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Applied Psycholinguistics 14 (1993), 285–298
Printed in the United States of America

Poor readers are not *easy* to fool: Comprehension of adjectives with exceptional control properties

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ABSTRACT
An earlier experiment by Byrne (1981) found that young, poor readers tend to act out sentences containing adjectives with object control, like *easy*, as though they were adjectives with subject control, like *eager*. Byrne interpreted this result as evidence that poor readers lag in the acquisition of syntactic knowledge underlying this distinction. However, the possibility that a processing limitation could have contributed to the poor readers' difficulties with object-control adjectives had not been fully explored. In an effort to tease apart these alternatives, we tested comprehension of object-control adjectives in second grade good and poor readers, using both an act-out task and a sentence–picture matching task. Contrary to Byrne's (1981) results, we did not find significant group differences in interpreting object-control adjectives with either task. Reasons for the discrepancy are suggested, and remedies for the pitfalls in designing experiments to assess syntactic knowledge in young children are proposed.

It is becoming increasingly apparent that the difficulties associated with reading disability extend beyond poor word decoding skills. A number of studies have shown that children with reading problems have difficulties in comprehension of certain types of spoken sentences. Relative clauses are perhaps the most frequently mentioned structures that cause problems for poor readers (Bar-Shalom, Crain, & Shankweiler, 1993; Byrne, 1981; Goldsmith, 1980; Mann, Shankweiler, & Smith, 1984; Smith, Macaruso, Shankweiler, & Crain, 1989; Stein, Cairns, & Zurif, 1984). Other constructions that have been implicated include passives (Stein et al., 1984), sentences

containing indirect and direct objects (Fletcher, Satz, & Scholes, 1981), certain types of imperative sentences (Macaruso, Bar-Shalom, Crain, & Shankweiler, 1989; Whitehouse, 1983), and sentences containing adjectives with exceptional control properties, such as *easy* (Byrne, 1981; Crain, 1987).

A plausible interpretation of these difficulties with spoken sentences is that young, poor readers are often delayed in acquiring certain aspects of syntactic knowledge (e.g., Byrne, 1981; Stein et al., 1984). An alternative explanation is that their difficulties stem from overloaded phonological processing capacities (e.g., Crain & Shankweiler, 1988; Mann et al., 1984; Shankweiler & Crain, 1986; Smith, Mann, & Shankweiler, 1986). A processing limitation may reflect the special memory requirements associated with analysis of complex sentences. In addition, it may reflect the complexity of the task used to assess comprehension.

Accordingly, for some years our research has addressed the problem of disentangling structural and processing contributions to performance on sentence comprehension tasks. For example, Mann et al. (1984) found that young, poor readers were significantly worse than good readers in acting out relative clause sentences. In a subsequent study, Smith et al. (1989) showed that reducing the syntactically irrelevant complexities of the target sentences and modifying the task to satisfy presuppositions associated with the use of relative clauses resulted in similar high levels of performance by both good and poor readers (see also Crain, Shankweiler, Macaruso, & Bar-Shalom, 1990). Findings such as these suggest that poor readers' difficulties in spoken sentence comprehension do not necessarily reflect deficient structural knowledge, but instead may reflect the processing demands associated with the comprehension task.

Mindful of these findings, we were led to reconsider a result in the research literature which is often cited as evidence for a structural deficit in poor readers. One of us (Byrne, 1981) found that young, poor readers tend to act out sentences containing adjectives with object control, like *easy*, as though they were adjectives with subject control, like *eager*. For example, they might act out the sentence, "The bird is easy to bite," as if it meant, "The bird finds it easy to bite [something]." Of course, a subject-control interpretation is correct for "The bird is eager to bite." Because sentences containing object-control adjectives (O-adjectives) and subject-control adjectives (S-adjectives) are short and of equivalent length, Byrne argued that the selective misinterpretation of O-adjective sentences should not be attributed to memory limitations. Instead, difficulties with these sentences were interpreted as evidence of a syntactic delay. Indeed, Chomsky (1969) proposed that O-adjective sentences are mastered later by normal children than S-adjective sentences because O-adjectives are syntactically more complex. However, the possibility that processing limitations could account for the special difficulty in comprehending O-adjective sentences had not been fully examined.

