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Brief Reports

Brief Report: Sentence Comprehension Strategies in Children with Autism and Specific Language Disorders[1]

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Two groups of children with language disorders—one group with autism and one with relatively specific language impairment (LI)—and two groups of normal children matched to the disordered groups for mental and receptive language age were asked to act out a series of sentences. Half the experimental sentences were in active voice, and half were the same sentences given in passive voice. Within each set, events described in the sentences were probable, neutral, or improbable. Results revealed that the autistic group made little use of a semantically based probable event strategy for acting out sentences, but were likely to use a syntactically based word order strategy. The LI group was no more likely than the autistic group to use the seman-

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tic strategy, and was equally likely to use word order. Both groups resembled normals matched for receptive language age.

This study examined the use of sentence comprehension strategies identified in normally developing children (see Chapman, 1978, for review) by two types of children with poor expressive language: those with autism and those with specific language impairments (LI) relative to nonverbal mental age. Little research on the comprehension skills of these children with more obvious expressive disorders has been carried out, and the intention in this study was to gain some insight into the development of receptive language skills in children with these syndromes.

The study drew on the literature on comprehension strategies in normal language development. Chapman (1978) has reviewed this literature, which suggests that children make use of a sequence of strategies for understanding sentences that allow them to appear to comprehend more complex language than they are able to respond to when nonlinguistic cues are removed. These strategies progress from total reliance on context and general knowledge to integrating linguistic information with world knowledge. Eventually, strategies become primarily linguistically based, and by age 4 or so children are overgeneralizing their knowledge of word order rules to sentences like the passive in which they do not apply.

Previous studies of high-functioning verbal autistic children (Tager-Flusberg, 1981) suggested that, while this group was able to make use of a word order strategy (interpreting noun–verb–noun sequences as encoding agent–action–object relations, resulting in incorrect interpretations of passive sentences), they were less likely than 3- to 4-year-old normal children to use a probable event strategy (assigning agent status to animate nouns, object status to inanimates). This finding was interpreted to indicate a relative strength in syntactic processing and a relative weakness in the use of semantic information on the part of autistic children.

The present study extended this investigation to a more heterogeneous group of autistic children, including those with both average and subaverage IQs—since such a distribution is more typical of the autistic population—and a matched group of children with relatively specific impairments in expressive language. In this way, an attempt was made to test the hypothesis that the performance of autistic subjects described by Tager-Flusberg was unique to the syndrome and not simply the result of language delay in general. There is reason to believe that nonautistic language-impaired children would perform differently from their autistic counterparts on a sentence comprehension test. That is, autistic children could be expected, on the basis of Tager-Flusberg's data, to use a word order (WO) strategy to process difficult sentences, while they would not be expected to make use of the developmental-

ly earlier probable event (PE) strategy, reflecting the generalized deficit in semantic processing hypothesized by Tager-Flusberg. Children with specific language impairments, on the other hand, could be expected to use a PE strategy to aid sentence comprehension at the appropriate developmental level, since these children are generally viewed as delayed rather than deviant in language acquisition (Morehead & Ingram, 1973). If the LI children showed any differences from normal development, however, one difference that might be expected to appear would be a failure to employ a WO strategy, which relies exclusively on grammatical skill. If LI children demonstrated some specific grammatical deficit, it might be reflected in a failure to use WO strategies for processing difficult sentences and a prolonged reliance on the more primitive PE heuristic. The present study investigated these hypothesized differences between autistic and LI children's responses to a sentence comprehension task.

METHOD

Subjects

There were six autistic and seven LI subjects involved in the study, and eight normal children in each of two age groups. All the children with disorders were enrolled in one of two programs for children with language disabilites; one in a inner-city public school and one in a suburban private school. The autistic children had been diagnosed by medical professionals or special educators according to the criteria of the DSM-III (American Psychiatric Association, 1980). Diagnoses were corroborated by teachers and observations of the experimenters. The LI group had poor speech skills in the absence of autistic behaviors. These diagnoses were also corroborated by our observations, and specific criteria for inclusion in this group, based on standardized testing and language sampling (see below), were employed.

