Abstract

This article examines the effects of age, cognition, and discourse skills on the clinical manifestations of formal thought disorder in 31 children with schizophrenia, 14 with schizotypal personality disorder (SPD), and 70 who were normal. The communication deficits of the 31 children with schizophrenia have three characteristics: illogical thinking, loose associations, and impaired discourse skills. Loose associations and illogical thinking reflect different aspects of impaired attention/information processing in children with schizophrenia. Only certain aspects of the discourse deficits of the children with schizophrenia are associated with the cognitive measures used in this study. The children with SPD have similar illogical thinking and loose associations scores but a narrower range of discourse deficits than the children with schizophrenia. Implications of the interaction between the clinical, cognitive, and discourse manifestations of the communication deficits of children with schizophrenia are discussed. The possible relationship between these manifestations and positive and negative symptoms of schizophrenia are also reviewed.


Formal thought disorder, a composite of clinical signs that reflect the way a patient presents his or her thoughts to a listener, has been regarded a hallmark of schizophrenia since the early descriptions of this illness (Kraepelin 1896). These clinical signs include loose associations and incoherence (DSM-III-R; American Psychiatric Association 1987) illogical thinking, loose associations, incoherence, and poverty of content of speech (DSM-III; American Psychiatric Association 1980), as well as those signs that traditionally have been used to describe formal thought disorder. This latter group includes derailment, digressive speech, tangentiality, circumstantiality, echolalia, and perseveration (Andreasen 1979). Although formal thought disorder has been studied widely in adults with schizophrenia (Oltmanns et al. 1985; Andreasen and Grove 1986; Holzman et al. 1986; Harrow et al. 1989), it has not been studied extensively in children with schizophrenia.

This article first reviews recent studies to determine the roles that age, cognition, and discourse skills play in the clinical manifestations of formal thought disorder in middle childhood schizophrenia spectrum disorders (i.e., schizophrenia and schizotypal personality disorder [SPD]). The article then examines whether children with schizophrenia have interrelated or independent communication deficits and concludes by presenting a heuristic model on the communication deficits of children with schizophrenia.

Age

A child’s ability to present thoughts to a listener in a coherent manner begins to develop between ages 2 and 3 (Shatz 1982). This capacity undergoes a major advance during middle
childhood and reaches mature adult levels during adolescence (Shatz 1982; Tunner et al. 1984; McTear 1985). A child must develop cognitive, linguistic, and pragmatic competence for this process to evolve adequately. Pragmatic competence refers to knowledge of the social aspects of a conversation, as well as the use of linguistic devices that tie spoken messages together, as well as turn-taking, pauses, and nonverbal communication. Formal thought disorder could represent the clinical manifestations of impaired interaction between these complex cognitive, linguistic, and pragmatic skills. The fact that these communication skills mature during middle childhood underscores the need for a developmental approach to the study of formal thought disorder in this age group.

From the developmental perspective, at least three obstacles hamper the assessment of formal thought disorder during middle childhood. First, young normal children often seem to be unaware of an adult listener's needs and assume that the adult makes logical (Piaget 1959) and linguistic (Maratos 1976) connections for them. We have no developmental norms on formal thought disorder in middle childhood. Whereas adults talk spontaneously in "paragraphs"—thus providing the listener with speech samples long enough for rating formal thought disorder—young children use only one to two utterances to express themselves. This underscores the importance of an interview technique that elicits adequate speech samples from children, as well as an instrument that assesses formal thought disorder within short units of speech.

Of the few studies that have been conducted on formal thought disorder in children (Kolvin 1971; Fish and Ritvo 1979; Cantor et al. 1982; Green et al. 1984; Arboleda and Holzman 1985; Caplan et al. 1989; Russell et al. 1989; Tompson et al. 1990), only two have used reliable and valid instruments with age-matched normal controls in a clinical assessment (Arboleda and Holzman 1985; Caplan et al. 1989; 1990c).