The purpose of this discussion is to present some findings that illustrate the practical difficulties in disentangling structural and processing contribu-

tions to performance on sentence comprehension tasks. Before accepting the conclusion that young, poor readers' misinterpretations of O-adjectives reveal a syntactic delay, we reexamined Byrne's (1981) experiment to identify possible nonsyntactic sources of difficulty associated with his act-out task. First, it may be relevant that Byrne did not explicitly test whether his subjects understood the meanings of the lexical items employed in the test sentences. In addition, an act-out task may give rise to interpretive difficulties associated with pragmatic factors. One problem hinges on the abstractness of adjectives like *easy* and *hard*. It may not have been apparent to some of the children how to act out the condition of being "hard to bite," as in, "The snake is hard to bite." As Hamburger and Crain (1984) pointed out, pragmatic concerns associated with planning a response may increase memory demands and thus mask syntactic knowledge.

These considerations impelled us to ask whether the poor readers' difficulties with O-adjectives in Byrne's (1981) study may have been due to factors other than syntactic knowledge. We therefore decided to conduct a new experiment to determine if young, poor readers have mastered the syntax associated with O-adjectives. In one task we attempted to confirm Byrne's original result by asking good and poor readers to act out O- and S-adjective sentences similar to the ones that Byrne used. In the other task, which was administered concurrently with the act-out task, the children's comprehension of O-adjective sentences was assessed using sentence–picture matching, which reduces nonsyntactic processing demands by eliminating the need to plan a response. In addition, the sentence–picture matching task incorporated a control that was missing from the act-out task: the subjects' comprehension of the meanings of the adjectives employed in the test sentences was assessed.

ACT-OUT TASK

The act-out task was patterned after Byrne's (1981), which was based on an earlier study by Cromer (1970). To obtain a generally valid result, the task was administered to two comparable samples of English-speaking children, one from the United States and one from Australia (where Byrne's original study was conducted). Twenty-eight children in the second year of school participated from each country. Each child initially received the Decoding Skills Test (DST) (Richardson & DiBenedetto, 1986) as a measure of reading ability and the Peabody Picture Vocabulary Test–Revised (PPVT) (Dunn & Dunn, 1981) as a measure of vocabulary knowledge from which an IQ estimate may be obtained.

Characteristics of the subjects are given in Table 1. For the U.S. sample, the good readers comprised 14 children (5 girls, 9 boys) with DST scores greater than 69, and the poor readers comprised 14 children (4 girls, 10 boys) with DST scores less than 56. The DST score is the total number of items read correctly on a list containing 60 words and 60 pseudowords, which were chosen to give full representation of the syllable types that

Table 1. *Characteristics of the good and poor readers*

	United States				Australia			
	Good		Poor		Good		Poor	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Age (months)	92.2	4.6	95.9	8.3	91.5	3.6	93.5	5.6
PPVT	115.4	11.1	108.9	9.4	109.9	7.0	102.3	10.5
DST[a]	97.2	16.1	37.9	12.0	95.9	10.4	28.5	15.8

[a]Maximum DST score = 120

occur in English. The reader groups did not differ significantly ($p > .05$) in mean age, nor in mean PPVT scores.

For the Australian sample, the good readers comprised 14 children (8 girls, 6 boys) with DST scores greater than 76, and the poor readers comprised 14 children (5 girls, 9 boys) with DST scores less than 57. The reader groups did not differ significantly in mean age. However, the poor readers' mean PPVT score was significantly lower than that of the good readers, $t(26) = 2.26$, $p < .05$. No poor reader obtained a score less than 85 (i.e., one standard deviation below the mean of the normative sample, which is 100). Thus, all subjects displayed vocabulary knowledge within the average range.

