible speech) reflect a deficit maintaining a discourse plan. Thirty-nine participants with DSM-III-R schizophrenia listened to two stories and answered a series of questions after each story. We manipulated two factors: (1) the presence of context before the stories (to influence generating a discourse plan); and (2) question type (structured vs. unstructured; designed to influence maintaining a discourse plan). Consistent with our hypotheses, low context was associated with less verbose and syntactically complex speech. In addition, patients produced more discourse coherence disturbances when responding to unstructured than when responding to structured questions. © 1997 Elsevier Science Ireland Ltd.

* Corresponding author. Western Psychiatric Institute and Clinic, 3811 O'Hara St., Pittsburgh, PA 15213, USA. Tel.: +1 412 3832173; fax: +1 412 6243429; e-mail: dmb1@pitt.edu.

1. Introduction

Numerous theorists have emphasized the centrality of a wide variety of language disturbances in schizophrenia. Based on their covariation, language disturbances in schizophrenic patients can be grouped into a number of broad categories, two of which are the focus of this article. The first, which we refer to as *negative thought disorder*, consists of reduced verbosity, reduced syntactic complexity, and increased pausing.[1] Several studies have shown that these phenomena tend to covary in schizophrenic patients (Resnick and Oltmanns, 1984; Alpert et al., 1993, 1994; Barch and Berenbaum, 1996), manic patients (Barch and Berenbaum, in press) and healthy controls (Daneman, 1991; Barch and Berenbaum, 1994). The second dimension, which we refer to as *discourse coherence disturbances* (Berenbaum and Barch, 1995), includes a subset of the classic subtypes of formal thought disorder (e.g. tangential responses, loss of goal, derailments, nonsequitur responses, distractible speech), as well as incompetent references. Again, numerous studies have demonstrated that these types of language disturbances tend to covary among schizophrenic patients (e.g. Andreasen, 1979; Harvey et al., 1992).

This study was designed to test the hypothesis that these two categories of language disturbances both reflect proximal deficits in the language production (LP) system, but each reflects a deficit in a different component of LP. We first describe this hypothesis in more detail and summarize supporting evidence.Next, we present the argument that, if LP disturbances in schizophrenia reflect deficits in the LP system, then manipulations that influence LP should also affect negative thought disorder and/or discourse coherence disturbances. Finally, we describe the specific manipulations of LP used in this study, and describe our a priori predictions about the effects of these manipulations on negative thought disorder and discourse coherence disturbances.

Drawing upon the psycholinguistic and cognitive literatures, we hypothesized that both negative thought disorder and discourse coherence disturbances among schizophrenic patients reflect LP deficits, but each may reflect a disturbance in a different component of LP. Specifically, we have suggested that negative thought disorder reflects a disturbance in generating a discourse plan (Barch and Berenbaum, in press). Generating a discourse plan involves planning and elaborating the conceptual content of speech. LP 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). As such, generating a discourse plan requires selecting ideas to be expressed, retrieving concepts or ideas from long-term memory, and connecting such ideas in a logical format. In healthy controls, research has demonstrated that both the frequency and duration of pausing increases as the difficulty of discourse generation increases (Lay and Paivio, 1970; Ford and Holmes, 1978). We believe that discourse generation deficits could also affect verbosity because difficulty generating goals or accessing conceptual content may lead to less speech. Difficulty generating a message and connecting concepts could also lead to less complex speech, if syntactic complexity also reflects the complexity of ideas and connections between thoughts to be expressed.

We (Barch and Berenbaum, in press) and others (e.g. Hoffman, 1987) have suggested that discourse coherence disturbances reflect deficits in the ability to maintain a discourse plan and to monitor the ongoing content of speech. Maintaining a discourse plan, as well as monitoring one's own output and the output of others to appropriately update this plan, is thought to support the production of an ongoing stream of coherent and connected discourse. For example, healthy controls who have difficulty maintaining discourse information also have difficulty producing clear references (Pratt et al., 1989). Further, in previous work we demonstrated that deficits on a task

---

[1]In prior work, we have found strong relationships between clinical ratings of poverty of speech and quantitative measures of verbosity and syntactic complexity (Berenbaum and Barch, 1997).

measuring the ability to maintain a discourse plan were associated with at least some subtypes of discourse coherence disturbances among schizophrenic patients (Barch and Berenbaum, 1996). In addition, several studies have found a relationship between global measures of positive thought disorder (whose composition included disturbances in discourse coherence) and deficits in the ability to monitor the source of speech (e.g. Harvey et al., 1990; Harvey and Serper, 1990) or to use prior discourse context to resolve ambiguous lexical items (Cohen et al., 1997). Thus, a number of different lines of research are consistent with the hypothesis that discourse coherence disturbances are associated with deficits in the ability to maintain a discourse plan and monitor the ongoing content of speech.

