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ABSTRACT

Artificial symbol-word correspondence in a simple paired associate learning task were used to determine whether disabled readers have a general problem dealing with complex and/or irregular rule systems. The performance of 36 normal readers and 36 disabled readers in grades 4 through 7 was compared. Disabled readers had IQ scores of 87 or above and reading achievement of at least 1.7 years below grade level. The 12 symbol-word correspondneces were differentiated on the dimensions of consistency and conditionality. Differences between normal and disabled reader groups were observed to be specific to the presence of a rule within the set to be learned. When no rule was present and the set was consistent, reader groups performed similarly well. When no rule was present and the set was inconsistent, reader groups performed similarly poorly. However, when a rule was present, which presumably could facilitate learning of the pairs, disabled readers performed significantly more poorly than normal readers. Disabled readers did not differ from normal readers in their ability to detect the rule within a set, as measured by a later transfer and verbalization task. Performance of normal and disabled readers on the paired associate task was not found to be significantly correlated with IQ score in either the rule or nonrule condition. Limited evidence also suggested that the presence of inconsistency in a task containing a rule more adversely affected the learning of disabled than that of normal readers. (Author/SEW)

SYMBOL-WORD CORRESPONDENCE LEARNING IN NORMAL AND DISABLED READERS

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Significant numbers of school aged children have severe reading difficulties which cannot be attributed to a general intellectual or sensory deficit, emotional disturbance, or gross neurological dysfunction (Farnham-Diggory, 1978; Rutter, 1978; Vellutino, 1979). Over the past century several single-factor and multi-factor explanations of reading disability have been proposed (Vellutino, 1979). Typically theories have characterized the reading disabled child as suffering a deficit in the performance of one or more elementary cognitive processes, such as perception, intersensory integration, serial organization, or short-term memory, which prevents the normal acquisition of reading skills. Empirical evidence, however, is accumulating that runs counter to simple process-deficit views of reading disability (Morrison & Manis, 1982; Vellutino, 1979). In addition to this body of disconfirming empirical evidence, process-oriented views have been criticized on a logical level for not explaining adequately the specificity and severity of the reading problem and for not describing adequately the mechanisms by which the deficit affects reading behavior (Morrison & Manis, 1982; Vellutino, 1979).

In an initial effort to find an alternative conceptualization, Morrison and Manis (1982) recently hypothesized that reading disability may present a problem in acquiring knowledge about words, particularly knowledge about spelling-sound correspondences. They suggested that the disabled readers' problem in word acquisition stems in part from a failure to master the complex, often irregular system of rules mapping symbols to sounds in English. Problems in learning these rules prevents the development of rapid, automated word decoding skills which in turn slows the development of higher-order reading and comprehension skills. The authors also suggested that learning complex and/or irregular rules may pose difficulty for disabled readers in other areas as well as reading. Supportive evidence in the reading domain for this view of reading disability has begun to accumulate (Guthrie, 1973; Guthrie & Seifert, 1977; Manis, 1981; Mason, 1976; Shankweiler & Liberman, 1972; Snowling, 1980).

Acquisition of spelling-sound correspondence knowledge appears extremely difficult for disabled readers. They lag three or more grade levels behind normal readers in the ability to pronounce familiar words and pseudowords (Guthrie, 1973; Guthrie & Seifert, 1977; Mason, 1976; Shankweiler & Liberman, 1972; Snowling, 1980). Disabled readers show even greater differences in rates of acquisition for different correspondences than do normal readers. Correspondences which appear most difficult for disabled readers to acquire also intuitively seem to be the most complex (Calfee, Venezky & Chapman, Note 1; Manis, 1981; Mason, 1976; Shankweiler & Liberman, 1972; Venezky, Chapman, & Calfee, Note 2).

Thus, there is preliminary evidence suggesting that disabled readers have a problem dealing with complex and/or irregular rule systems. The present experiment was designed to examine rule-learning in normal and disabled readers and to identify dimensions of rules which might predict the difficulty of their acquisition.

