

Repetition and Comprehension of Spoken Sentences by Reading-Disabled Children

DONALD SHANKWEILER AND SUZANNE T. SMITH

Haskins Laboratories and University of Connecticut

AND

VIRGINIA A. MANN

Haskins Laboratories and Bryn Mawr College

The language problems of reading-disabled elementary school children are not confined to written language alone. These children often exhibit problems of ordered recall of verbal materials that are equally severe whether the materials are presented in printed or in spoken form. Sentences that pose problems of pronoun reference might be expected to place a special burden on short-term memory because close grammatical relationships obtain between words that are distant from one another. With this logic in mind, third-grade children with specific reading disability and classmates matched for age and IQ were tested on five sentence types, each of which poses a problem in assigning pronoun reference. On one occasion the children were tested for comprehension of the sentences by a forced-choice picture verification task. On a later occasion they received the same sentences as a repetition test. Good and poor readers differed significantly in immediate recall of the reflexive sentences, but not in comprehension of them as assessed by picture choice. It was suggested that the pictures provided cues which lightened the memory load, a possibility that could explain why the

We are grateful to the staff of the East Hartford, Connecticut public schools for their generous cooperation in making this study possible. We record our thanks to the administrative staff, principals, reading consultants, third grade teachers, and students at the Barnes, Center, Mayberry, Silver Lane, and Stevens Schools. Special thanks are due to Edgar Zurif and Sheila Blumstein for bringing relevant aphasia studies to our attention and for valuable discussion. We also thank Stephen Crain and Carol Fowler for their helpful comments on earlier versions of the paper. The research and preparation of this manuscript was supported by NICHD Grant HD-01994 to Haskins Laboratories. Send requests for reprints to Dr. Donald Shankweiler, Haskins Laboratories, 270 Crown Street, New Haven, CT 06511.

poor readers were not demonstrably inferior in comprehension of the sentences even though they made significantly more errors than the good readers in recalling them. © 1984 Academic Press, Inc.

The problems of many children who are deficient in reading skills are not confined to reading and writing, but extend to abilities involving spoken language as well. Characteristically, the language tasks on which poor readers are deficient place a burden on verbal short-term memory. For example, tasks which require retention of spoken letter names (Shankweiler, Liberman, Mark, Fowler, & Fischer, 1979), and word strings and sentences (Mann, Liberman, & Shankweiler, 1980) have consistently distinguished poor readers in the early school years from their peers who are good readers. That the memory problems of the poor readers are language related is evident from the fact that they typically perform at a level equivalent to good readers on tasks that involve memory for nonlinguistic material such as photographs of faces (Liberman, Mann, Shankweiler, & Werfelman, 1982), visual nonsense designs (Katz, Shankweiler, & Liberman, 1981; Liberman et al., 1982) and visual-spatial sequences (Mann & Liberman, in press).

The purpose of the research we describe here was to investigate the abilities of third grade children who differ in reading ability to repeat and to comprehend a variety of spoken sentences. Our intent was to explore a possibility that arises from our earlier research (Shankweiler et al., 1979; Mann et al., 1980): that the limitation of verbal short-term memory, which is found to be characteristic of children with reading disability, may be associated with difficulty in spoken sentence comprehension. The expectation that this association would be found was motivated by a consideration of the need for an effective working memory during sentence processing. We assume that a system must exist for holding the words of a sentence and their order of occurrence in some kind of temporary store until the sentence structure can be apprehended. This would follow from the fact that the meaning of a sentence is not merely the sum of the meanings of the separate words it contains, but is derived from the relations between the component words that determine its syntactic and semantic structure. Given poor readers' problems in remembering ordered sequences of words, they might be expected to make mistakes in sentence processing whenever they are confronted with sentences that place the working memory system under stress.

In addition to the sheer number of words a sentence contains, its lexical content and manner of construction can be expected to affect how severely the working memory is taxed in processing it. Sentences with unpredictable or arbitrary semantic content may place a heavy load on working memory because they force the listener to process them fully and perhaps more than once in order to extract the content. The Token

Test of De Renzi and Vignolo (1962) contains such structures. This clinical diagnostic test, well known to students of aphasia, consists of sentences "commands" that request the subject to perform arbitrary manipulations of the token objects. We found a shortened version of the Token Test (De Renzi & Faglioni, 1978) to distinguish groups of good and poor readers in the third grade, but only on the complex structures in the final sections of the test (Smith, Mann, & Shankweiler, in preparation).

Since most of the Token Test items were insufficiently difficult to separate the good and poor readers, we sought to develop a sentence test that would be at once more sensitive and more analytic. The new measures were designed to discover whether poor readers are selectively impaired in coping with specific types of constructions that stress working memory more by their syntactic form than by their semantic content. Frequently, close grammatical relationships obtain between words that are distant from one another in the string, as in some relative clause sentences in which the logical subject is separated from its pronominal referent by a span of words. Sentences of this form should be very difficult to comprehend if there is inaccurate retention of the word string.