Our hypotheses about the mechanisms underlying LP disturbances in schizophrenic patients are derived primarily from the results of correlational studies. However, the use of experimental manipulations can improve our ability to explicitly test our hypotheses. If the hypotheses outlined above are correct, then manipulating factors that influence specific components of LP should also influence negative thought disorder and discourse coherence disturbances among schizophrenic patients. To examine the effect of such manipulations on LP, we developed a paradigm in which participants listen to stories and then answer a series of questions. This paradigm provides some degree of experimental control over the input to the LP system (i.e. semantic content, type of question), while still allowing for externally valid and realistic LP (i.e. natural responses to questions). Below we discuss two factors that may influence LP in the context of this experimental paradigm.

Although a great deal of theoretical work has been devoted to models of LP, relatively little empirical research has explored the factors that influence various components of LP. There is, however, a large literature on factors that influence language comprehension and memory processes. This literature may be able to provide clues concerning which factors influence LP in schizophrenic patients. As described above, gen-

erating a discourse plan is thought to involve the retrieval of conceptual information from working memory and/or long-term memory (e.g. Levelt, 1989). Thus, one factor that could influence the generation of a discourse plan is the ease of retrieving conceptual information to be expressed in speech. A number of studies have shown that both memory retrieval and language comprehension are influenced by the presence or absence of prior context (Summers et al., 1985; Kintsch, 1994). In memory retrieval, the presence of prior context is thought to provide additional cues for encoding which facilitate later retrieval of information (Summers et al., 1985). In the case of comprehension, the presence of prior context is thought to activate previously stored schemas (Schank and Abelson, 1977) that facilitate semantic processing of information (Kintsch, 1994). Prior context could play a similar role in LP. In the paradigm we employed, we attempt to manipulate the retrieval of information to be used in LP. We do so by either providing, or not providing, prior context for the story. The presence of contextual cues may facilitate the retrieval of information during message generation. If so, then we would expect the presence of prior context to be associated with less negative thought disorder, whereas the absence of such context should be associated with greater negative thought disorder.

A second factor that may influence LP is the structure of the question used to elicit a response. A 'structured' question that asks for specific information may provide a clear and concrete discourse topic, and thus facilitate the maintenance of an appropriate discourse plan. In contrast, an 'unstructured' question that provides only a vague and ill-defined topic might impede the maintenance of a discourse plan. We have hypothesized that deficits in maintaining a discourse plan contribute to discourse coherence disturbances. Thus, if question structure does influence the maintenance of a discourse plan, we would expect fewer disturbances in discourse coherence with structured questions, and more discourse coherence disturbances with unstructured questions.

The goal of this study was to test the hypothesis that factors influencing the generation or the

maintenance of a discourse plan should influence negative thought disorder and disturbances in discourse coherence among schizophrenic patients. To do so, we examined the impact that the following two factors had on LP: (1) the degree of prior context; and (2) question type (structured vs. unstructured). We predicted that: (1) participants who were provided with low context would exhibit less verbosity and syntactic complexity than participants who were provided with high context; and (2) participants would exhibit greater discourse coherence disturbances in response to unstructured questions than they would in response to structured questions.

2. Methods

2.1. Participants

Participants were 39 individuals with DSM-III-R schizophrenia, who were hospitalized at the time of their participation in the research project. Diagnoses were based on the psychotic and mood disorders sections of the Structured Clinical Interview for DSM-III-R (SCID, Spitzer et al., 1992) and a review of the participants' clinical records. The interviews were completed by one of the authors (DMB) who had extensive experience us-

ing a variety of different structured clinical interviews. Participants were excluded from the study for: (1) a score below 21 on the Mini-Mental State Examination (MMS, Folstein et al., 1975); (2) substance abuse within the past 6 months; (3) seizure disorders; (4) a history of head trauma; or (5) English as a second language. All but five of the participants were receiving some type of psychotropic medication. Additional demographic and clinical characteristics of the participants are shown in Table 1.

To explore the relationship between verbal intelligence and LP disturbances, the interviewer obtained a measure of each participant's verbal intelligence using the Peabody Picture Vocabulary Test — Revised (PPVT-R, Dunn and Dunn, 1981). One participant was unable to complete the PPVT-R. The mean standard score on the PPVT-R for the remaining 38 participants was 81.8 (S.D. = 21.5, range = 41–121).

2.2. Materials

2.2.1. Stories

Two stories were developed that were similar in structure and content. Each story described a series of events that involved one or more people. One story described a woman taking a walk and a series of events that occurred during the walk.