One problem with earlier work in this area which employed actual English correspondences in words or pseudowords was the lack of control of past exposure to examples of the correspondences. For example, Venezky, et al. (Note 2) argued that the differing rates of acquisition of spelling-sound correspondences were due to the unequal number of examples of each correspondence that children were exposed to in primary reading material and the sequence of introduction of the correspondences. They suggested, for example, that better performance in decoding short vowel correspondences than long vowel correspondences in the early grades is due to timing and type of instruction. On the other hand, Guthrie and Seifert (1977) argued that differing rates of acquisition which they observed were due to differences in the complexity of the various correspondences, not frequency of exposure. They argued that more complex rules are needed to decode long vowel correspondences than short vowel correspondences.

A larger problem with previous work has been the lack of a clear scheme to dimensionalize correspondences as complex or irregular to the reader. Suggestions for the scaling of complexity have been based on such factors as number of alternative pronunciations of a grapheme, number of orthographic units to be analyzed, and predictability of the correspondence. However, actual theoretical proposals of how knowledge of spelling-sound correspondences is represented by readers and how that knowledge is utilized in decoding words or pseudowords have been limited (Glushko, 1979).

Two major models have appeared in the literature for the representation of correspondence knowledge in the reader. In the "linguistic decision" model (Venezky, 1967; 1970) correspondence knowledge is represented as verbal instructions which the reader applies when analyzing a word or pseudoword in order to pronounce it. The other model may be called a "network" system. It depicts correspondence knowledge as networks of visually similar patterns which are automatically activated during the decoding process (Glushko, 1979). In this model, parts of a new word or pseudoword are matched to parts of words in the reader's existing knowledge base and pronunciation of the "new" unit is then determined by the pronunciation of its matches. While these models suggest important dimensions along which correspondences might be classified for difficulty, they have features which detract from their unmodified use as classification schemes for correspondence knowledge. The "linguistic decision" model contains the assumption that a child already has complex knowledge about words (e.g., knowledge of stress placement and morpheme boundaries) which is employed in rules governing spelling-to-sound correspondences. Thus, the model is probably too complex to serve as a psychological analog for the representation of spelling-sound correspondences in children. On the other hand, the "network" model appears too simplistic in not allowing for the use of rules at all. Only one dimension is suggested by this model on which correspondences may be classified for difficulty—that of consistency. Consistent correspondences, those which have no exceptions, are proposed to be more quickly decoded than those with exceptions because identical pronunciations for a spelling unit are activated in a consistent word network rather than a number of alternative pronunciations, as in the inconsistent word network.

In spite of their limitations, the models suggest two important dimensions along which correspondences might be classified. These are conditionality and consistency. Conditionality refers to whether a correspondence is determined by conditions in the word environment. If a correspondence is determined by conditions it may be viewed as a "ruleful" correspondence. A correspondence which is not determined by conditions in the word environment may be viewed as an arbitrary one-to-one paired associate. Consistency refers to whether a correspondence (either a one-to-one or rule type) has exceptions to it. The 2 x 2 table yields four types of correspondences which are described and illustrated below.

1) Consistent one-to-one. In this cell are correspondences that are not determined by the word environment. There are no exceptions to the correspondences in that the spelling unit is paired to one pronunciation. E.g., v=/v/, m=/m/.

2) Inconsistent one-to-one. In this cell are correspondences that are not determined by the word environment. There are exceptions in that a spelling unit is paired to more than one pronunciation. E.g., ea, as in each, bread, earn, hear, great.

3) Consistent rule. In this cell are correspondences that are determined by the word environment. A spelling unit is paired to more than one pronunciation by sets of conditions. There are no exceptions in that a spelling unit and a specific set of conditions will always determine the same sound. E.g., k when in initial position and before n is silent, as in know and knot.