Test materials for the act-out task are listed in Appendix 1. The test sentences contained four O-adjectives (*easy, fun, hard, difficult*) and four S-adjectives (*eager, glad, willing, happy*). We used the same set of O- and S-adjectives as Byrne (1981), with one exception: we replaced *tasty* with *difficult*. There were two sentences for each O-adjective and one for each S-adjective. Each occurrence of an O-adjective was paired with a different verb. Four verbs were used in all: *follow, bite, touch*, and *kiss*. Byrne had employed only one verb, *bite*, in his test sentences. *Wombat* replaced *squirrel* in the test sentences that were administered to the Australian children.

Subjects were tested individually. They were first introduced to two hand-puppets, a teddybear and a squirrel (or wombat). The tester then demonstrated two act-out scenes: the teddybear following the squirrel, and the squirrel kissing the teddybear. Subsequently, the children were asked to place the puppets on their hands and to act out each sentence spoken by the tester. The sentences were presented in the fixed random order shown in Appendix 1.

The results of the act-out task are summarized in Table 2. Overall, the subjects displayed a high level of performance in acting out the O-adjective sentences. Each reader group responded with greater than 75% accuracy, and no group differences were found in either sample ($p > .05$). Thus, we did not confirm the results obtained by Byrne in 1981.

The results were further examined using the classification scheme employed by Byrne in the earlier study (see Table 3). Subjects were categorized according to their performance on O-adjective sentences as follows: *primi-*

Table 2. *Performance on the act-out task: Number correct*

	United States				Australia			
	Good		Poor		Good		Poor	
Sentence type	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
O-adjective (8)	7.5	1.4	6.9	2.2	6.3	1.5	7.1	1.3
S-adjective (4)	3.9	0.4	3.3	0.6	3.2	0.8	3.4	0.7

Table 3. *Classification of performances on the act-out task*

	Byrne (1981)		United States		Australia	
	Good	Poor	Good	Poor	Good	Poor
Primitive	1	4	0	1	0	0
Intermediate	8	14	2	5	11	6
Passer	9	3	12	8	3	8

tive rule users interpreted all O-adjectives as if they were S-adjectives (e.g., by having the teddybear do the biting in "The teddybear is easy to bite"); *intermediates* interpreted some of the O-adjectives as S-adjectives, and *passers* interpreted all O-adjectives correctly.

In the present study, only one child (a poor reader in the U.S. sample) was classified as a primitive rule user. The remainder of the children interpreted at least some of the O-adjective sentences correctly. More than half of the subjects (55%) were classified as passers, and the remaining subjects fell into the intermediate category. In fact, half of the intermediates produced just one error in acting out the eight O-adjective sentences. If we relax the criterion for "passing" to include 7 out of 8 correct, 77% of the children, including more than half in each group, would be considered to display mastery.

Performance on the O-adjective sentences may be contrasted with performance on the putatively less complex S-adjective sentences. As revealed in Table 2, performance on the S-adjective sentences was less than perfect. No reader group difference was found in the Australian sample, but in the U.S. sample, the good readers outperformed the poor readers, $t(26) = 3.00$, $p < .01$. However, we found that these poor readers had difficulty with only one S-adjective sentence: "The teddybear is eager to touch." They were only 43% accurate on this sentence, whereas they were 95% accurate on the remaining S-adjective sentences. For the other three reader groups, more than 65% of the errors with S-adjectives also occurred on this sentence. Apparently, many of the children were uncertain about the control properties of *eager*.