Table 1
Clinical and demographic characteristics of participants

Characteristic	Low context (n = 17)		High context (n = 22)	
	Mean	S.D.	Mean	S.D.
Age	32.0	(7.5)	37.4	(10.1)
Education (in years)	13.8	(1.5)	13.5	(2.5)
Mini-Mental State Examination	27.6	(2.4)	27.5	(1.6)
Peabody Picture Vocabulary Test	77.0	(18.6)	85.9	(24.1)
Age at first hospitalization (in years)	21.0	(5.7)	23.9	(9.0)
Number of previous hospitalizations	7.9	(5.0)	8.6	(6.3)
Length of current hospitalizations	311.8	(443.2)	236.0	(380.4)
Chlorpromazine equivalents[a]	1005.5	(715.6)	1428.0	(1593.7)
Total BPRS score	44.3	(12.6)	45.0	(11.7)

[a] Calculated using only those patients receiving neuroleptics. Note: daily oral doses of neuroleptics were converted to chlorpromazine equivalents according to guidelines suggested by Davis et al. (1993). Depot doses were converted to average daily dosages using the guidelines suggested by Baldessarini (1985).

The second story described a meeting of a card club and the series of events that occurred during their meeting.[2]

2.2.2. Questions

Each story was followed by three questions — one unstructured, and two structured. We defined 'structured' as a question that provided a specific, circumscribed topic. We defined 'unstructured' as a question that provided a vague, general topic. The questions were designed to be identical in length and type for the two stories. For both stories, the unstructured question was 'Please tell me something about this story.' For the short story, the structured questions were 'What did Anna do on her walk before work?' and 'In your opinion, what kind of person is Anna?' For the long story, the structured questions were 'What did the card club do during its meeting?' and 'In your opinion, what kind of person would like to join this club?'

2.2.3. Context

Presentation of each of the stories was preceded by one of two sets of instructions. One set simply told participants that they would be hearing a story and that they would be asked questions following the story (low context condition). The second set of instructions also told participants that they would be hearing a story and that they would be asked questions following the story. However, these instructions also told participants what the story was about and the type of questions they would be asked (high context condition).

---

[2] We attempted to manipulate the influence of working memory function on LP by varying story length. Our hypothesis was that longer stories would use more working memory resources. However, story length did not have an influence on the language variables. In retrospect, this was not surprising because both stories contained a relatively large quantity of information, and only a relatively small amount of information can be maintained in working memory at any one time (Baddeley, 1994). Thus, the processing requirements for both stories probably exceeded those available in working memory (Ericsson and Kintsch, 1995).

2.3. Procedure

A research assistant, blind to the participant's diagnosis and current level of symptomatology, conducted the experimental portion of the study. A predetermined written protocol was used to guide the administration of the experimental tasks. Both stories were audiotaped in the same woman's voice and presented to the participant via earphones. Question type was manipulated within participants, such that each subject answered all questions following each story. Order of story administration, and of question administration following each story, was counterbalanced across participants. Context was manipulated between participants, in that each participant received only one instruction type (low vs. high context), which was the same for both stories. Participants were randomly assigned to one of the context conditions.

2.4. Language ratings

Each subject's responses to all questions after each story were transcribed by one research assistant and checked for accuracy by two additional research assistants. These transcripts were used to make all of the language ratings described below.

2.4.1. Verbosity

Verbosity was measured by counting the number of words per interview for each participant.

2.4.2. Syntactic complexity

One of two advanced speech communications graduate students coded the number of independent and dependent clauses in each participant's transcribed speech sample. A subset of 10 transcripts were rated by both graduate students in order to calculate interrater reliability. 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 0.93 for independent clauses and 0.71 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).

2.4.3. Formal thought disorder ratings (FTD)

A trained undergraduate research assistant scored the categories from the Scale for the Assessment of Thought, Language, and Communication (TLC, Andreasen, 1986) that we believe reflect disturbances in discourse coherence: (1) tangential responses; (2) loss of goal; (3) derailment; (4) non-sequiturs; and (5) distractible speech (Berenbaum and Barch, 1995). Ratings of these categories used the revised definitions described by Berenbaum et al. (1985). We summed the number of occurrences for each of the subtypes together to create a total FTD score. To correct for verbosity, the total FTD score was divided by the number of T-units (independent clauses). T-units rather than words were used to correct for verbosity given that the phenomena included in discourse coherence typically cannot occur more than once per T-unit. A subset of 14 transcripts were also rated by one of the authors (DMB), for the purpose of calculating interrater reliability. Interrater reliability, measured using an intraclass correlation treating the raters as random effects and the individual rater as the unit of reliability, was 0.90 for the total FTD score.

2.4.4. Incompetent references

A trained BA level research assistant rated incompetent references according to the criteria outlined by Halliday and Hasan (1976). An incompetent reference was defined as a demonstrative, personal, or comparative reference with either an unrecoverable referent or with two or more possible referents. To correct for verbosity, the number of incompetent references was divided by the number of words. A subset of 26 transcripts was also rated by one of the authors (DMB), for the purpose of calculating interrater reliability. Interrater reliability, measured using an intraclass correlation treating the raters as random effects and the individual rater as the unit of reliability, was 0.73.