Kolvin (1971) reported that 60 percent of children with late-onset (prepubertal) psychosis had disorder of association, 45 percent had derailment of thought, and 51 percent had talking past the point. Cantor et al. (1982) identified loose associations, neologisms, illogicality, poverty of speech, and poverty of content of speech in children with both early-onset (mean age = 4.82 years) and adolescent-onset (mean age = 8.5 years) schizophrenia. Green et al. (1984) found that all the children with schizophrenia in their sample fulfilled the DSM-III schizophrenic inclusionary criterion for formal thought disorder signs. Russell et al. (1989) made reliable global clinical ratings of the DSM-III criteria of formal thought disorder using the Interview for Childhood Disorders and Schizophrenia (ICDS; Russell et al. 1989). They found incoherence or marked loosening of associations, illogical thinking, or poverty of speech content in 40 percent of their sample.

Arboleda and Holzman (1985) were the first to use a psychological instrument to assess formal thought disorder, the Thought Disorder Index (TDI; Johnston and Holzman 1979) in childhood. The TDI codes the frequency and severity of 20 categories of verbal responses to standard Rorschach cards that have been grouped into four broad categories of thought disorder: associative, combinatory, disorganized, and unconventional verbalizations (Johnston and Holzman 1979; Holzman et al. 1986).

Arboleda and Holzman (1985) also demonstrated the importance of using suitable control groups and of controlling for the level of cognitive development in children under 10 years of age. They found that children with psychosis, psychotic spectrum disorders, and children at risk for schizophrenia and affective disorder had more severe TDI levels than normal children and children with nonpsychotic psychiatric diagnoses (Arboleda and Holzman 1985). Using the TDI and the Family Consensus Rorschach Task (Loveland et al. 1963), Tompson et al. (1990) demonstrated that children with schizophrenia and those with SPD had significantly more thought disorder and disturbed attention than de-
pressed children.

Caplan et al. (1989) used a different approach to study formal thought disorder in middle childhood schizophrenia. They developed the Story Game, an indirect interviewing technique that elicits speech samples adequate for rating formal thought disorder in children. A trained clinician administers the three parts of the Story Game to the child. In the first part, the child hears an audiotaaped story about a dream about a friendly ghost and an ostracized little boy, respectively. The child retells the tale and answers standardized, open-ended questions on each story. In the second part of the Story Game, the child makes up a story chosen from five topics (the Incredible Hulk, a witch, a good or a bad child, an unhappy child). The topics of the stories in the Story Game were chosen because of their potential for eliciting pathologic thought content in children.

To ensure standardization, the stories and the instructions to the child are audiotaaped. The standard questions that follow the stories, however, are not prerecorded. This enables the interviewer to use open-ended questions to elicit an adequate speech sample from the child. Videotapes of the 20- to 25-minute Story Game are independently rated for formal thought disorder by two trained raters who have no psychiatric background or previous knowledge of the individual child’s diagnosis.

Caplan et al. (1989) operationalized the four DSM-III signs of formal thought disorder (i.e., illogical thinking, loose associations, incoherence, and poverty of content of speech) to determine if they could be reliably and validly measured despite the nondiscursive nature of children’s speech. Since Andreasen’s Thought, Language, and Communication Scale (1979) was the basis for the DSM-III definitions of these four formal thought disorder signs, the resulting instrument, the Kiddie Formal Thought Disorder Rating Scale (K-FTDS), was based on Andreasen’s instrument (Caplan et al. 1989).

The K-FTDS includes four signs: illogical thinking, loose associations, incoherence, and poverty of content of speech. To be rated as having illogical thinking, the child’s speech must meet one of three criteria. First, the child uses causal utterances inappropriately. For example, “I left my hat in her office because her name is Mary.” Second, the child presents the listener with unfounded and inappropriate reasoning in noncausal utterances. For example, “Sometimes I’ll go to bed and when I’m done laughing, I start wheezing and that’s when I relax.” Third, the child contradicts him or herself within one to two utterances by simultaneously making and refuting statements. For example, “I don’t like that story, but I liked it.”

A child is classified as having loose associations when he or she makes a statement that is off-topic without having previously prepared the listener for the topic change. For example, Interviewer: “Why do you think that’s a reason not to like Tim?” Child: “And I call my mom ‘Sweetie’.”

An utterance is rated as incoherent if the rater cannot comprehend it because of scrambled syntax. For example, Interviewer: “What happened next in your story?” Child: “The day no witches no day goes.”