As was the case with S-adjective sentences, performance also varied across the set of O-adjective sentences. For example, 47% of the errors with O-adjectives occurred on the two sentences containing *fun*. These findings suggest that accurate performance on the act-out task is highly dependent on the peculiarities of specific lexical items. The changes in vocabulary introduced into the present study may have had greater implications than we anticipated. The inclusion of a different adjective and different verbs may have made our act-out task easier than Byrne's (1981) original task. In fact, collapsing over groups, the children in the present study had much more success in acting out O-adjective sentences than the children in Byrne's original study (87% correct vs. 64% correct). In any case, we believe that the modifications made in the present study strengthened the "naturalness" of the task and thus provided a more valid test of the syntactic delay hypothesis (see Shankweiler, Crain, Gorrell, & Tuller, 1989). As mentioned earlier, another factor associated with accurate performance may be the ability to overcome the pragmatic difficulties intrinsic to the act-out task. Taken together, these factors help to explain why we did not confirm the deficit in poor readers found in Byrne's earlier study.[1]

SENTENCE–PICTURE MATCHING TASK

The sentence–picture matching task can be argued to pose fewer processing demands than the act-out task. In sentence–picture matching, the child is required to retain the input string in working memory only long enough to derive an interpretation and match it to an appropriate picture. The demands associated with planning and implementing a response, as in the act-out task, are averted. Based on these observations, we chose to assess the syntactic knowledge of good and poor readers with a sentence–picture matching task. Two pictures were created for each test sentence, one depicting the object-control interpretation and the other the subject-control interpretation. For example, the two pictures shown in Figure 1 were presented with the sentence, "The bear is easy to reach." The lower picture shows a boy reaching for a bear that is genuinely easy to reach, which corresponds to the correct object-control interpretation. The foil shows a bear reaching for honey that is easily within reach, which corresponds to the incorrect subject-control interpretation.

Three groups of good and poor readers were tested with the sentence–picture matching task. Two of the groups comprised the same subjects who participated in the act-out task. The third group consisted of 16 good readers and 18 poor readers in the second grade who had participated in a study of relative clause syntax (Smith et al., 1989). Selection criteria for the subjects in the Smith et al. study were essentially the same as in the act-out task.

Test materials for the sentence–picture matching task are listed in Appendix 2. Test sentences 1–8 contained the four O-adjectives: *easy, impossible, hard,* and *difficult*. (Each of these adjectives was used in the act-out task except *impossible*, which replaced *fun*). Each adjective appeared in two

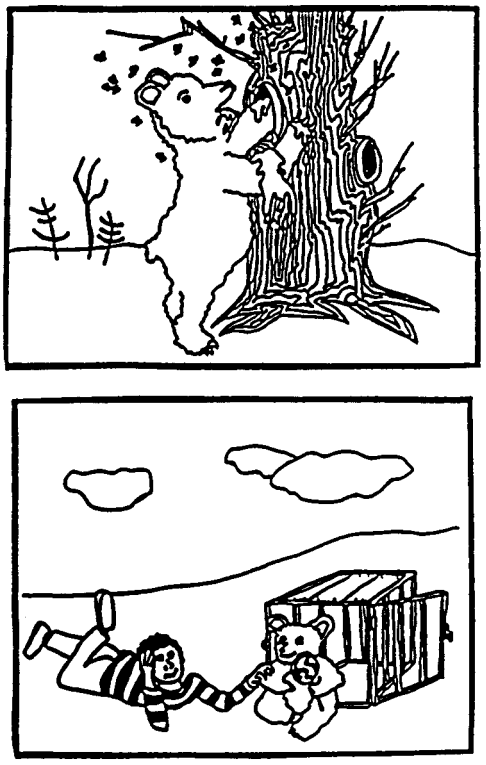

Figure 1. Picture pair for "The bear is easy to reach."

sentences. Test sentences 9–12 contained adjectives that are ambiguous with regard to their control properties. For example, given "The man is too dirty to serve," the child may select a picture of a dirty man not being permitted to serve someone (the subject-control interpretation) or a picture of a dirty man being refused service (the object-control interpretation). The ambiguous sentences allowed us to determine which interpretation the children preferred for adjectives that, in the adult grammar, have both an object-control and a subject-control interpretation. Sentences 13–16 presented the four O-adjectives in a simplified form (e.g., "It is easy to reach the bear"). These sentences were included as controls to assess the children's comprehension of the specific lexical items and the appropriateness of the pictures. If the children knew the meanings of the O-adjectives and the pictures accurately depicted these meanings, then they should display few errors on these sentences.