The average age of the autistic group was 6.5 years, ages ranged from 4 to 9. Mean nonverbal mental age (MA) of this group, tested on the *Leiter International Performance Scale* (Arthur, 1952), was 41.8 months, for an average nonverbal IQ of 57. Mean receptive language level on the *Sequential Inventory of Communicative Development* (SICD-R; Hedrick, Prather, & Tobin, 1975) was 32.7 months; mean MLU in morphemes (Brown, 1973) was 1.8, for an age-equivalent of 25.8 months (Miller, 1981). (See Table I.) At this level of receptive language development normal children would be expected to be using a PE strategy in comprehending difficult sentences (Chapman, 1978).

Children were included in the LI group if they showed at least a 6-month delay in expressive language—as indexed by MLU age-equivalent (Miller, 1981)—relative to nonverbal mental age. Four subjects originally tested had

Table I. Means (and Standard Deviations) of Subject Characteristics

Diagnostic group	Age equivalent (in months)	Nonverbal mental age (in months)	Nonverbal IQ	SICD receptive age equivalent (in months)	MLU	MLU age (in months)
Autistic	78 (21.6)	41.8 (10.9)	57 (18)	32.7 (6.9)	1.8 (0.9)	25.8 (4.0)
LI	57.6 (7.2)	45.8 (8.8)	80 (12)	35.4 (7.5)	2.3 (0.7)	29.3 (5.5)
2-year-old normal	34.8 (2.1)					
3-year-old normal	43.4 (2.45)					

to be dropped from the study because they failed to meet this criterion. The mean chronological age in the LI group was 4.8 years, the age range from 3 to 8. Mean nonverbal mental age on the Leiter was 45.8 months, for a mean nonverbal IQ of 80. Mean receptive SICD age was 35.4 months. Mean MLU was 2.3, for an age equivalent of 29.3 months (Miller, 1981). This level of functioning would also predict the use of a PE strategy in Chapman's (1978) scheme.

The normal children were all students in a middle-class preschool in Portland, Oregon. Students in the school had been screened for speech, language, and hearing problems and all the subjects were considered by their teachers to be developing normally. They were divided into two groups based on age. The younger group had an average age of 34.8 months (SD = 2.5 months, range 30–37). The age level was chosen to correspond to the average receptive language age of the two delayed groups and is referred to as the 2-year-old group. The older normal group had an average age of 43.4 months (SD = 2.1, range 40–47). This age level was chosen to correspond to the average nonverbal mental age of the two disordered groups and is referred to as the 3-year-old group. These subjects were given only the sentence comprehension test.

Results of t tests showed no significant differences in nonverbal MA, receptive, or expressive language age between the two disordered groups. The LI group was somewhat younger and, since mental ages were comparable between the two groups, their IQs were higher. It should be noted that even though average IQ for the LI group was in the normal range, these subjects are probably somewhat lower functioning than those often discussed in the literature on specific language disorders. They were not selected because they had IQs in the normal range. Rather, they were included only if a significant discrepancy between nonverbal MA and expressive language was present. Follow-up studies of language-impaired children (Eisenson, 1972; Paul & Co-

hen, 1984) suggest that, in fact, many children diagnosed as "aphasic" in the preschool period do function in the borderline or retarded range by school age, as did three of the present subjects. Nonetheless, this group of LI children may differ from others often reported under this rubric, so that differing results may be due to differing subject characteristics.

One-way analysis of variance showed there were no differences between the chronological age of the 2-year-old group and the receptive language ages of the two disordered groups ($F = 0.246$). A similar analysis revealed that there were no differences between the chronological age of the 3-year-old group and the nonverbal mental ages of the two disordered groups ($F = 0.442$). T testing revealed there were significant differences between the ages of the two normal groups ($t = 7.07$, $p < .0005$).