Poverty of content of speech is rated if within two utterances the child does not elaborate on the topic of conversation. For example, “I suppose ... What? Maybe ... Well yes, I see. I suppose that’s all.”

Scores derived from the K-FTDS ratings are frequency counts of the scale’s four signs, divided by the number of utterances made by the child. In 31 children with schizophrenia and 14 with SPD ages 7.4 to 12.5 years, the chance-corrected reliability statistic kappa (Fleiss 1973) of illogical thinking and loose associations was 0.78 (standard error [SE] = 0.03) and 0.66 (SE = 0.01), respectively (Caplan et al. 1989). Incoherence and poverty of content of speech, however, occurred infrequently (Caplan et al. 1989, 1990c).

In these studies, the children with schizophrenia and those with SPD were diagnosed with the ICDS by a research team blind to the present formal thought disorder data (Russell et al. 1989). In addition to questions from The Schedule for Affective Disorders and Schizophrenia for School-Age Children (Kiddie-SADS; Puig-Antich and Chambers 1978) and the Diagnostic Interview for Children and Adolescents (DICA; Herjanic and Campbell 1977), the ICDS (kappa = 0.89) includes questions that ensure an adequate assessment of schizophrenia and SPD. At the time of testing, 70 percent of the children with schizophrenia and 36 percent of the children with SPD were inpatients. Half the children with schizophrenia and one-third of the children with SPD were taking neuroleptic medication. The remaining children had not received neuroleptics for at least 2 weeks before their participation in the study. Children with schizophrenia who had a
neurologic, language, or hearing disorder were excluded from the studies.

Figure 1 presents the K–FTDS scores of 70 normal children, ages 4.5–12.5 years. These normal subjects were recruited from four Los Angeles schools and from the community via advertisements in a local newspaper. We screened the normal children for neurologic, psychiatric, language, or hearing disorders through a telephone conversation with the parent. We excluded children from the normal sample if they manifested symptoms of these disorders either at the time of the study or in the past.

From the developmental perspective, the normal children under age 7 had significantly more illogical thinking than those above age 7 (Caplan et al. 1989, 1990c). Loose associations, however, occurred only in normal children under age 7 (Caplan et al. 1989, 1990c). Incoherence and poverty of content of speech were not found in the normal sample.

Similarly, the younger patients with schizophrenia used significantly more illogical thinking and loose associations than the older patients with schizophrenia (Caplan et al. 1989, 1990c) (figure 2). Eighty percent (4/5) of the children with schizophrenia and a mental age below 7 years had illogical thinking compared to 58 percent (7/12) and 36 percent (5/14) of the children with schizophrenia above ages 7 and 9.6 years, respectively. Loose associations were found in 90, 75, and 50 percent of the children with schizophrenia and a mental age below 7 years, between 7 and 9.6 years, and above 9.6 years.

Because of the small cell sizes of 2, 3, and 7 in the schizotypal subjects below age 7, between 7 and 9.6 years, and above 9.6 years, respectively, these age-related analyses were not meaningful (Caplan et al. 1990c) (figure 3).

The age at onset, not the duration of illness, correlated significantly with the severity of both the illogical thinking and loose associations scores of the children who had schizophrenia (Caplan et al. 1990c). This finding implies a possible impact of middle-childhood-onset schizophrenia on maturation of the cognitive and linguistic/pragmatic skills involved in logical thinking and topic maintenance.

Above and beyond these developmental effects, both the children

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**Figure 1.** Illogical thinking (ILL) and loose associations (LA) by age in normal children (n = 70)
with schizophrenia (figure 2) and the children with SPD (figure 3) used more illogical thinking and had higher loose associations scores than normal children with whom they were matched by chronologic and mental age (Caplan et al. 1989, 1990c). There were no statistically significant differences, however, in the illogical thinking and loose associations scores of the children with schizophrenia and those with SPD, who were matched for mental age and IQ (Caplan et al. 1990c). The sum of the illogical thinking and loose associations scores correctly classified 85 percent of the children with schizophrenia or SPD and 85 percent of the normal children (Caplan et al. 1990c). When they were considered separately, illogical thinking and loose associations had a sensitivity of 82 and 71 percent, respectively. Their specificities were 66 and 97 percent, respectively.