In summary, the four measures of LP examined in the data analyses were: (1) verbosity as measured by the total number of words; (2) syntactic complexity as measured by the number of dependent clauses per T-unit; (3) the number of FTD disturbances per T-unit; and 5) the number of incompetent references per word. Each participant had two scores for each ofthese variables, one for each question type (structured, unstructured). There was one unstructured question, but there were two structured questions. Therefore, a single structured question score was computed by averaging the scores for the two structured questions.

2.5. Data analyses

The effects of context and question type were explored using two MANOVAs, with the dependent variables categorized into two conceptual groups: (1) negative thought disorder, as measured by verbosity and syntactic complexity; and (2) discourse coherence disturbances, as measured by FTD and incompetent references. For each of the two MANOVAs, context (low vs. high context) was a between-subjects factor, and question type (structured vs. unstructured) was a within-subject factor. Significant effects were followed with planned comparisons. The measures scored as proportions (all but number of words) had non-normal distributions. For these dependent measures, we used an arcsine transformation to normalize the data for the MANOVA analysis (Neter et al., 1990).

3. Results

3.1. Negative thought disorder

We began by examining the influence of context and question type on the measures of verbosity and syntactic complexity (means and standard deviations in Table 2). The MANOVA revealed significant main effects of context ($F_{1,37}$ = 3.37, $P < 0.05$) and question type ($F_{1,37}$ = 7.86, $P < 0.001$). The interaction was not significant. Univariate ANOVAs were used to follow-up on the significant main effects. As predicted, participants displayed greater syntactic complexity ($F_{1,37}$

= 4.17, $P < 0.05$) with high context than they did with low context. In addition, there was a trend for participants to display greater verbosity ($F_{1,37}$ = 3.26, $P < 0.08$) with high context than they did with low context. The main effect of question type was due to participants displaying greater verbosity ($F_{1,37}$ = 5.34, $P < 0.05$) and greater syntactic complexity ($F_{1,37}$ = 8.98, $P < 0.01$) when responding to unstructured questions than when responding to structured questions.

3.2. Discourse coherence disturbances

This MANOVA revealed a significant main effect of question type ($F_{2,36}$ = 5.39, $P < 0.01$). No other main effects or interactions were significant. The means and standard deviations for FTD and incompetent references are shown in Table 2. Consistent with our hypothesis, participants displayed significantly more instances of FTD when responding to the unstructured question than when responding to the structured questions ($F_{1,37}$ = 7.30, $P < 0.05$). Participants also displayed more incompetent references in response to the unstructured question than in response to the structured questions, but this effect was not statistically significant ($F_{1,37}$ = 2.50, $P = 0.12$).

3.3. Correlations among language variables

We next examined the correlations among the language variables. Because the distributions of some of the measures were positively skewed, we utilized Spearman rank-order correlations instead of Pearson product–moment correlations. As predicted, lower verbosity was strongly associated with lower syntactic complexity ($r = 0.42$, $P < 0.01$). Also as predicted, FTD and incompetent references were strongly positively associated ($r = 0.57$, $P < 0.01$). We also examined the relationship between negative thought disorder and discourse coherence disturbances. To do so, we created total scores for discourse coherence disturbances and negative thought disorder. The total score for discourse coherence disturbances was the sum of the z-scores for FTD and incompetent references. The total score for negative thought disorder was the sum of the z-scores for verbosity and syntactic complexity; this total score was reverse coded so that a higher number indicated greater negative thought disorder. There was a strong inverse correlation between negative thought disorder and discourse coherence disturbances ($r = -0.43$, $P < 0.01$).

Table 2
Means and standard deviations for language variables

Language variable	Question type			
	Structured		Unstructured	
	Mean	S.D.	Mean	S.D.
Number of words				
Low context	27.3	(21.4)	71.5	(48.7)
High context	69.3	(121.2)	163.7	(245.3)
Dependent clauses per T-unit				
Low context	0.06	(0.08)	0.18	(0.24)
High context	0.14	(0.12)	0.25	(0.20)
Discourse coherence (no. of FTD occurrences per T-unit)				
Low context	0.006	(0.018)	0.088	(0.245)
High context	0.002	(0.007)	0.080	(0.173)
Incompetent references per word				
Low context	0.0019	(0.010)	0.0005	(0.010)
High context	0.0009	(0.001)	0.0059	(0.010)

3.4. Correlations between language variables and clinical / demographic variables

Independent sample t-tests indicated that participants in the high context and low context conditions did not differ significantly on any clinical or demographic variables. However, participants in the high context condition tended to be slightly older, to have scored higher on the PPVT, to be taking higher doses of antipsychotic medications, and to have been in the hospital a shorter length of time, even though these differences were not statistically significant. To examine whether any of these variables might have been mediating the effects of prior context on LP, we examined the correlations between the clinical/demographic variables and the language measures. The language variables were not associated with age (average $r = -0.02$; range, -0.20 to 0.20), PPVT scores (average $r = -0.08$; range, -0.07 to 0.10), chlorpromazine equivalents (average $r = -0.07$; range, -0.21 to 0.10), or length of current hospitalization (average $r = 0.06$; range, -0.05 to 0.15). This pattern of correlations suggests that the effects of prior context on LP among schizophrenic patients were not the result of potential clinical or demographic differences between groups.