4) Inconsistent rule. In this cell are correspondences that are determined by the word environment. A spelling unit is paired to more than one pronunciation by sets of conditions. There are exceptions in that a spelling unit and a specific set of conditions will determine a particular sound for a proportion of the occurrences, but not for all of the occurrences. E.g., g is soft before e, i and y, as in gem, gin, gym. Exceptions to the soft g correspondence include get, girl, give.

	Consistent	Inconsistent
One-to-One	Many consonant correspondences fit this cell, e.g., the pronunciations of r, p, v, d, f, j, m, n.	Many vowel digraph correspondences fit this cell, e.g., the pronunciations of ea, ou, oo.
Rule	Examples are the hard and soft c, the sounded and silent h, and the long a correspondences.	Examples are the soft g, the long o, e, and short u correspondences.

An attempt to test these dimensions is presented here employing artificial symbol-word correspondences in a simple associative learning task. The use of artificial novel stimuli eliminates the need to control for the frequency of past exposure and allows for an easily conducted first test of the scheme. It was assumed that if disabled readers' learning is severely affected by inconsistency or complexity, the problem would be apparent even in a simple task such as paired associate learning when a rule and/or inconsistency were introduced.

Method

Subjects

Thirty-six disabled readers in grades four through seven and 36 normal readers in grades four through six participated. All had normal vision and hearing, spoke English as a first language, and had no diagnosed neurological abnormalities, speech deficits, or severe emotional disturbances. Subjects were selected from four predominantly middle class urban and suburban schools. The disabled readers were included in the study only if they had IQ scores 87 or above and if their reading achievement was at least 1.7 years below grade level. IQ scores on all subjects were obtained from students' school files. Reading achievement scores were obtained from performances on the Word Recognition subtest of the <u>Woodcock Reading Mastery Tests</u> administered by the researcher prior to subject selection.

Assignment of subjects to four treatment conditions was conducted in order to achieve relatively similar representation of schools and sexes within the groups and to achieve relatively equal mean IQ, age, grade, and reading achievement scores for each ability treatment group. Identifying information for the treatment groups is shown in Table 1.

Materials

Four books of stimuli were prepared, each containing materials for the learning of a set of 12 symbol-word paired associates. The four sets of paired associates were differentiated on the dimensions of consistency and conditionality and were: 1) A consistent one-to-one set in which unrelated words were arbitrarily matched to unrelated symbols; 2) an inconsistent one-to-one set in which unrelated words were arbitrarily matched to symbols but each of every two symbols was confusable by differing only a slight degree; 3) a consistent rule set in which each of every two words was related to the other by the rule, "opposite," and their respective symbols were also graphically related; and 4) an inconsistent rule set which was composed of symbol-word pairs from sets two and three described above. Symbols were simple geometric figures (a major figure with a dot or a star subscript). Words were high frequency words, half nouns and half adjectives (all $\geq$ 100 per million, <u>American Heritage Word Frequency Book</u>, 1971). Books were constructed so that a symbol drawn in black ink appeared on each 8" by 10" white page. The word corresponding to the symbol was presented <u>verbally</u>, not visually. For the two books containing rule sets, 12 additional symbols appeared on the last 12 pages. These did not appear earlier during learning and were used to examine whether the child had detected the rule and whether he/she could generalize it to new instances.

All correspondences for each condition are presented in Table 2. (It may be noted that construction of the sets to represent four learning conditions allowed six symbol-word pairs to be identical across sets while the other six varied.) As shown in the table, each set of 12 correspondences represents a classification type. In the consistent one-to-one set the main figures of the symbols were unrelated as were the words. Thus, the child could disregard the star or dot and simply learn the correspondences as simple paired associates. This was deemed roughly analogous to the child's learning to pronounce a consonant which has only one pronunciation regardless of the word environment. In the inconsistent one-to-one set the same main figure was used for two symbols whose unrelated word correspondences could only be differentiated on the basis of the star or dot figure. There was no pattern among the correspondences to aid in learning. Thus, this set too had to be learned as paired associates but additional attention had to be paid to the stars and dots. This learning was deemed analogous to the child's learning the various pronunciations of a spelling unit (e.g., ea as in heat, threat, earn) where no pattern of conditions are available to aid him/her.