We conducted two additional studies with the same groups of good and poor readers who had received the Token Test. In planning these studies we sought guidance both from the literature on acquisition of syntax by normal children and from studies of sentence comprehension by adults with acquired aphasia. In our first study (Mann, Shankweiler, & Smith, in press) we examined sentences with relative clause structures in which we varied the point of attachment of the relative clause to the main clause. We found that the poor readers made more errors than the good readers on each of four sentence types, but when the four types were ranked in order of difficulty for good and poor readers separately, the ordering was the same for both groups. The finding that the poor readers were generally worse in comprehension of relative clause sentences, but within this broad class were affected by syntactic variations in the same way that the good readers were, suggests that efficiency of working memory, and not differential grasp of syntactic structure, is the characteristic on which the groups are most readily distinguished.

Thus, the data from studies of sentence memory, the Token Test, and comprehension of relative clause structures are consistent with the possibility that poor readers have deficiencies in sentence processing that are an expression of their difficulties in retaining verbal material in working memory. However, we cannot exclude the possibility that other linguistic deficiencies are present in these children.¹ Although our research to date

¹ Nor can we exclude the possibility that the strategies they employ on certain other cognitive tests may be deviant (see Wolford & Fowler, 1984).

has not identified any constructions on which poor readers are selectively impaired, we have found that such children usually make more errors in sentence processing than good readers of comparable age and IQ (Mann et al., in press). Poor readers' failures to process sentence materials accurately could reflect memory limitations primarily, as we have suggested, or alternatively such failures could be symptoms of delayed acquisition of portions of the grammar, as Byrne (1981) has proposed. The possibility that poor readers may have primary syntactic deficits deserves thorough systematic study in which a variety of syntactic structures is examined.

The study we describe here begins to address this need. It focuses on attribution of reference in sentences containing a reflexive pronoun. Our reasons for selecting this problem from among the many possibilities for approaching sentence comprehension were two. First, pronoun reference is tightly governed by syntactic constraints. Since correct attribution of coreference of a reflexive pronoun requires that the perceiver recover the syntactic structure of the whole sentence, comprehension of pronoun reference is a test of sensitivity to grammatical structure. Second, there is evidence that aphasia in adults is often associated with problems in assigning reference to reflexive pronouns. Our study was inspired by an investigation of comprehension of the reflexive by Blumstein, Goodglass, Statlender, and Biber (1983). These investigators compared comprehension of sentences in which a reflexive pronoun is coreferent to an immediately preceding noun phrase, with that of sentences in which the reflexive is coreferent to a noun phrase that occurred earlier in the sentence. Examples 1a and 1b illustrate these types:

- 1a. The chef watched the boy bandage himself.
- 1b. The chef watching the boy bandaged himself.

Using a two-choice picture-verification task to probe subjects' comprehension of the coreferent of the reflexive in sentences such as 1a and 1b, Blumstein et al. (1983) found that all aphasic subgroups performed better on 1a than on 1b. Indeed, they performed at chance on sentences like 1b, that cannot be successfully comprehended by adherence to a processing strategy in which pronoun reference is inflexibly attributed to the nearest preceding noun phrase. Thus, Blumstein et al. (1983) concluded that the aphasic subjects failed to process fully the syntactic structure of sentence like 1a and 1b, and that they apparently had a tendency to revert to the immature "minimum distance" strategy often attributed to young children (Chomsky, 1969).

Further motivation for our decision to examine children's comprehension of constructions containing reflexive pronouns came from studies that specifically examined developmental changes in pronoun comprehension. Solan (1981) has shown that children of age five or younger recognize the basic constraints on reflexive pronouns. It must be acknowledged,

however, that young children do make mistakes in processing pronouns. We note in this connection findings of Read and Hare (1979), who suggest that certain nuances of pronoun use, which turn on the correct parsing of sentences involving more than one clause, may be late to mature. Among a group of children aged 6 to 12 studied by these investigators, only the oldest subjects in the sample gave grammatically correct interpretations to all types of multiclausal constructions that incorporated reflexive pronouns, and even the most successful were not as consistent as adult subjects. Thus, although children may very early apprehend constraints on pronoun reference, there seems to exist considerable individual variation in sophistication in handling reflexive pronouns in multiclausal structures, giving ample scope for differences between good and poor readers at the third grade level.

Attribution of pronoun reference seemed, then, to be an important area for further investigation. Accordingly, our study was designed to assess comprehension and immediate recall of sentences containing pronouns. Third grade children who were good and poor readers were first tested for sentence comprehension by a picture verification test; in a subsequent session on a different day the same sentences were presented for immediate recall.