4. Discussion

The results of this study provide support for our hypothesis that both negative thought disorder and disturbances in discourse coherence among schizophrenic patients reflect deficits in specific components of LP. Furthermore, the experimental manipulations used in this study allow us to draw stronger causal inferences regarding the relationships between deficits in LP components and language disturbances in schizophrenic patients than could be drawn using a correlational design. As predicted, the manipulation designed to influence the generation of a discourse plan altered the level of negative thought disorder among schizophrenic patients. Specifically, the degree of context (low vs. high) in our LP paradigm influenced the level of verbosity and syntactic complexity among schizophrenic

patients. Compared with patients in the low context condition, patients in the high context condition said more, and what they said was more syntactically complex. This finding provides support for the hypothesis that the presence of prior context influences the retrieval of information during the generation of a discourse plan, and that disturbances in generating a discourse plan are associated with decreased verbosity and syntactic complexity among schizophrenic patients.

As predicted, the manipulation designed to affect the maintenance of a discourse plan influenced the level of discourse coherence disturbances among schizophrenic patients. Specifically, participants displayed significantly fewer instances of FTD in response to the structured questions than in response to the unstructured question. Although participants also displayed fewer incompetent references in response to structured vs. unstructured questions, this difference was not statistically significant. Our logic in varying the type of question was that structured questions would serve to provide a clear and specific discourse topic, and thus would facilitate the maintenance of the discourse topic and plan. As discussed in the introduction, we have suggested that discourse coherence disturbances among schizophrenic patients reflect deficits in the ability to maintain a discourse topic/plan and to monitor appropriately the ongoing content of speech. Thus, finding that responses to more structured and focused questions contained less FTD supports this hypothesis. Negative thought disorder also varied with question structure, in that participants displayed less negative thought disorder with unstructured questions. This result is the opposite of what one would predict if structure were positively influencing the initiation of a discourse plan. Thus, these findings are consistent with the hypothesis that the presence of structure improves the maintenance of a discourse plan (i.e. fewer discourse coherence disturbances), but does not improve the initiation of a discourse plan (i.e. no decrease in negative thought disorder).

Consistent with prior research, we found that the two measures of negative thought disorder (verbosity and syntactic complexity) were strongly

associated among schizophrenic patients. We also found that the two measures of discourse coherence disturbances (incompetent references and formal thought disorder) were strongly associated. Furthermore, we found a strong negative correlation between negative thought disorder and discourse coherence disturbances. In other words, lower verbosity and syntactic complexity were associated with fewer discourse coherence disturbances, whereas greater verbosity and syntactic complexity were associated with more discourse coherence disturbances. This was true even though the measures of discourse coherence were corrected for verbosity.