In the consistent rule-set, the same main figure was again used for two symbols whose word correspondences could only be differentiated by the star or dot figure. However, there was now a pattern in the set to aid the child's learning—the word correspondences were opposites. If the child recognized this pattern he/she could use it to learn more efficiently. This learning set was considered analogous to the learning of the pronunciation for a spelling unit when the correspondence is determined by a set of conditions and there are no (or very few) exceptions (e.g., an i before a consonant and a final e is pronounced long, as in fine, and like). The last set, inconsistent rule, was similar to the consistent rule set; however, four of the correspondences were arbitrary and did not follow the conditional pattern of the others in the set. This learning set was considered analogous to the child's learning of a spelling unit whose pronunciation is determined by a set of conditions only a proportion of the occurrences (e.g., an o before a consonant and a final e is pronounced long, as in home, smoke; common exceptions occur such as some, love).

Eight random orders of a 12-symbol set were contained in each book to provide four alternating study and test trials, with one exception. Where the difference between one word correspondence and another was discernible only by a dot or a star added to the main figure, no more than two occurrences of the same major figure appearing on consecutive pages were allowed in any one study or test trial.

Procedure

Each subject was tested individually in a quiet room separate from the classroom. The task was introduced as a memory game and subjects were asked to remember the word that accompanied the symbol. On study trials the experimenter verbally described each symbol and announced the word that went with it (e.g., "An arrow with a dot goes with boy"). The subject was required to repeat this aloud. On test trials the experimenter described the symbol again and asked the subject to respond with the word. If subjects could not remember a response, they were encouraged to make a guess. No feedback was given to the subject's response on test trials. Four study-test phases were given to each subject. Subjects learning rule correspondences were given an additional task after the four study-test trials. A new symbol was shown and the experimenter described it and announced the word that went with it. Then a second symbol was shown in which the main figure remained the same but the subscript dot changed to a star, or vice versa, and the subject was asked to guess what the word might be. Six different instances were presented. Following this last phase the subject was asked what helped him/her make a guess on the new symbols. The whole session lasted about 20 minutes.

Results

A four-way mixed analysis of variance was conducted on number of accurate responses with Ability (Normal or Disabled Readers), Consistency (Consistent or Inconsistent correspondence set), and Type (One-to-One or Rule correspondence set) as between-subject variables, and Trials (1 through 4) as a within-subject variable. Accuracy varied significantly according to Consistency, $F(1,64) = 18.81$, $p \leq .0001$, with consistent correspondences being recalled more accurately than inconsistent correspondences. Accuracy improved across trials, $F(3,192) = 87.49$, $p \leq .0001$, with accuracy on each successive trial significantly greater than the one preceding it, $ts(192) > 3.57$, $ps < .001$. These main effects, however, were qualified by several significant interactions.

A significant Ability by Type interaction, $F(1,64) = 4.77$, $p \leq .033$, shown in Table 3, indicated no difference in correct responding between normal and disabled readers on one-to-one symbol-word correspondences, $t(64) = 1.40$, p = n.s., but a major difference between the groups for number correct on the rule symbol-word correspondences, $t(64) = 4.78$, $p \leq .001$ with disabled readers performing significantly more poorly than the normal readers. Normal readers performed significantly better on rule type correspondences than on one-to-one correspondences, $t(64) = 2.63$, $p \leq .02$ whereas disabled readers performed significantly worse on rule types than on one-to-ones, $t(64) = 3.54$, $p \leq .001$. This finding suggests that while disabled readers may perform similarly to normal readers on rote one-to-one associative learning tasks, they markedly differ on tasks which introduce an element of complexity such as the use of a rule. In order to rule out the possibility that differences in IQ scores between disabled and normal readers were contributing to this finding, the relationship between accuracy and IQ score was examined. Performance of normal and disabled readers was not found to be significantly correlated with IQ score in either the one-to-one or the rule conditions ($ps \geq .20$).