Incoherence occurs infrequently in children with schizophrenia and children with SPD, and this formal thought disorder sign is also rare in adult schizophrenia patients (Andreasen and Olsen 1982). In contrast, poverty of content of speech is a consistent finding in adult schizophrenia subjects, but not in children with schizophrenia (Andreasen and Grove 1986). This low base rate of poverty of content of speech in children with schizophrenia could reflect developmental factors. Latency-aged children use nondiscursive and unelaborated speech. It is possible that children must be competent users of discursive speech for a reliable rating of poverty of content of speech to be made (Caplan et al. 1989).

In summary, children with schizophrenia spectrum disorder have more severe thought disorder than those with other psychiatric disorders (Arboleda and Holzman 1985; Tompson et al. 1990). Of the four \textit{DSM-III} formal thought disorder signs, illogical thinking and loose associations were reliable and valid measures of formal thought disorder in children with schizophrenia and children with SPD above age 7 (Caplan et al. 1989, 1990c). From the developmental perspective, illogical thinking and loose associations were found in normal children under age 7 (Caplan et al. 1989, 1990c). The more severe il-
logical thinking and loose associations in the younger children with schizophrenia spectrum disorder might imply that the onset of this disorder in middle childhood might impair maturation of cognitive skills that children use to present their thoughts to the listener in a logical and cohesive manner. Onset of schizophrenia spectrum disorder in late childhood, however, might spare the maturation of these skills. Further research is needed to determine if this hypothesized impact on the development of thought processing is specific for childhood-onset schizophrenia spectrum disorders or applies to other childhood-onset psychiatric disorders as well.

**Cognitive Development**

Studies of the cognitive correlates of formal thought disorder in children with schizophrenia addressed three questions. First, is formal thought disorder a function of global or specific cognitive deficits in children who have schizophrenia? Second, what is the relationship between formal thought disorder and the cognitive deficits that children who have schizophrenia share with adults who have schizophrenia? Third, does formal thought disorder reflect impaired cognitive development?

Regarding the relationship between formal thought disorder and global or specific cognitive deficits, children with schizophrenia and children with SPD had illogical thinking and loose associations irrespective of their full-scale IQ scores (Caplan et al. 1990c). Their loose associations scores correlated significantly with the Wechsler Intelligence Scale for Children-Revised (WISC-R; Wechsler 1974) distractibility and verbal comprehension factor scores (Caplan et al. 1990a). Illogical thinking, however, was not associated with WISC-R factor scores. These findings suggest that loose associations reflect specific, not global, cognitive deficits. Since illogical thinking and loose associations were apparently not correlated (Caplan et al. 1990a), these findings also raised the intriguing possibility that illogical thinking and loose associations could have different cognitive correlates.

As to the relationship between
formal thought disorder and core deficits of schizophrenia, Asarnow (Asarnow and Sherman 1984; Asarnow et al. 1991) reported that, like adults who have schizophrenia, children with schizophrenia demonstrate significantly lower scores on a partial-report span of apprehension task compared to younger mental-age-matched normal children. On the basis of these findings, Asarnow hypothesized that both adults and children with schizophrenia have a core deficit in recruiting and allocating information-processing capacity for controlled attentional processes (Asarnow et al. 1986).

Based on an earlier finding that loose associations have a specificity of 97 percent (Caplan et al. 1990c), we hypothesized that loose associations might reflect the core attention/information processing deficits described by Asarnow et al. (1984). On a subsample of 19 out of the 31 children in the schizophrenia sample, we found that illogical thinking, not loose associations, was related to the performance on the partial-report span of apprehension task (Caplan et al. 1990a). We proposed the following explanation for this finding (Caplan et al. 1990a). The child with illogical thinking presents the listener with inappropriate reasoning. We hypothesized that the requirement to present the listener with logical reasoning taxes the momentary processing capacity and ability to screen out extraneous stimuli in the child who has schizophrenia (Caplan et al. 1990a).