METHOD

Subjects. The subjects were 35 third grade children attending the public school system of a small Northeastern city. All were native speakers of English with no known speech or hearing deficiencies, who had an intelligence quotient of 90 or better, as measured by Peabody Picture Vocabulary Test (Dunn, 1965). Their inclusion in the experiment was initially based on teachers' evaluations of reading ability, and confirmed by scores on the reading subtest of the Iowa Test of Basic Skills (Hieronymus & Lindquist, 1978) which had been administered approximately 4 months prior to our study. Three boys and fifteen girls whose mean Iowa grade-equivalent score was 4.59 (range = 4.1 to 5.2) comprised the good reader group; nine boys and eight girls whose mean Iowa grade-equivalent score was 2.32 (range = 1.7 to 2.6) comprised the poor reader group.² The groups did not differ significantly in IQ (109.3 for good readers and 107.7 for poor readers), nor in age (110.5 months for good readers; 107.4 months for poor readers).

Materials. The test materials (see Appendix) consisted of eight tokens of each of five sentence types: Each sentence poses a problem in perception of pronoun reference. A sample set appears below:

- (A) The fireman watched the soldier bandage himself.
- (B) The fireman watching the soldier bandaged himself.
- (C) The fireman bandaged her.
- (D) The soldier bandaged himself.
- (E) The soldier bandaged him.

² The groups were thus not equivalent in the proportion of boys and girls. We do not regard this as a serious imbalance, however, since research has shown that the patterns of deficits characteristic of children with reading disability do not vary with the sex of the child (Lieberman & Mann, 1981).

Type A sentences are declarative sentences in which the reflexive pronoun occurs in a relative clause modifying the object of the main clause, thus causing the referent of the reflexive to be the object of the main clause. The pronoun reference can be correctly assigned following the minimum distance principle, since the pronominal referent is the agent immediately preceding the reflexive pronoun. Type B sentences are declarative sentences with a single, center-embedded, relative clause that modifies the subject of the main clause, thus causing the referent of the reflexive pronoun to be the subject of the main clause. In contrast to Type A sentences, the referent of the pronoun in type B sentences cannot be correctly assigned by following the minimum distance strategy, since it is the agent most remote from the reflexive.

The remaining three types of sentences were controls designed to assess comprehension of personal and reflexive pronouns in single-clause sentences. Type C sentences tested the comprehension of personal pronouns, incorporating gender difference as a cue for establishing reference. Types D and E tested comprehension of reflexive and personal pronouns, respectively, without the gender cue.

Eight sentences of each type were constructed using noun agents that can be unequivocally represented and verbs that refer to actions that can be illustrated clearly in drawings. Half of the sentence sets employed male agents and half employed female agents, with Type C sentences incorporating agents of different sexes. The 40 test sentences were randomized and recorded by a speaker who read each one aloud with natural intonation. Each sentence was preceded by an alerting stimulus (a bell).

The tape for the repetition task was recorded separately. It included the original sentences of the comprehension test interspersed with an additional eight control sentences. These control sentences equalled or slightly exceeded the length of Type A and Type B sentences and incorporated the same agents and actions, but lacked reflexive pronouns. Each was of the form "The nurse and the policewoman sprayed water on the flowers" (see Appendix).

Picture-verification test: In order to assess the ability of subjects to comprehend the reflexive pronoun in each type of construction, we created a four-alternative, forced-choice picture verification task in which subjects were presented with a 2×2 array of line drawings and were asked to point to the drawing that most accurately depicted the meaning of the sentence as heard. The response array for each sentence included four $5 \times 3\frac{1}{4}$ -in. pictures, one correctly depicting sentence meaning, and three foils, each depicting an incorrect interpretation of the sentence. Each picture displayed two agents; the placement of these remained constant within an array, and was varied randomly across arrays. The position of the correct picture and the three different foils was varied so that each appeared with equal frequency in each of the four possible positions within the array.

The foils for sentence Types A and B provided the critical measures. Foil 1 for Type A sentences depicted the reflexive pronoun contained in the subordinate clause as incorrectly attributed to the subject of the main clause. Foil 1 for Type B sentences correctly depicted the actions expressed by each verb, but depicted the reflexive as incorrectly attributed to the object of the subordinate clause. This foil provided the test of whether subjects were following a minimum distance strategy, an assignment that was characteristic of adult aphasics studied by Blumstein et al. (1983). Foil 2 for both Type A and B sentences allowed a test of whether the subject had attended to the entire sentence. This foil depicted the correct attribution of the reflexive to its referent, but incompletely represented the relation between the agents indicated by the first verb. For example, in sentence A (see above), the nurse is *not* watching the policewoman, and in B, the policewoman is *not* watching the nurse. Foil 3 for A and B sentences allowed the reflexive pronoun to be interpreted as a personal pronoun.

Foils for the control sentences (C, D, and E) were as follows: Foil 1 depicted reversed roles of the two noun agents. Foil 2 depicted the pronoun incorrectly—i.e., personal pronouns in Type C and E sentences were depicted as reflexive pronouns; reflexive pronouns

in Type D sentences were pictured as personal pronouns. Foil 3 depicted a role reversal and misrepresented the pronoun as described above.