A marginally significant Ability x Consistency x Trial interaction, $F(3,192) = 2.08$ $p \leq .105$, provided limited evidence that inconsistency effected the learning of disabled readers more strongly than normal readers. As shown in Figure 1, the mean score for the consistent sets on each of the four trials did not differ significantly between disabled and normal readers, ts $(64) \leq .77$, ps = n.s. For Trials 1 and 2 the mean score for the inconsistent sets did not differ either, ts $(64) \leq 1.26$, ps = n.s. However, by Trials 3 and 4, normal readers performed significantly better, than disabled readers. While inconsistency appears to have been detrimental to the learning of both groups, it appears to have affected the disabled readers to a greater degree.

The marginally significant interaction of Ability by Consistency by Type by Trials, $F(3,192) = 2.10$, $p \leq .101$, presents a clearer pattern of ability group learning differences under the different conditions of the experiment. As illustrated in Figure 2, for each trial disabled readers did not differ significantly from normal readers under the consistent one-to-one correspondence learning condition, ts $(64) < 1.29$, ps = n.s., nor under the inconsistent one-to-one correspondence learning condition, ts $(64) < .50$, ps = n.s. A very different pattern emerged for the rule sets. By Trial 4 under the consistent rule condition, normal readers attained a marginally significant greater score than the disabled readers, $t(64) = 1.88$, $p < .10$. And under the inconsistent rule correspondence condition, normal readers attained a significantly greater score than disabled readers on Trials 2 through 4, ts $(64) > 2.17$, ps $\leq .05$. An examination of performances between Trial 1 and Trial 4 indicated scores of normal readers increased significantly within each learning condition, ts $(192) > 4.36$, ps $< .001$. However, while disabled readers' scores increased significantly between Trial 1 and Trial 4 in the one-to-one conditions and the consistent rule condition, ts $(192) > 3.23$, ps $< .01$, they did not increase significantly between Trial 1 and Trial 4 under the inconsistent rule condition, $t(192) = 1.62$, p = n.s. Furthermore, after an increase in number correct from Trial 1 to Trial 2 under the consistent rule condition, scores of disabled readers plateaued resulting in no significant differences between their scores on Trial 2, 3, or 4, ts $(192) < .49$, ps = n.s.

To summarize, disabled readers' learning did not appear to differ from that of normal readers' on the symbol-word correspondence sets which contained no rule relationships among the correspondences. Disabled and normal readers performed similarly well on the consistent one-to-one correspondences and similarly poorly on the inconsistent one-to-one correspondences. However, on sets containing rule relationships, the learning of disabled reader groups differed from that of the normal groups. Normal readers' scores improved across trails under the rule condition while disabled readers showed little improvement. In addition, limited support was found that the addition of inconsistency to the rule condition affected performance of disabled readers more than normal readers.

Transfer Task

Total number of correct responses was tallied for each subject in the rule condition on the transfer task. A response was considered correct if it could be reasonably considered as an "opposite" concept from that given in the example. All but one of the disabled readers were able to perform correctly on the transfer task and were able to verbalize the rule, "opposite", as were the normal readers. (Sixteen normal readers and 11 disabled readers achieved perfect scores, 2 normal readers and 5 disabled readers missed one item, 1 disabled reader missed two items, and 1 disabled reader missed them all.)

The findings on the transfer task and on the request to children to explain how they knew what to do on the transfer task were puzzling in light of the results on the learning task. Since disabled readers did not differ from normal readers in their ability to detect the relatively simple rule, the performance differences under the rule conditions may have been the result of disabled readers, for reasons unknown, not having engaged successfully in the subsequent cognitive operations necessary for utilizing the rule to aid their learning.