Subjects were tested individually. The tester read each sentence aloud, and the child was asked to point to the picture that best fits the meaning of the sentence. The sentences were presented in the fixed random order shown in Appendix 2.

The mean number of object-control responses for each sentence type and for each reader group is presented in Table 4. No reader group differences were obtained in any of the samples for the eight object-control sentences, the four control sentences, or the four ambiguous sentences ($p > .05$).

As evident in Table 4, however, overall performance levels on the O-adjective sentences were less than perfect. Percent correct ranged from a high of 86% to a low of 78%. As in the act-out task, incorrect responses were not uniformly distributed across the sentences. Performance on the two sentences containing the phrase "impossible to jump" accounted for 82% of the errors. For the remaining O-adjective sentences, the subjects responded with 95% accuracy. Unanticipated difficulty with the phrase "impossible to jump" was also apparent in the children's performance on the control sentences. All but one of the errors on these sentences occurred for, "It is impossible to jump the frog."

One possible reason why the children had difficulty with "impossible to jump" may be that they did not understand the use of *impossible*. However, we consider it more likely that the picture pairs used to test "impossible to jump" were difficult to interpret. One of these picture pairs, which was used to test "The frog is impossible to jump" and "It is impossible to jump the frog," is presented in Figure 2.

With a new group of subjects, we asked whether the picture pairs used with "impossible to jump" were, in fact, ambiguous. In order to rule out limitations in vocabulary knowledge, we decided to pose the question to adults. Presented with a shortened version of the sentence–picture matching task, 24 adults were asked to select the correct picture and provide a confidence rating for their choice. Variants of the original test sentences were created by interchanging *impossible* with *hard*, an adjective that did not present much difficulty to the children. Examples of the new sentences are "The frog is hard to jump" and "The boy is impossible to catch." The picture pairs originally presented with *impossible* and the pairs originally presented with *hard* were now tested with each adjective. The crossing of picture pairs and adjectives allowed us to tease apart difficulties associated with the pictures from difficulties associated with *impossible*.

The adults made few errors in selecting the correct picture. However, their confidence ratings clearly indicate that the pictures originally presented with *impossible* were more difficult than the pictures originally presented with *hard*. There were 24 instances of a low confidence rating (or an incorrect response) for the pictures originally presented with *impossible*, while only 5 were given for the pictures originally presented with *hard*. Moreover, 10 instances of a low confidence rating (or an incorrect response) occurred when *hard* was presented with the original *impossible* pictures, but only 2 when *impossible* was presented with the original *hard* pictures. This suggests that the source of difficulty in the children's performance was the original *impossible* pictures, and not the adjective itself.

Finally, as revealed in Table 4, no reader group showed a definite preference for either a subject-control or an object-control interpretation for the four ambiguous sentences. Thus, bias did not enter into performance on the O-adjective sentences.