In support of this hypothesis, Andreasen has suggested that negative formal thought disorder signs, such as illogical thinking and poverty of speech content, are reflected in the difficulty adult schizophrenia patients have in generating conversation (Andreasen and Grove 1986). Nuechterlein has also suggested that the negative signs of adult schizophrenia patients could reflect processing overload (Nuechterlein et al. 1986). The child with illogical thinking also appears to have difficulty generating logical reasoning, and this could be a negative sign of childhood-onset schizophrenia.

In contrast, the child with loose associations unpredictably changes the topic of conversation without preparing the listener for the topic change. We postulated that the cognitive demands of this situation reflect distractibility and that loose associations are a positive sign of early-onset schizophrenia (Crow et al. 1980). Several studies support this hypothesis, reporting a relationship between positive symptoms of schizophrenia, such as loose associations and distractibility in adult schizophrenia patients (Oltmanns et al. 1979; Cornblatt et al. 1985; Harvey and Brault 1986; Harvey et al. 1988). These findings indicate that two formal thought disorder signs, illogical thinking and loose associations, reflect different aspects of impaired attention/information processing in children with schizophrenia (Caplan et al. 1990a).

Finally, to answer the third question—whether formal thought disorder reflects impaired cognitive development—we examined the relationship between K-FTDS scores and Piagetian measures of conservation using the Goldschmid-Bentler Concept Assessment Kit—Conservation (Goldschmid and Bentler 1968). A child successfully performs a conservation task with this instrument if he or she understands that changes in the form or shape of matter do not involve changes in the quantity of matter (Piaget 1959). Fifteen children with schizophrenia and six with SPD performed more poorly than normal children in the conservation of continuous and discontinuous matter (Caplan et al. 1990b). To conserve continuous matter, the child needs to recognize that there is no change in the amount of water transferred from a narrow and tall container to a flat and shallow container. In the discontinuous matter task, a glass full of popcorn is divided among six smaller glasses.

The performance of the children with schizophrenia and those with SPD on these two tasks was associated with their illogical thinking scores (Caplan et al. 1990b). Their ability to conserve matter on tasks that did not involve a change in the matter as well as in the container was associated with the presence of both illogical thinking and loose associations (Caplan et al. 1990b). These findings provided additional evidence that illogical thinking and loose associations reflect different cognitive deficits.

From an information-processing perspective, the acquisition of conservation skills in normal children involves the ability to attend to multiple cues simultaneously (O’Bryan and Boersma 1971; Flavell 1985), to discriminate salient cues (O’Bryan and Boersma 1971; Flavell 1985), and to respond to perceptual stimuli using socially appropriate reality-based reasoning (Mehler and Bever 1967; Acredolo 1982; Flavell 1985). To conserve continuous and discontinuous matter successfully, the child needs to screen out the extraneous information derived from the containers and focus attention on the matter. In the other conservation tasks, however, the child was exposed only to the changes in matter,
and there is less of a demand to screen out extraneous stimuli. The findings of the conservation and span of apprehension studies, therefore, are convergent and support the association between information-processing deficits and illogical thinking.

Finally, we hypothesized originally that the developmental component of formal thought disorder could be tapped by conversation measures. Our findings indicated a definite trend for an association between the conservation competence and formal thought disorder scores of the schizophrenia and SPD subjects even after controlling for age. This trend suggested that, as demonstrated in studies of adult schizophrenia patients (Mook 1973; Schakelford 1976; Sollod and Lapidus 1977), poor conservation competence is associated with the disease process independent of age in children with schizophrenia and those with SPD.

In summary, in children with schizophrenia, illogical thinking and loose associations represent specific, not global, cognitive deficits. These formal thought disorder signs are associated with the cognitive deficits that children who have schizophrenia share with adults who have schizophrenia and do not represent delayed maturation. Finally, illogical thinking and loose associations reflect different aspects of impaired attention and information processing and might represent negative and positive symptoms of schizophrenia, respectively.

**Discourse Skills**

To present the listener with coherent information, a speaker needs to use linguistic devices, such as cohesion and reference patterns, to tie together his or her clauses (sentences) (Halliday and Hassan 1976). These linguistic devices enable the listener to follow who and what the speaker is referring to and how what he or she says relates to what the speaker or the listener said previously.