Procedures

Subjects were tested individually by a speech-language pathologist. Disordered subjects were given the Leiter and SICD-R in separate sessions. MLUs for the two disordered groups were calculated from samples of spontaneous speech collected during free play with the examiner following the first two testing sessions. In addition, play assessments were also conducted for each disordered subject. This was done in order to insure that children were functioning at a cognitive stage that would allow them to have accumulated some knowledge about event probabilities. The presence of functional play was taken as evidence that some knowledge of conventional use and the probability of events had been accumulated, which in turn was thought to enable subjects to have access to a PE strategy.

Ungerer and Sigman's (1981) method of play assessment was employed. This involved presenting children with a set of common objects and toys, observing the ways in which the child used the objects, and rating object use as exploratory, functional, or symbolic. All subjects showed some spontaneous functional use of the materials. In addition, all demonstrated some spontaneous symbolic play, as would be expected, given their mental ages.

In the comprehension task itself, which was given to all subjects, a set of toys corresponding to the nouns used in the test sentences was placed in front of the child. As a pretest, the child was asked to select each object when it was named by the examiner. Verbs were pretested by handing the subject an object and asking him/her to perform an action on it ("Push this"). Subjects who could not identify all the nouns or act out all the verbs were eliminated (three disordered subjects were excluded as a result of this procedure). Immediately following the pretest, practice sentences containing only two elements (action–object: "Push the shoe") were presented. All practice sentences were in active voice and examples of both probable ("Kiss the baby")

and improbable sentences ("Kick the apple") were given. All subjects performed accurately on these practice sentences. Test sentences were then presented in two different random orders and the subjects were told to act them out.

There were 24 test sentences, modified slightly on the basis of pilot testing, from those used by Tager-Flusberg (1981). Modifications were based on the fact that pilot testing had revealed that several of the verbs used in Tager-Flusberg's study were not familiar to the majority of these subjects. These verbs were eliminated and replaced with verbs to which the children were more readily able to respond. Half the sentences were in active voice ("The girl pats the horse"), the other half were the same sentences transformed into passive voice ("The horse is patted by the girl"). Within each voice set there were three subsets: a probable group, a neutral, and an improbable. The probable sentences contained animate (or, in the case of *car* and *truck,* moving) agents. Objects of action were either inanimate (*shoe, box*) or obviously the usual receivers of the actions predicated in the sentences (*pat horse, carry baby*). Examples of probable sentences include, "The girl carries the baby," and "The truck carries the box." Improbable sentences described the reversal of each relation given in the probable sentences ("The baby carries the girl; the box carries the truck"). Neutral sentences had animate or moving elements as both agents and objects. In these neutral sentences, there were equal probabilities for each form of the relations expressed ("The truck pushes the car: the car pushes the truck") to occur (Tager-Flusberg, 1981).

Scoring and Assignment of Strategy Use

The subjects' responses were recorded on-line by the examiner who noted exactly what the subject did with the objects in response to each stimulus sentence. On the basis of these written records, responses were later coded as *correct* if the subject accurately acted out the relations described in the stimulus sentence, *reversed* if the subject reversed agents and objects, *child-as-agent* if the subject omitted the stated agent and performed the correct action himself on the named object, *other* if some other response were given, and *no response* if the child did not manipulate the objects at all. A second rater rechecked the coding of a subset of the records of the subjects' responses and consistent agreement was found.

Strategy use was then assigned on the basis of these coded responses. The use of a PE strategy was determined using Tager-Flusberg's (1981) criteria. In order to be credited with using a PE strategy, the subject had to act out the probable sentences correctly and reverse the improbable sentences, regardless of voice. One point was awarded for each correct probable sen-

tence and for each reversed improbable sentence. Subjects were considered to be using a PE strategy if they received 12 of the 16 possible points. (The probability of achieving this score by chance, according to the binomial theorem, is .14.)