Procedure. Subjects were tested individually in two half-hour sessions. The comprehension test was administered first followed by the repetition test at least 1 week later. When testing comprehension, the examiner placed the relevant array of pictures before the subject immediately prior to the initiation of each tape-recorded sentence. The decision to expose the picture array before sentence onset was dictated by a concern not to overload the short-term memory. Subjects were instructed to listen to the whole sentence, to examine each of the four pictures, and then to point to the one that best showed what the sentence meant. Emphasis was placed upon listening to the entire sentence before pointing, and choosing the picture only after examining all of the alternatives. A bell signalled the onset of each test sentence. If a subject requested that a sentence be repeated, the experimenter replayed the sentence once, noting the repetition on the score sheet.

In the sentence repetition task, subjects were instructed to listen to each taped sentence and to repeat it back immediately. Each sentence was played only a single time. If a child requested that a sentence be repeated, the examiner encouraged him to report as much as could be remembered. The responses were transcribed by the experimenter during the session, and also preserved on tape for later error analysis.

RESULTS

Sentence repetition

The repetition data were analyzed both in terms of the number of incorrectly recalled sentences, and in terms of the total number of individual errors made, including omissions, substitutions, reversals, tense changes, and pronoun errors within each sentence. The results of each scoring procedure are summarized in Table 1 for each type of sentence (the five Test Types A-E and the additional control type), separately for good and poor readers.

Poor readers made more errors than good readers with respect to the number of sentences and the number of words incorrectly recalled. Pearson product-moment correlation coefficients were computed for each error measure and the reading scores from the Iowa test. Each was negatively correlated with reading ability: $r(35) = -.48$, $p < .01$ for sentences; $r(35) = -.45$, $p < .01$ for words. Each set of error measures was also subjected to an analysis of variance in which type of sentence (Types A-E and the control sentences) was the within-subjects factor and reading group the between-subjects factor. Significant main effects were obtained for type of sentence, both for the number of sentences incorrectly recalled, $F(5, 165) = 37.81$, $p < .001$ and number of words, $F(5, 165) = 21.97$, $p < .001$. The effects of reader group were also significant: $F(1, 33) = 8.80$, $p < .006$ for sentences, $F(1, 33) = 6.40$, $p < .017$, for words. However, there was no interaction between reading ability and the effect of sentence type. For children in both reading groups, more errors were made on Type A and B sentences and length-matched control sentences, than on Types C, D, and E ($t(33) = 6.87$, $p < .001$.)

Table 2 displays the distribution of errors for each reader according to error type and word class. The greatest proportion of errors for both

TABLE 1

SENTENCE REPETITION: MEAN NUMBER OF SENTENCES INCORRECTLY RECALLED^a AND MEAN NUMBER OF WORDS INCORRECTLY RECALLED IN SENTENCES OF EACH TYPE

Sentence type	Reader group	
	Good (<i>N</i> = 18)	Poor (<i>N</i> = 17)
	Sentences	
A	2.22 (1.55) ^b	3.41 (1.70)
B	2.06 (2.01)	3.82 (2.19)
C	0.39 (0.92)	1.00 (0.79)
D	0.22 (0.55)	1.23 (1.09)
E	0.11 (0.32)	0.88 (0.99)
Control	2.00 (1.68)	2.70 (1.83)
	Words	
A	3.06 (2.31)	4.94 (2.33)
B	3.89 (5.26)	7.35 (7.44)
C	0.39 (0.98)	1.00 (0.79)
D	0.22 (0.55)	1.41 (1.28)
E	0.11 (0.32)	1.06 (1.25)
Control	3.33 (3.27)	5.47 (4.39)

^a Max = 8.

^b Mean (*SD*).

reader groups occurred on nouns and verbs. Substitutions within word class, e.g., saying "a" for "the," "fireman" for "farmer," or "hissself" for "himself," make up the greatest proportion of errors for both reader groups. The proportion of deletion errors (deletion of whole words) and errors involving inflections (e.g., omission of the possessive "s" or omission or change of verb tense markers) was comparable for each group. Intrusions, i.e., inserting extra words into a sentence, occurred rarely. It is apparent from Table 2 that although the poor made more errors than the good readers in most error categories the distribution of the errors is highly similar in the two groups.