Discussion

Differences between normal and disabled reader groups on a symbol-word correspondence learning task were observed to be specific to the presence of a rule relationhip within the set of pairs to be learned. The results suggested that disabled readers may have a particular problem dealing with rules. The findings were supportive of the Morrison and Manis (1982) theoretical perspective on reading disability and supported the previous work by Manis (1981) which suggested that disabled readers have a specific deficiency in their knowledge of complex (rule related) spelling-sound correspondences. It was expected that if disabled readers had more difficulty on the rule sets relative to normal readers they would also not be able to succeed on a transfer task based on the rule or verbalize the rule. Because this pattern did not occur, interpretation of the transfer and verbalization data was difficult.

The finding that disabled readers learn simple one-to-one associations as well as normal readers corresponded with previous research which has indicated no difference between poor and average readers on paired associate learning when pairs were composed of symbols or symbol strings and words (Denner, 1970; Firth, 1972). Additional evidence indicating that disabled readers experience no great difficulty learning rote associations between symbols and words has been found by Harrigan (1976) and Rozin, Poritsky, and Stotsky (1971). In contrast, differences between poor/disabled readers and normal readers have been found when symbols have been paired with nonsense syllables (Otto, 1961; Vellutino, Steger, Harding, & Phillips, 1975; Samuels & Anderson, 1973).

Vellutino (1979) argued that the difficulties disabled readers experience associating symbols with nonsense syllables results from a general language deficit in disabled readers. Vellutino (1979) suggested that this notion is further supported by the evidence showing no differences between disabled and average readers on nonverbal association tasks (Vellutino, Steger, Harding, & Phillips, 1975). However, other studies have found performance differences between normal and disabled readers on various verbal and nonverbal tasks (Corkin, 1974; Cummings & Faw, 1976; Morrison, Giordani & Nagy, 1977; Morrison, 1978; Noelker & Schumsky, 1973; Wolford & Fowler, Note 3).

The evidence from the present study and from other studies which have shown no ability differences for the paired associate learning of symbols and words argues against a general verbal deficit in disabled readers. Rather, it suggests that disabled readers may differ from normal readers when complex additional information is available in the learning process. It is suggested that the use of the "opposite" rule to aid memory of pairs under the rule conditions required a greater number of cognitive operations than the memory of the consistent one-to-one pairs.

Possibly disabled readers' problems with rules may be more related to the application of rules as aids to learning information than to a failure to actually acquire rules. This interpretation would be consistent with Torgesen's (1977) suggestion that disabled readers are inactive learners and deficient in the management of learning strategies. However, Torgesen's view of disabled readers as inefficient learners appears too general to be a satisfactory explanation for all of the results. Disabled readers learned just as well as normal readers on the one-to-one correspondence sets suggesting active learning by the disabled readers on these sets. It is possible that transfer and verbalization tasks such as those employed in the present study are not good indicators of learning on a prior task.

The present results suggested that disabled readers had problems applying the rule in the paired associate task, not with detecting it. However, the rule employed was probably relatively easy. The results did not suggest that with more difficult rules disabled readers will not have problems with the induction process. There is some evidence in the literature suggesting that disabled readers may differ from normal readers in the level of abstraction they employ in task solution and if this were the case, difficulties with rule induction as well as rule application might occur for disabled readers with more difficult rules. Blank and Bridger (1967) found that group differences between poor/disabled and normal readers in the fourth grade increased as the complexity of the stimulus demands increased on a temporal sequence coding task. A later study (Blank, Weider, & Bridger, 1968) found similar group differences between poor/disabled and normal readers in the first grade. Blank, Weider, and Bridger (1968) proposed that the disabled reader's initial approach to any abstract task may be less conceptual than that of the normal reader and thus might put him/her at a constant disadvantage which might be cumulative in any task requiring abstraction and conceptualization. Reading appears to be just such a task since stimuli must be grouped according to common elements which are then further grouped and arranged in hierarchical order (Gibson & Levin, 1975; Singer, 1960).