Adult schizophrenia subjects with and without formal thought disorder underutilize some of these discourse devices and overutilize others (Rochester and Martin 1979; Harvey 1983; Harvey and Brault 1986). We used Halliday and Hassan’s analysis of cohesion (1976) on transcriptions of the videotaped Story Game (Caplan et al. 1989) to compare children who have schizophrenia with normal subjects matched for mental-age. We found that children with schizophrenia like adults with schizophrenia, spoke less and did not provide the listener with enough links (cohesive ties) to previous utterances or with enough reference (referential cohesion) to people, objects, or events mentioned in earlier utterances (Caplan et al. 1992). Children with schizophrenia also broke the flow of conversation by referring to people, objects, or events in their immediate surroundings and by not focusing on the ongoing conversation (exophora) (Caplan et al. 1992). Like adult thought-disordered schizophrenia patients (Rochester et al. 1979; Harvey 1983; Harvey and Brault 1986), children with schizophrenia who had loose associations confused the listener by the unclear and ambiguous way they referred to people, objects, and events (unclear/ambiguous reference) (Caplan et al. 1992).

Children with schizophrenia, however, had three discourse deficits that distinguished their speech from that of adult schizophrenia patients (Caplan et al. 1992). They provided the listener with fewer connectives between contiguous clauses (conjunction) and with less repetition of words or word roots (lexical cohesion) than normal children. Finally, the children with schizophrenia also appear to omit part of a previous clause on the presumption that the listener retained enough information from this clause (ellipsis). By using fewer conjunctions, less lexical cohesion, and more ellipsis than normal children, the child with schizophrenia makes it difficult for the listener to piece together the parts of his or her speech.

As to the relationship of cohesion and reference patterns to formal thought disorder, children with schizophrenia who had loose associations used significantly less referential cohesion and significantly more exophora than normal children (Caplan et al. 1992). In comparison, children with schizophrenia who did not have loose associations used significantly fewer conjunctions and words per clause than normal children. The loose associations scores of the children with schizophrenia were significantly correlated with their lexical cohesion and ellipsis scores. There was no relationship, however, between illogical thinking and the cohesion and reference pattern scores of the children with schizophrenia. These findings suggest that the presence and absence of loose associations, but not illogical thinking, were each associated with distinct discourse characteristics.

A study comparing the communication deficits of 13 children with SPD and 12 children with schizophrenia matched by age and IQ revealed that, like the children with schizophrenia, the SPD chil-
children provided the listener with few references to people, objects, and events mentioned in previous sentences (referential cohesion) and with few connections between contiguous sentences (conjunction) (Caplan and Gutherie 1992). In addition, the SPD children frequently interrupted the flow of conversation to refer to themselves and to their immediate environment (exophora). In contrast to the children with schizophrenia, the SPD children displayed a more restricted range of discourse deficits. In addition, their discourse deficits did not appear to be associated with clinical measures of loose associations.

In summary, those children who had schizophrenia with and without loose associations had different discourse profiles. Those with loose associations used less referential cohesion, but more exophora and ellipsis, than normal children. Those without loose associations used fewer conjunctions and words per clause than normal children. SPD children had a narrower range of discourse deficits than children with schizophrenia, and these deficits were not related to loose associations.

**Model of the Communication Deficits of Children With Schizophrenia**

This article presents the results of a principal components analysis computed to determine if the communication deficits of 31 children with schizophrenia represent a homogeneous dysfunction with clinical, cognitive, and linguistic manifestations. Based on our earlier findings (Caplan et al. 1990a, 1990b, 1990c, 1992), we predicted that the communication impairment of children with schizophrenia is heterogeneous and reflects two communication factors: a loose associations/distractibility/discourse factor and an illogical thinking/conservation/span of apprehension factor.

This analysis confirmed that the communication deficits of children with schizophrenia are not homogeneous but revealed three separate principal components (table 1). The first component includes discourse measures other than exophora. The second factor included the WISC-R distractibility factor score, the WISC-R verbal factor score, and loose associations. The third factor consisted primarily of illogical thinking and exophora.