Sentence Comprehension

Having established that the poor readers were less accurate in verbatim repetition of the test sentences, we turned next to the results of the measure of sentence comprehension, the four-choice picture verification test. The initial analysis was performed on the number of error responses made on each sentence type (A-E). The correlation between total errors and the Iowa score yielded a nonsignificant value of $r(35) = -.14$. Analysis of variance for the factors sentence type and reader group revealed a highly significant effect of sentence type, $F(4, 132) = 38.06$, $p < .001$, but no significant difference between children in the two reading

TABLE 2
DISTRIBUTION OF REPETITION ERRORS ACCORDING TO WORD CLASS AND ERROR TYPE^c

Reader Group ^b :	Error Type												Percentage of total errors			
	Substitution		Deletion		Intrusion		Inflection ^c		Good		Poor					
	Good	Poor	Good	Poor	Good	Poor	Good	Poor	Good	Poor	Good	Poor	Good	Poor		
Word class																
Nouns	3.44	6.06	0.55	1.23	0.00	0.06	0.39	0.12	0.00	0.06	0.39	0.12	39.8	35.2		
Verbs	0.83	1.17	0.28	0.53	0.00	0.12	1.89	3.47	0.00	0.12	1.89	3.47	27.3	24.9		
Pronouns	1.00	3.76	0.55	0.41	0.17	0.29	NA	NA	0.17	0.29	NA	NA	15.6	21.0		
Article	1.00	1.47	0.55	1.53	0.00	0.00	NA	NA	0.00	0.00	NA	NA	14.1	14.2		
Prep./Conj.	0.11	0.35	0.17	0.23	0.06	0.41	NA	NA	0.06	0.41	NA	NA	3.1	4.7		
% Total errors	58.0	60.4	19.1	18.5	2.1	4.2	20.7	16.9	2.1	4.2	20.7	16.9				

^a Mean number errors per subject.

^b Good readers: $N = 18$; poor readers: $N = 17$.

^c Not applicable for articles, pronouns, prepositions, and conjunctions.

groups, $F(1, 33) = 0.40$. Moreover, there was no interaction between individual sentence type and reader group, $F(4, 132) = 1.53$.

Table 3 shows a breakdown of the errors by sentence type and serves to confirm the absence of interaction between the reader groups. It may be seen that many more errors occurred on Sentences A, B, and E, than on C and D. The difference between A and B on the one hand, and C and D on the other, was expected. The comparatively high error rate on Type E may have occurred for a special reason.³

A detailed analysis of the error pattern was undertaken in which choice of foils was examined for the critical Sentence Types A and B, which were designed to indicate whether poor readers tend to adopt a minimum distance strategy in assigning a referent to the reflexive pronoun. An analysis of variance was performed on this portion of the error data, in which the factors were sentence type, foil type, and reader group. There was a significant effect of sentence type, $F(1, 33) = 31.53, p < .001$, and foil type, $F(2, 66) = 4.64, p < .02$. Moreover, there was an interaction of foil type and reading ability, $F(2, 66) = 4.02, p < .03$. However, there was no interaction of foil type \times sentence type \times reading ability.

The distribution of errors across the foils for Type A and B sentences is shown in Table 4. The figures in this table are a breakdown of the error means shown in Table 3 according to foil type. Foil 1 in Type B sentences provided the critical test of adherence to the minimum distance principle. Choice of this foil would indicate that in the assignment of pronoun reference, the subject is using a minimum distance strategy in lieu of full syntactic analysis. This was the error that aphasic patients, studied by Blumstein et al. (1983), tended to make. The subjects of the present study also showed a tendency to make this error, i.e., they tended to assign the reference to the agent in closest proximity rather than to the referent dictated by the syntax. However, although the poor readers selected Foil 1 more frequently than good readers, the difference was not confined to Type B sentences, as indicated by the lack of a three-way interaction between sentence type, foil type, and reader group. The poor readers tended instead to make more errors on Type 1 foils for all sentence types, $t(33) = 1.92, p < .05$, suggesting that their difficulty

³ The higher error rate on Type E sentences than Types C and D, which were matched with these for length, requires comment. E sentences were designed as controls to test basic grasp of pronoun use, and therefore few errors were anticipated from children in the age range of our subjects. The analysis revealed that the principal error on this sentence type was to interpret a pronoun as though it were a reflexive. Thus, the sentence, "the astronaut poured him a drink" was interpreted to mean that the astronaut poured a drink for himself. We speculate that this interpretation reflects a dialect preference and not a genuine confusion in assigning pronoun reference. In support of this, we note that on Type C sentences, where reference is established by gender, such misinterpretations practically never occurred.

TABLE 3
SENTENCE COMPREHENSION: MEAN NUMBER AND PERCENTAGE OF ERRORS ON SENTENCES OF EACH TYPE^a

Sentence type	Reader group			
	Good (<i>N</i> = 18)		Poor (<i>N</i> = 17)	
	Mean (<i>SD</i>)	%	Mean (<i>SD</i>)	%
A	1.56 (0.92)	18.35	1.35 (1.00)	14.27
B	3.11 (2.08)	36.59	3.88 (2.44)	41.01
C	0.78 (0.65)	9.18	0.35 (0.70)	3.70
D	0.50 (0.71)	5.88	0.59 (0.71)	6.23
E	2.55 (2.12)	30.00	3.29 (1.79)	34.79

^a Max = 8.

cannot be understood as an inordinate reliance on the minimum distance strategy. Had this been the case, the poor readers should not have been made more Foil 1 errors than the good readers on Type A sentences in which Foil 1—in violation of the minimum distance principle—incorrectly attributed the reflexive to the subject of the main clause. As for the other foils, any differences between good and poor readers failed to reach significance. Selection of Foil 2, which controlled for inattention to the first verb of the sentence in both Type A and B sentences, occurred only rarely in either sentence type. Foil 3, which depicted the reflexive pronoun as a personal pronoun in both sentence types, was selected slightly more frequently, but differences between reader groups were minimal.