Kress's (1956) investigation of the relationship between concept formation ability and achievement in reading lends additional support to the notion that disabled readers may approach tasks at a less abstract level than normal readers. Kress matched 25 pairs of disabled and normal readers on age and IQ and compared their performances on several concept formation tasks. Disabled readers, compared to achieving readers, lacked flexibility, hypothesis testing, a willingness to exhaust all solutions, persistence in problem-solving under changing conditions, ability to draw inferences, ability to shift set, ability to analyze the factors present, adequate labels for common concepts, and adquate concepts for dealing with language. Among other characteristics, disabled readers exhibited a tendency to cling to previously acceptable solutions, and a dependence upon the physical characteristics of objects. If these characteristics accurately describe disabled readers, their failure to acquire adequate reading skills would not be difficult to understand since making sense out of the spelling-sound correspondence system appears to require many of these abilities.

In conclusion, the findings offer indirect support for Morrison and Manis's (1982) proposal that at the heart of the disabled reader's problem is the complex and often inconsistent system of rules to be learned and applied in the reading process. The differences which occurred in paired associate learning between normal and disabled readers when a rule was present suggest that observed differences in reading between the groups may be related to the presence of conditional relations in the reading task. Further research with more difficult rules may prove fruitful in determining whether the difficulty with rules for disabled readers lies in their acquisition or application. In addition, further investigation into the ability of disabled readers to deal with abstract concepts and into their use of strategies for learning may yield further evidence bearing on their difficulties in learning to read.

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Table 1

Mean Age, IQ, Grade, Reading Grade-Equivalent Score, Reading Percentile Score, and Sex for Subject Groups (standard deviations in parentheses)

Treatment Group	Consistent One-To-One		Inconsistent One-To-One		Consistent Rule		Inconsistent Rule	
	Normal Readers (N = 9)	Disabled Readers (N = 9)	Normal Readers (N = 9)	Disabled Readers (N = 9)	Normal Readers (N = 9)	Disabled Readers (N = 9)	Normal Readers (N = 9)	Disabled Readers (N = 9)
Age	11.67 (.83)	11.51 (.84)	11.81 (.76)	11.89 (1.03)	11.43 (.66)	11.53 (1.02)	11.17 (.97)	11.92 (1.18)
IQ[a]	105.11 (9.99)	96.67 (10.20)	103.00 (8.72)	95.22 (6.55)	104.00 (9.84)	96.78 (5.93)	105.89 (9.03)	97.11 (8.10)
Grade	6.17 (.71)	6.12 (.54)	6.18 (.74)	6.36 (1.00)	6.06 (.67)	6.03 (.83)	5.63 (.84)	6.38 (1.36)
Reading[b] Grade Equivalent Score	7.80 (1.93)	3.40 (.68)	7.24 (1.36)	3.57 (1.26)	7.29 (1.26)	3.44 (.87)	7.32 (2.17)	3.11 (.79)
Reading[b] Percentile Score	63.56(13.10)	8.67 (8.11)	60.78 (10.00)	11.00 (9.43)	62.22(10.76)	10.78 (7.06)	65.89(10.56)	5.78 (4.84)
Sex of Subjects	3F 6M	2F 7M	3F 6M	1F 8M	3F 6M	1F 8M	3F 6M	1F 8M

[a] IQ scores were from school files and were based on Otis-Lennon Test of Mental Ability for normal readers and the WISC-R (full scale) for the majority of the disabled readers (other IQ tests for the disabled readers were the Woodcock-Johnson, Otis-Lennon, and Lorge-Thorndike).

[b] Reading Achievement was based on the Word Recognition subtest score of the Woodcock Reading Mastery Test administered by the researcher.