Table 4. *Performance on the sentence-picture matching task: Number object-control responses*

	United States				Australia				Smith et al. (1989)			
	Good		Poor		Good		Poor		Good		Poor	
Sentence type	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
O-adjective (8)	6.7	0.9	6.8	1.0	6.9	0.9	6.2	1.6	6.3	0.7	6.6	1.2
Control (4)	3.8	0.4	3.4	0.5	3.6	0.5	3.8	0.4	3.9	0.3	3.7	0.6
Ambiguous (4)	1.8	0.7	2.1	0.8	1.4	1.1	1.6	0.9	2.1	1.0	2.2	1.1

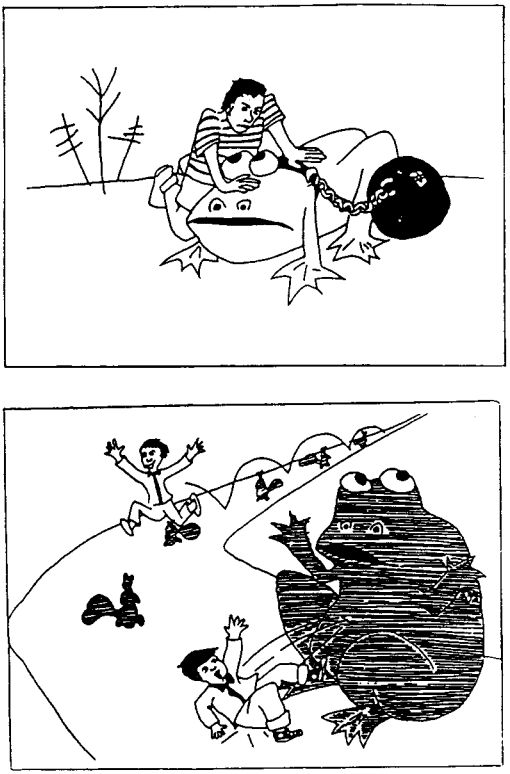

Figure 2. Picture pair for "The frog is impossible to jump."

DISCUSSION

In sum, the results with both tasks support the conclusion that young, poor readers are not delayed in acquiring the syntactic knowledge necessary to comprehend sentences containing object-control adjectives like *easy*. The good and poor readers demonstrated high levels of performance with these sentences in both the act-out and sentence–picture matching tasks, and no reader group differences were found. Thus, we were unable to confirm the difference obtained by Byrne (1981).

In interpreting these results, we find it useful to distinguish between strong and weak versions of the syntactic delay hypothesis. A strong version would state that young, poor readers treat *every* O-adjective as if it were an S-adjective. This version is clearly unsupported by the data. For example, only one poor reader acted out all eight O-adjective sentences incorrectly. Every other child produced at least three correct responses in acting out O-adjective sentences. A weak version of the syntactic delay hypothesis would propose that, when the control properties of an adjective are un-

known, the child reverts to a (default) subject-control interpretation. Even the weak version finds little support in the data. First, the children did not show a bias toward a subject-control over an object-control interpretation when presented with ambiguous adjectives, like *dirty*, in the sentence–picture matching task. Second, performance on S-adjective sentences in the act-out task was not perfect, which suggests that a default strategy was not followed. For example, many subjects treated the apparently unfamiliar adjective *eager* as if it had the control properties of an O-adjective. Finally, on only 12 occasions in the act-out task did a child respond incorrectly to both presentations of an O-adjective. In contrast, on 34 occasions a child responded incorrectly on one presentation of an O-adjective, but correctly on the other. This pattern of inconsistent responding is also incompatible with the default notion. Thus, the results of this study do not favor either a strong or a weak version of the syntactic delay hypothesis. Instead, they are consistent with a number of recent findings in the literature that argue for intact syntactic abilities in young, poor readers in the face of deficiencies in retaining linguistic information.[2]

Our experience in this study highlights some of the practical difficulties that arise in experiments designed to assess syntactic comprehension in young children. First, results from the act-out task show that knowledge of specific lexical items can affect performance on a comprehension task. For example, many children erred in acting out the sentence containing the S-adjective *eager*, presumably because they were unfamiliar with the control properties of this particular adjective. Second, results from the sentence–picture matching task indicate the importance of evaluating the adequacy of the test materials used to assess comprehension. The children displayed poor performance on sentences containing the O-adjective *impossible*, not because of failure to comprehend the meaning of the adjective, but because of difficulty in interpreting the pictures presented with this adjective. Thus, children's performance may reflect eccentricities of the particular task used to assess comprehension. This is underlined in comparisons of the children's performance across the two tasks employed in this study. Many of the children who produced errors on O-adjective sentences in the act-out task had no difficulty with the same structures in the sentence–picture matching task. For example, of the six children who had the most difficulty with O-adjective sentences on the act-out task (i.e., who had an error rate of 50% or more), three of the children made no errors with O-adjective sentences on the sentence–picture matching task (excluding the two "impossible to jump" sentences).