Selection of foils on the control sentences (C, D, and E) also showed no reader group differences. The few errors that occurred on Type C and D sentences, involved primarily Foil 2, i.e., the treating of a personal

TABLE 4
DISTRIBUTION OF ERRORS BY FOIL TYPE FOR SENTENCE TYPES A AND B: MEAN NUMBER ERRORS

Sentence Type	Foil type	Reader group	
		Good (<i>N</i> = 18)	Poor (<i>N</i> = 17)
Sentence Type A	1	0.00 (0.00) ^a	0.18 (0.39)
	2	0.56 (0.70)	0.29 (0.84)
	3	1.00 (0.68)	0.88 (0.78)
Sentence Type B	1	1.50 (1.85)	2.82 (2.76)
	2	0.78 (0.73)	0.41 (0.62)
	3	0.83 (0.99)	0.65 (0.70)

^a Mean (*SD*).

pronoun as a reflexive, or vice versa. As we mentioned earlier, somewhat more errors occurred on Type E sentences. These predominantly involved personal pronouns in locative constructions (Sets 4 and 6 in Appendix) and indirect object constructions (Sets 2, 5, and 8 in Appendix) having been misinterpreted as reflexive pronouns (choice of Foil 2). Such misinterpretations are common to many young children and may reflect a tendency to "flatten" embedded structures (Tavakolian, 1981).

DISCUSSION

This study was undertaken as part of a continuing investigation of the nature of language impairment in children who fail to make expected progress in learning to read. Here we have asked whether poor readers' problems with language extend to the processing of multiclausal spoken sentences involving attribution of pronoun reference. To this end we have tested good and poor readers' repetition and comprehension of the same set of sentences.

With respect to repetition, more errors occurred on the longer, complex sentences. Structural differences between sentences matched for length are not significantly reflected in error rates, although a tendency is present for fewer errors to occur on sentences that can be interpreted by following the minimum distance principle (Type A). The poor readers were overall less accurate than the good readers in repeating sentences of every type. Sentence type did not significantly affect the extent of differences related to reading ability when the data are examined for number of correct responses and for the pattern of errors. This is in keeping with a finding we reported earlier (Mann et al., 1980) in which it was demonstrated that good and poor readers, similar to the present subjects, though a year younger, differed markedly in recall of both meaningful and meaningless sentences, but the differences were constant across a variety of sentence structures. The results of both studies are consistent with the many lines of evidence that implicate working memory in the language-related deficits of poor readers.

The test for comprehension of the sentences by the picture verification task revealed appreciably more errors on complex sentences than on simple ones. The errors were chiefly confined to multiclausal constructions and to the specific locative and indirect object structures that have been identified by other investigators as sources of potential confusion in young children (e.g., Read & Hare, 1979; Roeper, 1982; Solan, 1981). The comparison of greatest interest, between sentences that can be interpreted by following the minimum distance principle (Type A) and those that cannot (Type B), revealed that significantly more errors occurred on the latter, suggesting that the children in our study resorted occasionally to immature parsing strategies. Unlike the repetition test, however, the picture verification test of comprehension did not significantly distinguish

the good and poor readers. Such difficulties as the subjects did encounter were common to both groups of children. The children's difficulties with the more complex structures were minor in comparison to the problems that the aphasic patients of Blumstein et al. (1983) encountered with similar sentences. The aphasics performed at chance level on all sentences in which the structure did not allow application of the minimum distance principle, and, indeed, they failed to interpret reflexive pronouns correctly even in simple sentences.

Though these results did not reveal the expected differences between the good and poor readers in comprehension of complex sentences containing reflexive pronouns, we must acknowledge, and take account of, other indications that our good and poor readers are not wholly equivalent in their abilities to comprehend spoken sentences. First, we should note that the children in our two reading groups did not perform equivalently on the reading subtest of the Iowa Test of Basic Skills. The inferior performance of the poor reader group on this test of reading comprehension does not necessarily indicate language processing limitations as such; it may instead reflect limitations that are specific to written language, such as slow and inaccurate word decoding. By studying comprehension of spoken sentences, we hoped to gain a perspective on possible language comprehension limitations, independent of specific reading difficulties. In this connection, it is appropriate to refer to a companion study to the present one in which we tested the same groups of subjects on a different occasion with a different set of sentences (Mann, Shankweiler, & Smith, in press). In that study, unlike the present study, the poor readers displayed a significant deficit in comprehension. There, the method of testing was by object manipulation, not picture verification. Thus the answer to the question of whether the poor readers are below par on comprehension may depend on which structures are assessed and on the method of testing.