To assess the frequency of WO strategies, Tager-Flusberg's (1981) method was used again and only neutral sentences were considered. Children were given credit for using WO if they were correct on the active sentences and incorrect on the passives. One point was awarded for each correct active and reversed passive. Children were considered users of a WO strategy if they received 6 of the 8 possible points.

RESULTS

Table II shows the mean number correct (out of four) for each sentence condition for each group. The scores were analyzed as three-factor (diagnostic group, voice, probability level) mixed design analysis of variance with repeated measures on two factors (voice, probability level). In order to perform this analysis, equal numbers within each group were needed, so subjects in the three larger groups (LI, younger normal, and older normal) were randomly excluded to achieve equal group size. There was a significant difference among the groups ($F = 6.34$, $p < .05$). There were also significant effects of voice ($F = 17.97$, $p < .05$) and probability ($F = 18.33$, $p < .05$), and no significant interaction effects. Planned comparisons revealed that there were no differences between the two disordered groups or between the two normal groups, but there was a difference that approached significance ($t = 1.45$, $p < .10$) between the disordered groups and the 3-year-old group, suggesting more correct responses overall on the part of the 3-year-olds when compared the two disordered groups.

Table II. Mean number correct responses (out of 4) for each sentence condition for four subject groups

Diagnostic group	Voice					
	Active			Passive		
	Probable	Neutral	Improbable	Probable	Neutral	Improbable
Autistic	3.5	3.5	1.5	2.5	0.7	0.7
LI	3.6	3.3	1.6	2.3	1.1	0.4
2-year-old normal	3.4	3.5	2.4	2.3	1.4	1.9
3-year-old normal	3.8	3.4	3.3	2.9	2.6	2.1

Table III. Number and Percentage of Subjects Using Comprehension Strategies in Each Diagnostic Group

Diagnostic group	n	Strategy: Probable event		Strategy: Word order	
		n	%	n	%
Autistic	6	2	33	5	83
LI	7	3	43	4	57
2-year-old normal	8	1	13	4	50
3-year-old normal	8	1	13	2	25

These results indicated that the two disordered groups were responding in a similar fashion to the task. Main effects suggest all subjects were responding more accurately to active than to passive sentences, and more accurately to probable sentences. The analysis of variance showed, in other words, that passive sentences were harder to understand than actives and less probable relations were more difficult than more predictable ones for all groups.

In order to determine whether—despite the apparent similarities—any differences in strategy use between the two disordered groups could be found, the number of subjects in each group using either a PE or WO strategy was examined.

Table III shows the number and percentage of each group using each strategy. Two-proportion z tests showed that there were no significant differences in the number of subjects from the two disordered groups who used either strategy. The only difference to reach significance ($Z = 2.16$) was the difference between the 3-year-old normal group and the autistic group in terms of use of the word order strategy. Autistic children used word order more frequently than the 3-year-olds, who appeared to respond correctly more often and rely less on strategies of any kind. Contrary to expectations, then, as many autistic as LI children were using a PE strategy, and as many LI subjects as autistics were using WO. The autistic group, though, was using the word order strategy significantly more often than normal children matched for mental age.

An additional analysis looked at what the disordered groups of children did when they did *not* reverse agents and objects. Surprisingly enough, neither group failed to respond at all. On the few occasions in which children did something other than reverse agents and objects they used a "child-as-agent" strategy (Chapman, 1978), making themselves the agents of an action–object sequence. This strategy is used by normal children at a lower level of development (about 18–24 months). While it occurs quite infrequently in this sample (11% of total responses), some interesting differences can be

Table IV. Percentage Responses Employing a Child-As-Agent Strategy for Each Sentence Condition in Each Diagnostic Group