The presence of a strong correlation, even though negative, between negative thought disorder and discourse coherence disturbances suggests that these two dimensions of language disturbances in schizophrenic patients are not independent. In previous work (Barch and Berenbaum, 1994), we hypothesized that a common, more general cognitive disturbance — a deficit in working memory function — contributes to both: (1) deficits generating a discourse plan (and thus negative thought disorder); and (2) deficits maintaining a discourse plan and monitoring the ongoing content of speech (and thus discourse coherence disturbances). On the surface, this might seem like a counterintuitive proposal. However, deficits on tasks thought to measure working memory function have been linked to both negative thought disorder (Nuechterlein et al., 1986) and discourse coherence disturbances (Serper, 1993; Strauss et al., 1993; Docherty et al., 1996; Cohen et al., 1997). In addition, research with healthy controls has shown that reduced working memory capacity is associated with both: (a) reduced verbosity, reduced syntactic complexity, and increased pausing (Daneman, 1991; Barch and Berenbaum, 1994); and (b) increased referential errors (Pratt et al., 1989; Daneman, 1991) and off-target verbosity, which is extended speech that is lacking in focus or coherence (Arbuckle and Gold, 1993). Interestingly, studies often find negative correlations between discourse coherence disturbances and reduced verbosity, suggesting that schizophrenic patients tend not to display both types of LP disturbances simultaneously (e.g. Andreasen, 1979; Oltmanns et al., 1985; Harvey and Serper, 1990). As a means of explaining these findings, we proposed that negative thought disorder and discourse coherence disturbances reflect tradeoffs in the way schizophrenic patients respond to reduced working memory resources
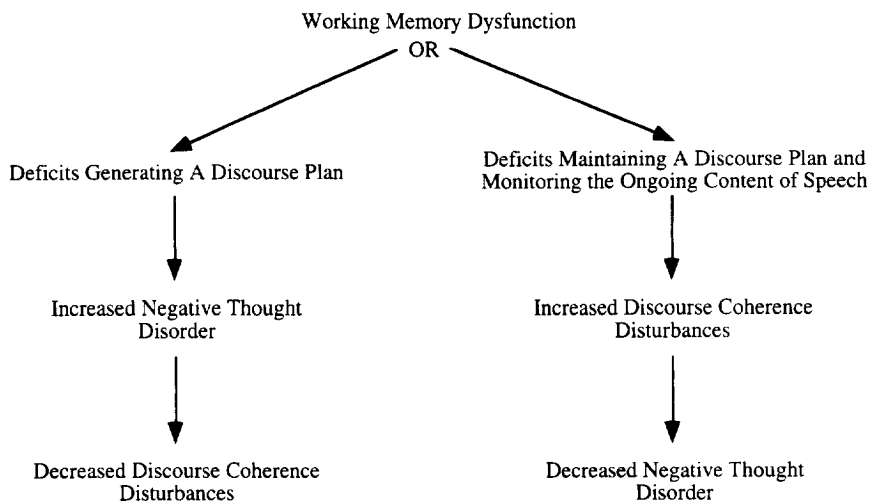

Fig. 1. Relationships between working memory dysfunction, deficits in language production, negative thought disorder and discourse coherence disturbances.

(Barch and Berenbaum, 1994). Thus, as illustrated in Fig. 1, we propose that reduced working memory function can contribute to either: (1) difficulties generating a discourse plan; or (2) difficulties maintaining a discourse plan and monitoring the ongoing content of speech. In other words, this hypothesis suggests that discourse coherence disturbances and negative thought disorder are inversely correlated because: (a) conserving working memory resources by reducing verbosity and syntactic complexity leaves resources available for maintaining a discourse plan, which in turn leads to fewer discourse coherence disturbances; and (b) continuing to produce relatively verbose and syntactically complex speech does not leave enough resources available for maintaining a discourse plan, which in turn leads to a greater number of discourse coherence disturbances.

The finding of a negative correlation between negative thought disorder and discourse coherence disturbances is consistent with our hypothesis that these two types of language disturbances reflect alternative manifestations of a deficit in working memory capacity. However, at least two other explanations for the negative correlation between discourse coherence disturbances and negative thought disorder are possible. One possibility is that individuals who produce more speech simply have more opportunities to produce discourse coherence disturbances. However, we used discourse coherence measures that were corrected for verbosity, which argues against this hypothesis. Another possibility is that the act of producing discourse coherence disturbances (e.g. losing one's goal) leads individuals to produce more speech. The use of experimental manipulations, similar to the ones employed in this study, will help determine which of these hypotheses best explains the negative correlation between discourse coherence disturbances and negative thought disorder. Specifically, we need to conduct further research that manipulates the level of verbosity and/or syntactic complexity and examines its impact on disturbances in discourse coherence. It should also be noted that support for the hypothesis that negative thought disorder and discourse coherence disturbances reflect al-

ternative manifestations of a working memory deficit will not provide a complete account of such language disturbances. A more complete account of language deficits in schizophrenia will need to specify what factors determine when working memory dysfunction leads to reduced verbosity and syntactic complexity (avoiding discourse coherence disturbances) as opposed to when working memory dysfunction leads to adequate verbosity and syntactic complexity with increased discourse coherence disturbances.

This study was designed to examine factors that influence LP in schizophrenic patients, and thus did not include a control group. One might wonder, however, how controls would have performed in our paradigm. In prior work, we hypothesized that non-schizophrenic and schizophrenic participants lie at different points along the continua of language and information processing function, but that the relationships between language and information processing are similar in the two groups (Barch and Berenbaum, 1994). This hypothesis is based on the assumption that cognitive disturbances in schizophrenic patients represent a quantitative, and not a qualitative, change from normal functioning. As pointed out by Maher (1988), there is a case to be made that psychological processes should be assumed to be normal until their pathological nature has been demonstrated independently (p. 333). Thus, we predict that controls will show similar effects of structure and question type on language output, although perhaps to a lesser degree.