Little information is available at present about the capabilities of good and poor readers to comprehend various types of sentences. A recent study by Byrne (1981), which came to our attention after this experiment and the one of Mann et al. were completed, also finds differences in sentence comprehension (as tested by object manipulation) on some sentence types but not on others. The sentences which separated the reader groups in Byrne's study contained unusual constructions and semantic anomalies. Having found that some shorter sentences distinguished the reader groups more readily than longer ones, Byrne argued that memory factors could not be responsible for the differences. This conclusion does not necessarily follow. As we noted earlier, more is involved in memory-related difficulty than sentence length alone. Anomalous sentences, even if they are short, may place extra-heavy demands on working memory because they are likely to be misinterpreted on first

construal and therefore need to be "replayed" from memory, in order to properly establish their structure. Such rehearsal would require complete retention.

In regard to the method of testing, we may speculate that the picture verification task of the present study may have stressed short-term memory less than the "acting out" manipulation task of Mann et al. (in press). It is pertinent that in the present experiment, the subjects were allowed to inspect the sheet containing the four multiple-choice picture foils as the sentence was being read, a procedure that could be expected to minimize the need for rehearsal. In contrast, the manipulation procedure of the Mann et al. study merely presented the child with a random arrangement of the three relevant actors (toy animals) in advance of presentation of the sentence. It is clear that the picture test gives more concurrent information, and thus might be expected to stress working memory significantly less. This speculation is supported by the findings of Elmore-Nicholas and Brookshire (1981) in which performance of aphasic adults on a sentence verification task was facilitated by the presence of pictures. Thus, there may be no real inconsistency in the findings of the two studies that tested sentence comprehension in these subjects. Conceivably, the present experiment failed to detect real differences between the reading groups because the method of testing did not give adequate scope for differential performance.

In summary, the poor readers of this investigation were less accurate than the good readers in immediate recall of sentences containing reflexive pronouns, but were not deficient in comprehension of the same sentences. They were deficient, however, both in recall and interpretation of another set of complex sentences, as reported by Mann et al. (in press). We suspect that the comprehension testing conducted with these children yielded inconsistent results because the picture verification procedure used to test reflexive pronouns was insufficiently sensitive. The performances of the poor readers did not closely resemble those of the adult aphasics studied by Blumstein et al. (1983). Unlike the aphasics, neither good nor poor readers displayed rigid adherence to a minimum distance strategy for determining pronoun reference. Nevertheless, reading-disabled children—the present group included—have not typically been found to be the equals of good readers in processing spoken sentences (Byrne, 1981; Mann et al., in press), nor, as we have noted, in the use of short-term memory codes which so often are impaired in aphasia (Goodglass, Denes, & Calderon, 1974; Martin & Caramazza, 1982). It seems important, therefore, to explore fully the relations between short-term memory deficits and sentence-processing deficits, and in this regard to seek a better understanding of the similarities and differences between developmental language disorders, such as specific reading disability, and linguistic deficits in the acquired aphasias.

APPENDIX

Sentence Sets Used in Comprehension and Repetition

- I.
 - A. The fireman watched the soldier bandage himself.
 - B. The fireman watching the soldier bandaged himself.
 - C. The fireman bandaged her.
 - D. The soldier bandaged himself.
 - E. The soldier bandaged him.
- II.
 - A. The astronaut watched the sailor pour himself a drink.
 - B. The sailor watching the astronaut poured himself a drink.
 - C. The sailor poured her a drink.
 - D. The astronaut poured himself a drink.
 - E. The astronaut poured him a drink.
- III.
 - A. The farmer watched the Indian pull himself up the rope.
 - B. The farmer watching the Indian pulled himself up the rope.
 - C. The policewoman pulled him up the rope.
 - D. The Indian pulled himself up the rope.
 - E. The farmer pulled him up the rope.
- IV.
 - A. The clown watched the boy spill paint on himself.
 - B. The boy watching the clown spilled paint on himself.
 - C. The girl spilled paint on him.
 - D. The clown spilled paint on himself.
 - E. The boy spilled paint on him.
- V.
 - A. The girl watched the grandmother make herself a sandwich.
 - B. The girl watching the grandmother made herself a sandwich.
 - C. The Indian made her a sandwich.
 - D. The grandmother made herself a sandwich.
 - E. The girl made her a sandwich.
- VI.
 - A. The nurse watched the policewoman spray perfume on herself.
 - B. The policewoman watching the nurse sprayed perfume on herself.
 - C. The clown sprayed perfume on her.
 - D. The nurse sprayed perfume on herself.
 - E. The nurse sprayed perfume on her.
- VII.
 - A. The waitress watched the ballerina dress herself.
 - B. The waitress watching the ballerina dressed herself.
 - C. The nurse dressed him.
 - D. The ballerina dressed herself.
 - E. The waitress dressed her.
- VIII.
 - A. The witch watched the queen pick herself a flower.
 - B. The queen watching the witch picked herself a flower.
 - C. The queen picked him a flower.
 - D. The witch picked herself a flower.
 - E. The queen picked her a flower.