Diagnostic group	Voice					
	Active			Passive		
	Probable	Neutral	Improbable	Probable	Neutral	Improbable
Autistic	8.3	16.7	16.7	20.8	16.7	16.7
LI	7.1	7.1	7.1	7.1	7.1	0

seen between the two groups' use of this response type. First, for the easiest sentences, the probable actives, its frequency of use was quite low and was similar for both groups (see Table IV). For all other sentence conditions, however, more autistic children used a child-as-agent response than did LI children (three in the autistic group as opposed to one in the LI group) Although this difference failed to reach significance ($t = 0.88$) because of the small number of observations and the very large standard deviation in the autistic group, it does suggest that perhaps autistic children are more prone to adopting the child-as-agent strategy than LI children are. None of the normal children used this strategy.

DISCUSSION

The results of this study suggest that children with both autism and specific language impairment respond to a sentence comprehension task in a manner similar to that used by normal children at similar levels of comprehension ability.

One obvious source of error in the present study stems from the small size of the sample. For example, five of the six autistic children used WO strategies by Tager-Flusberg's (1981) method, whereas only 4 of the 7 LI children did. A larger sample might have yielded a significant difference in the use of word order. But the fact remains that some (more than half) of the LI children did use word order in interpreting sentences. Moreover, only a minority employed the expected probable event strategy.

These findings appear consistent with current conceptions about the autistic syndrome; that is, autistic children exhibit relatively well-preserved grammatical development—relative to MA—but show restricted ability in semantic/pragmatic development and have difficulty bringing their conceptual knowledge to bear on the task of understanding and producing language. However, comparison to the performance of the contrast groups must call this interpretation into question. In fact, few of the subjects in this study, even the 2-year-olds, made use of PE strategies. It appears that children functioning at the developmental levels present here have "outgrown" their need

for probable event interpretations. It should be noted, too, that there *is* evidence of the use of world knowledge in the interpretation of sentences in the autistic group. Their performance on probable sentences is consistently more accurate than on improbable ones, as shown in the ANOVA results. So, while autistic children do not generally adopt a probable event interpretation when faced with a difficult sentence, they do perform more accurately on sentences whose encoded probabilities are high.

The findings for the LI group suggest that, in terms of comprehension strategy use, these children behave similarly to normal children at similar developmental levels. Few normal children, even in the 2-year-old group, made use of a probable event strategy, so the LI group's failure to employ this heuristic should not be surprising. LI children used a word order strategy with similar frequency to that seen in normals. Bishop (1982) reported that word order strategies were used more consistently by children with Landau-Kleffner syndrome (an acquired form of childhood language disorder accompanied by seizures) than by normal 4-year-olds. Bishop suggested that this overreliance on word order may reflect an inability of language-impaired children to process the hierarchical structure of language, which would force them to rely heavily on sequential information. However, when LI subjects with more diverse etiologies are carefully matched to normals on the basis of receptive and mental ages, they appear to be more similar to the normals than they are different. This finding supports the view of the LI population as delayed rather than deviant in language acquisition.

CONCLUSION

Children with autism and developmental language disorders who are at similar stages of language and cognitive development appear to perform more similarly than might be expected on this comprehension task, which attempts to tap their use of word order and event probability in interpreting sentences. In general, both groups appear to be functioning very similarly to normal children matched for receptive language level. If these results are borne out in studies with larger samples and across developmental levels, then our notions about the roots of linguistic behavior in autistic and LI children may bear reexamination. The language-processing deficits seen in autism may be less unique to the syndrome than previously thought. This study highlights the difficulty of inferring comprehension ability and the need to address questions of linguistic processing in disordered populations. Further studies are needed to answer these questions, perhaps by means of examining the levels of processing that lead up to the behaviors observed here. That is, the stages of perceiving, decoding, and intermediate levels of interpreting

sentences might be broken down and differences among diagnostic groups identified. Such research would help to elucidate the findings of the current study.

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