The results of this study have potential implications for compensatory strategies to be used when working with schizophrenic patients. In particular, our finding regarding the relationship between question type and discourse coherence disturbances suggests that communication with patients displaying significant formal thought disorder may be improved by structuring the discourse interaction. Anecdotally, clinicians and researchers have often noted this fact, reporting that patients are more coherent with brief, focused questions, and tend to perform better in structured situations. This study begins to provide empirical support for these anecdotal observations, as well as a theoretical explanation for the positive influence of

structure on schizophrenic patients. In addition to question structure, there are other potential factors that might support the maintenance and updating of a discourse plan, and thus might help reduce discourse coherence disturbances. For example, Hoffman and Satel (1993) recently reported preliminary evidence that training patients to develop and maintain appropriate discourse plans led to a reduction in language processing disturbances.

Acknowledgements

Appendix

Story 1

Anna Thompson is from Chicago. She has been living in the city for two years. For the past year, Anna has been working in a department store. One day, Anna woke up early. It was a beautiful day, so she decided to go for a walk before work. After taking a quick shower, Anna went outside. When she walked out her door, Anna saw her neighbor leaving for work. Anna stopped and said hello to her neighbor. Anna then left for her walk. Anna was hungry, so she stopped at a bakery and bought some rolls. While she was walking, Anna saw a big crowd gathered around a store. When she got closer to the people, Anna saw two clowns in the middle of the crowd. The clowns were juggling balls and doing tricks. Anna stopped to watch the clowns. The people in the crowd were laughing and smiling. They seemed to be enjoying the clowns' performance. Anna saw a sign that said a circus was coming to town. The clowns were from the circus. Finally, Anna decided she should walk home. Anna thought it would be fun to see the circus. It took about ten minutes for Anna to walk home. On the way home, Anna stopped and picked up a newspaper. As she walked into the house, Anna decided that taking a walk before work was a good idea.

Story 2

The Diamond Club is a card club. Every week the Diamond Club gets together and plays cards. The Diamond Club started two years ago. The members have been meeting every week since the club started. There are five people in the Diamond Club right now. Each week the club meets at a different members house. This week the Diamond Club is meeting at Sally's house. Sally started the Diamond Club. She has always loved to play cards. The members of the club arrived at Sally's house around six o'clock. Everyone was happy to see each other. Sally asked if anyone was thirsty. Everyone in the club was thirsty, so Sally made some lemonade. Sally made enough lemonade to last all night. She knew her friends would want more lemonade later. It was a little crowded at Sally's house. She did not have enough chairs for everyone to sit on. The members of the club did not mind. They decided to just sit on the floor. For a while everyone sat and talked and drank lemonade. After a while, Sally suggested that they have dinner. It was getting late, so everyone agreed. Sally had made dinner. She knew everyone in the club liked Mexican food, so she had made tacos and nachos. Sally made a lot of food because she knew that everyone would be hungry. Since there were not enough chairs, the club decided to have a picnic dinner. They spread out a blanket on the floor and ate dinner sitting on the floor. The dinner was very good. Everyone kept telling Sally what a good cook she was. In fact, the food was so good that the Diamond Club ate all of it. Everyone helped clean up after dinner. After they finished the dishes, everyone sat down again. It was time to start playing cards. After talking about it for a while, they decided to play hearts. This was everyone's favorite card game. Sally dealt the cards and everyone started to play. All the club members were good at playing cards, so the game was pretty exciting. A different person won each hand. However, it did

not matter who won. The members of the Diamond Club just liked to have fun playing. After they had played hearts for a while, they decided to try a different game. Sally suggested a new game called spades. She offered to teach the club how to play spades. Everyone in the club thought this was a great idea. They always liked to learn new card games. It did not take long for the card club to learn how to play spades. It was a fairly easy game. Sally was also a good teacher. Everyone liked playing spades. They thought it was a fun game to play. After a few hands, some of the members started to yawn. It was getting late and everyone was getting tired. They decided it was time for everyone to go home. As everyone was leaving, they thanked Sally for another fun meeting of the Diamond Club.

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., 1993. Mapping schizophrenic negative symptoms onto measures of the patient's speech: set correlational analysis. Psychiatry Research 48, 181–190.

Andreasen, N.C., 1979. Thought, language, and communication disorders: diagnostic significance. Archives of General Psychiatry 36, 1325–1330.

Andreasen, N.C., 1986. Scale for the assessment of thought, language, and communication (TLC). Schizophrenia Bulletin 12, 473–482.

Arbuckle, T.Y., Gold, D.P., 1993. Aging, inhibition, and verbosity. Journal of Gerontology 48, P225–P232.

Baddeley, A., 1994. The magical number seven: still magic after all these years? Psychological Review 101, 353–356.

Baldessarini, R.J., 1985. Chemotherapy in Psychiatry. Harvard University Press, Cambridge, MA.

Barch, D.M., Berenbaum, H., 1994. The relationships between information processing and language production. Journal of Abnormal Psychology 103, 241–250.

Barch, D.M., Berenbaum, H., 1996. Language production and thought disorder in schizophrenia. Journal of Abnormal Psychology 105, 81–88.