Control Sentences (Repetition)

1. The sailor and the fireman poured coffee from the pot.
2. The astronaut and the sailor bandaged the boy's hand.
3. The boy and the Indian pulled the sled up the hill.
4. The clown and the farmer spilled paint on the sidewalk.
5. The queen and the grandmother made sandwiches for lunch.
6. The nurse and the policewoman sprayed water on the flowers.
7. The witch and ballerina dressed for the party.
8. The waitress and the girl picked flowers in the park.

REFERENCES

- Blumstein, S., Goodglass, H., Statlender, S., & Biber, C. 1983. Comprehension strategies determining reference in aphasia: A study of reflexivization. *Brain and Language*, **18**, 115-127.
- Byrne, B. 1981. Deficient syntactic control in poor readers: Is a weak phonetic memory code responsible? *Applied Psycholinguistics* **2**, 201-212.
- Chomsky, C. 1969. *The acquisition of syntax in children from five to ten*. Cambridge, MA: MIT Press.
- De Renzi, E., & Faglioni, P. 1978. Normative data and screening power of a shortened version of the Token Test. *Cortex*, **14**, 41-49.
- De Renzi, E., & Vignolo, L. A. 1962. The Token Test: A sensitive test to detect receptive disturbances in aphasia. *Brain*, **85**, 665-678.
- Dunn, L. M. 1965. *Peabody picture vocabulary test*. Circle Pines, MN: American Guidance Service.
- Elmore-Nicholas, B., & Brookshire, R. H. 1981. Effects of pictures and picturability on sentence verification by aphasic and nonaphasic subjects. *Journal of Speech and Hearing Research*, **24**, 292-298.
- Goodglass, H., Denes, G., & Calderon, M. 1974. The absence of correct verbal mediation in aphasia. *Cortex*, **10**, 264-269.
- Hieronymus, A. N., & Lindquist, E. F. 1978. *Iowa Test of Basic Skills*. Boston: Houghton Mifflin.
- Katz, R. B., Shankweiler, D., & Liberman, I. Y. 1981. Memory for item order and phonetic recoding in the beginning reader. *Journal of Experimental Child Psychology*, **32**, 474-484.
- Liberman, I. Y., & Mann, V. A. 1981. Should reading remediation vary with the sex of the child? In A. Ansara, N. Geschwind, A. Galeburda, N. Albert, & N. Gartrell (Eds.), *Sex differences in dyslexia*. Towson, MD: The Orton Society.
- Liberman, I. Y., Mann, V. A., Shankweiler, D., & Werfelman, M. 1982. Children's memory for recurring linguistic and non-linguistic material in relation to reading ability. *Cortex*, **18**, 367-375.
- Mann, V. A., & Liberman, I. Y. Phonological awareness and verbal short-term memory: Can they presage early reading problems? *Journal of Learning Disabilities*, in press.
- Mann, V. A., Liberman, I. Y., & Shankweiler, D. 1980. Children's memory for sentences and word strings in relation to reading ability. *Memory & Cognition*, **8**, 329-335.
- Mann, V. A., Shankweiler, D., & Smith, S. T. The association between comprehension of spoken sentences and early reading ability: The role of phonetic representation. *Journal of Child Language*, in press.
- Martin, R. C., & Caramazza, A. 1982. Short-term memory performance in the absence of phonological coding. *Brain and Cognition*, **1**, 50-70.

- Read, C., & Hare, V. C. 1979. Children's interpretations of reflexive pronouns in English. In F. R. Eckman, & A. J. Hastings (Eds.), *Studies in first and second language acquisition*. Rowley, MA: Newbury House.
- Roeper, T. 1982. On the importance of syntax and logical use of evidence in language acquisition. In S. A. Kocaj, II (Ed.), *Language development*, Vol. 1, *Syntax and semantics*. Hillsdale, NJ: Earlbaum.
- Shankweiler, D., Liberman, I. Y., Mark, L. S., Fowler, C. A., & Fischer, F. W. 1979. The speech code and learning to read. *Journal of Experimental Psychology: Human Learning and Memory*, 5, 531-545.
- Solan, L. 1981. The acquisition of structural restrictions in anaphora. In S. L. Tavakolian (Ed.), *Language acquisition and linguistic theory*. Cambridge, MA: MIT Press.
- Tavakolian, S. L. 1981. The conjoined-clause analysis of relative clauses. In S. L. Tavakolian (Ed.), *Language acquisition and linguistic theory*. Cambridge, MA: MIT Press.
- Wolford, G., & Fowler, C. A. 1984. Differential use of partial information by good and poor readers. *Developmental Review*, 4, 16-35.