Span of apprehension and conservation scores were not included in the principal components analysis because they were available for only 19 and 15 children with schizophrenia, respectively. A Pearson pairwise correlation revealed no statistically significant correlation between the span of apprehension and discourse scores. An examination of the relationship between conservation and the linguistic/pragmatic measures, however, demonstrated that children with schizophrenia and those with SPD who had better conservation competence used more conjunctions ($t = 2.91, p = 0.009$), were more verbally productive (words per clause) ($t = 2.89, p = 0.009$), and had higher verbal comprehension WISC-R factor scores ($t = 2.66, p < 0.01$) than those with poor conservation competence (figure 4). An analysis of covariance adjusted for the formal thought disorder measures revealed a main effect of loose associations ($F = 9.17; df = 3,16; p = 0.008$) on the relationship of conservation competence with the scores for conjunction and verbal productivity (figure 4).

The use of conjunctions, verbal productivity, and loose associations appears, therefore, to be related to conservation competence (figure 4). To join the statements presented in two contiguous clauses with a conjunction, the child needs to perceive the contiguity between these two clauses. Similarly, to conserve competently, the child must perceive the invariance of matter despite the change in its shape. The child with loose associations does not present the listener with the conversational links that maintain the topic of conversation. From an information-processing perspective, therefore, we postulate that similar processing impairments might un-
Figure 4. Clinical, cognitive, and discourse components of the communication deficits of children with schizophrenia

Illogical Thinking
- Span of Apprehension
  - Decreased processing capacity
- Conservation
  - Reduced screening out of extraneous stimuli
- Discourse
  - Reduced screening out of non-conversation related stimuli (exophora)

NEGATIVE SYMPTOM OF CHILDHOOD SCHIZOPHRENIA?
- Loose Associations
  - Discourse
    - Referential Cohesion
    - Lexical Cohesion
    - Ellipsis
    - Conjunctions
    - Verbal Productivity
  - Conservation
    - Reduced identification of invariance of matter

POSITIVE SYMPTOM OF CHILDHOOD SCHIZOPHRENIA?
- WISC-R Distractibility Factor
- WISC-R Verbal Comprehension

The inclusion of exophora in the illogical thinking factor was not predicted. As described above, illogical thinking is associated with low scores on the partial report span of apprehension task (Asarnow and Sherman 1984) and with conservation deficits on the Goldschmid and Bentler task (1968). What do these three measures have in common? Instead of screening out extraneous stimuli from the testing environment and focusing on the linguistic context of the conversation, children with schizophrenia who have exophora break the flow of conversation to refer to stimuli in the testing situation or environment (figure 4). It is possible that the requirement to present the listener with logical reasoning, to focus on the linguistic context of a conversation, and to detect the invariance of matter despite the change in the container all tap the core information processing deficit described by Asarnow and Sherman (1984) in these children (figure 4). Since the measures for both conservation and the partial report span of apprehension were not included in the principal components analysis, further study is warranted to examine this hypothesis.

Are these three communication factors related to the positive and negative symptoms described in adults with schizophrenia (Crow 1985; Andreasen et al. 1990; Carpenter and Buchanan 1989)? The hypothesis that illogical thinking and loose associations represent negative and positive symptoms in childhood-onset schizophrenia has already been presented in a previous section of this article. The first communication factor, the discourse factor, however, includes verbal productivity (words per clause), as well as linguistic devices that tie the speaker's clauses together and make them more understandable to the listener. Reduced use of these communication devices might be comparable to the alogia of adult schizophrenia patients with negative symptoms (Grove and Andreasen 1985). Therefore, like the illogical thinking factor, the discourse factor might also represent a negative sign of schizophrenia in childhood. We are currently examining the relationship between these three communication factors and other positive and negative signs in children with schizophrenia.

In summary, despite the relatively small sample size, a principal component analysis of the clinical, cognitive, and discourse
correlates of the communication impairment of children with schizophrenia revealed three independent components. Certain aspects of the discourse component appear to be related to conservation competence. The loose associations and illogical thinking components, however, probably reflect different attention/information-processing impairments. Finally, the discourse and illogical thinking deficits might represent negative signs and the loose associations factor, positive signs, in childhood-onset schizophrenia.

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Acknowledgments

This study was supported by USPHS grant MH-00538 from the National Institute of Mental Health. The author thanks Amy Mo and Jean de Traversay for their technical assistance.

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