Barch, D.M., Berenbaum, H., in press. Language generation in schizophrenia and mania. Journal of Psycholinguistic Research.

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

Berenbaum, H., Barch, D.M., 1997. The relationship between clinical ratings of poverty of speech and quantitative measures of syntactic complexity and verbosity. Unpublished data.

Berenbaum, H., Oltmanns, T.F., Gottesman, I.I., 1985. Formal thought disorder in schizophrenics and their twins. Journal of Abnormal Psychology 94, 3–16.

Cohen, J.D., Barch, D.M., Carter, C.S., Servan-Schreiber, D., 1997. Schizophrenic deficits in the processing of context: converging evidence from three theoretically motivated cognitive tasks. In submission.

Daneman, M., 1991. Working memory as a predictor of verbal fluency. Journal of Psycholinguistic Research 20, 445–465.

Davis, J., Janicak, P., Linden, R., Moloney, J., Pavkovic, I., 1993. Neuroleptics and psychotic disorders. In: Cle, J.T., Enna, S.J. (Eds.), Neuroleptics: Neurochemical, Behavioral, and Clinical Perspectives. Raven Press, New York.

Docherty, N.M., Hawkins, K.A., Hoffman, R.E., Quinlan, D.M., Rakfeldt, J., Sledge, W.H., 1996. Working memory, attention, and communication disturbances in schizophrenia. Journal of Abnormal Psychology 105, 212–219.

Dunn, L.M., Dunn, L.M., 1981. The Peabody Picture Vocabulary Test — Revised. American Guidance Service, Circle Pines, Minnesota.

Ericsson, K.A., Kintsch, W., 1995. Long-term working memory. Psychological Review 102, 211–245.

Folstein, M.F., Folstein, S.E., McHugh, P.R., 1975. Mini-mental state: a practical method for grading the cognitive state of patients for the clinician. Journal of Psychiatric Research 12, 189–198.

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

Halliday, M.A.K., Hasan, R., 1976. Cohesion in spoken and written English. Longmans, London.

Harvey, P.D., Docherty, N.M., Serper, M.R., Rasmussen, M., 1990. Cognitive deficits and thought disorder: II. An 8-month followup study. Schizophrenia Bulletin 16, 147–156.

Harvey, P.D., Lenzeneger, M.F., Keefe, R.S.E., Pogge, D.L., Serper, M.R., Mohs, R.C., 1992. Empirical assessment of the factorial structure of clinical symptoms in schizophrenic patients: formal thought disorder. Psychiatry Research 44, 141–151.

Harvey, P.D., Serper, M.R., 1990. Linguistic and cognitive failures in schizophrenia. Journal of Nervous and Mental Disease 178, 487–494.

Hoffman, R.E., 1987. Computer simulations of neural information processing and the schizophrenia-mania dichotomy. Archives of General Psychiatry 44, 178–188.

Hoffman, R.E., Satel, S.L., 1993. Language therapy for schizophrenic patients with persistent voices. British Journal of Psychiatry 162, 755–758.

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

Kintsch, W., 1994. Text comprehension, memory, and learning. American Psychologist 49, 294–303.

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

Levelt, W.J.M., 1989. Speaking: From Intention to Articulation. MIT Press, Cambridge, MA.

Maher, B.A., 1988. Delusions as the products of normal cognitions. In: Oltmanns, T.F., Maher, B.A. (Eds.), Delusional Beliefs. Wiley, New York, pp. 333–336.

Neter, J., Wasserman, W., Kutner, M.H., 1990. Applied Linear Statistical Models. Irwin Press, Boston.

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.

Oltmanns, T.F., Murphy, R., Berenbaum, H., Dunlop, S.R., 1985. Rating verbal communication impairment in schizophrenia and affective disorders. Schizophrenia Bulletin 11, 292–299.

Pratt, M.W., Boyes, C., Robins, S., Manchester, J., 1989. Telling tales: aging, working memory, and the narrative cohesion of story retellings. Developmental Psychology 4, 628–635.

Resnick, H.S., Oltmanns, T.F., 1984. Hesitation patterns in the speech of thought-disordered schizophrenic and manic patients. Journal of Abnormal Psychology 93, 80–86.

Schank, R., Abelson, R., 1977. Scripts, Plans, Goals, and Understanding. Erlbaum, Hillsdale, NJ.

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.

Strauss, M.E., Buchanan, R.W., Hale, J., 1993. Relations between attentional deficits and clinical symptoms in schizophrenic outpatients. Psychiatry Research 47, 205–213.

Summers, W.V., Horton, D.L., Diehl, V.A., 1985. Contextual knowledge during encoding influences sentence recognition. Journal of Experimental Psychology (Learning, Memory and Cognition) 11, 771–779.