To conclude, these findings suggest ways in which both lexical knowledge and the pragmatic requirements of the experimental task may contribute to success or failure in tests of syntactic comprehension. They teach us to appreciate the need for special attention to controls in developing experimental tasks. It is especially important to ascertain that the subjects comprehend the key lexical items in the relevant contexts. Moreover, the pragmatic requirements of the assessment task need to be carefully scrutinized to ensure that they do not create problems of their own.

APPENDIX 1

SENTENCES FOR ACT-OUT TASK

Practice sentences

1. The squirrel follows the teddybear.
2. The teddybear kisses the squirrel.

Test sentences

1. The squirrel is happy to follow.
2. The teddybear is easy to touch.
3. The squirrel is fun to bite.
4. The teddybear is hard to kiss.
5. The teddybear is eager to touch.
6. The squirrel is difficult to follow.
7. The teddybear is glad to kiss.
8. The teddybear is easy to bite.
9. The squirrel is fun to kiss.
10. The squirrel is willing to bite.
11. The squirrel is hard to follow.
12. The teddybear is difficult to touch.

APPENDIX 2

SENTENCES FOR SENTENCE–PICTURE MATCHING TASK

Practice sentences

1. The pig is under the house.
2. The bunny is in the basket.

Test sentences

1. The kangaroo is easy to reach.
2. The frog is impossible to jump.
3. The rabbit is hard to catch.
4. The porcupine is difficult to chase.
5. The bear is easy to reach.
6. The kangaroo is impossible to jump.
7. The boy is hard to catch.
8. The octopus is difficult to chase.
9. The man is too dirty to serve.
10. The policeman is too nice to shoot.
11. The monster is too nasty to help.
12. The lady is too old to teach.

13. It is easy to reach the kangaroo.
14. It is impossible to jump the frog.
15. It is hard to catch the boy.
16. It is difficult to chase the octopus.

ACKNOWLEDGMENTS

We are grateful to Eva Bar-Shalom, Ruth Fielding-Barnsley, and Suzanne Smith for their help in data collection. We also thank the staff and students of the Armidale (Australia) and Coventry (CT, U.S.) public schools for their cooperation. Brian Byrne, Stephen Crain, and Donald Shankweiler received financial support under visiting scholar schemes of the University of New England and the University of Connecticut Research Foundation. Stephen Crain and Donald Shankweiler also received support from a Program Project Grant to Haskins Laboratories, New Haven, CT, from the National Institute of Child Health and Human Development. The work of Paul Macaruso was supported by a grant from the James S. McDonnell Foundation to the Neurolinguistics Laboratory, MGH Institute of Health Professions.

NOTES

1. Restrictions prohibiting intelligence testing in Australian schools made it infeasible for Byrne (1981) to obtain IQ scores on his subjects. In lieu of a formal test, teachers were asked to match the good and poor readers on numerical skills. As a further control, Byrne excluded from his analysis of performance on O-adjective sentences any subject who failed to score perfectly on the S-adjective sentences. Given this limited set of controls, however, we cannot rule out the possibility that the poor reader group in Byrne's original study contained children with below-average intelligence and/or insufficient vocabulary knowledge.
2. See, in particular, Bar-Shalom et al. (1993), Crain et al. (1990), Macaruso et al. (1989), and Smith et al. (1989).

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