Symbol-Word Correspondence Sets

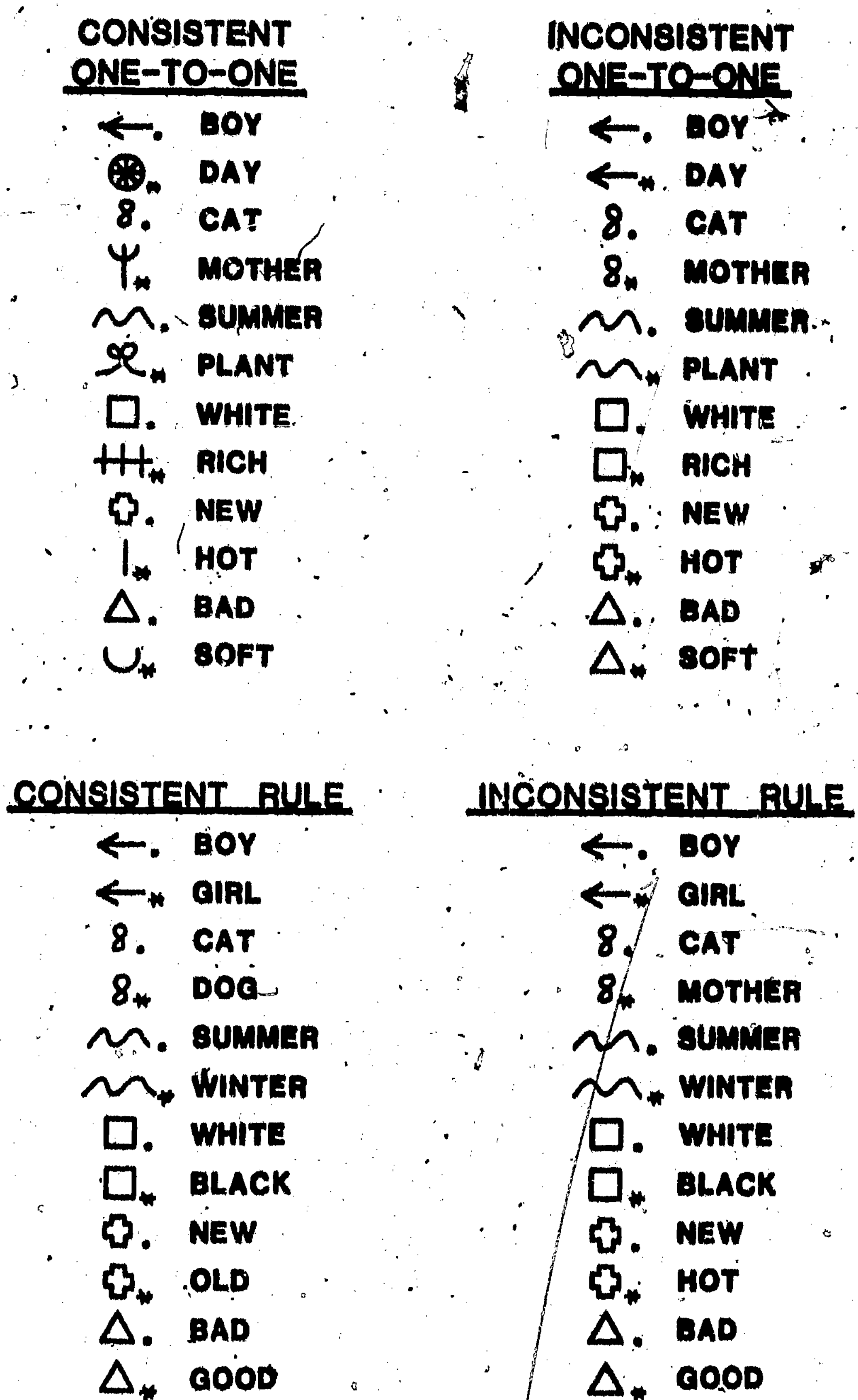

Table 2

Table 3

Mean Total Correct Responses as a Function of Correspondence Type and Reading Ability[a] (standard deviations in parentheses).

Correspondence Type	Reading Ability			
	Normal Readers		Disabled Readers	
One-to-One	N = 18	22.33 (9.98)	N = 18	24.22 (12.60)
Rule	N = 18	25.89 (7.05)	N = 18	19.44 (9.16)

[a] Mean total possible correct for each entry equals 48.

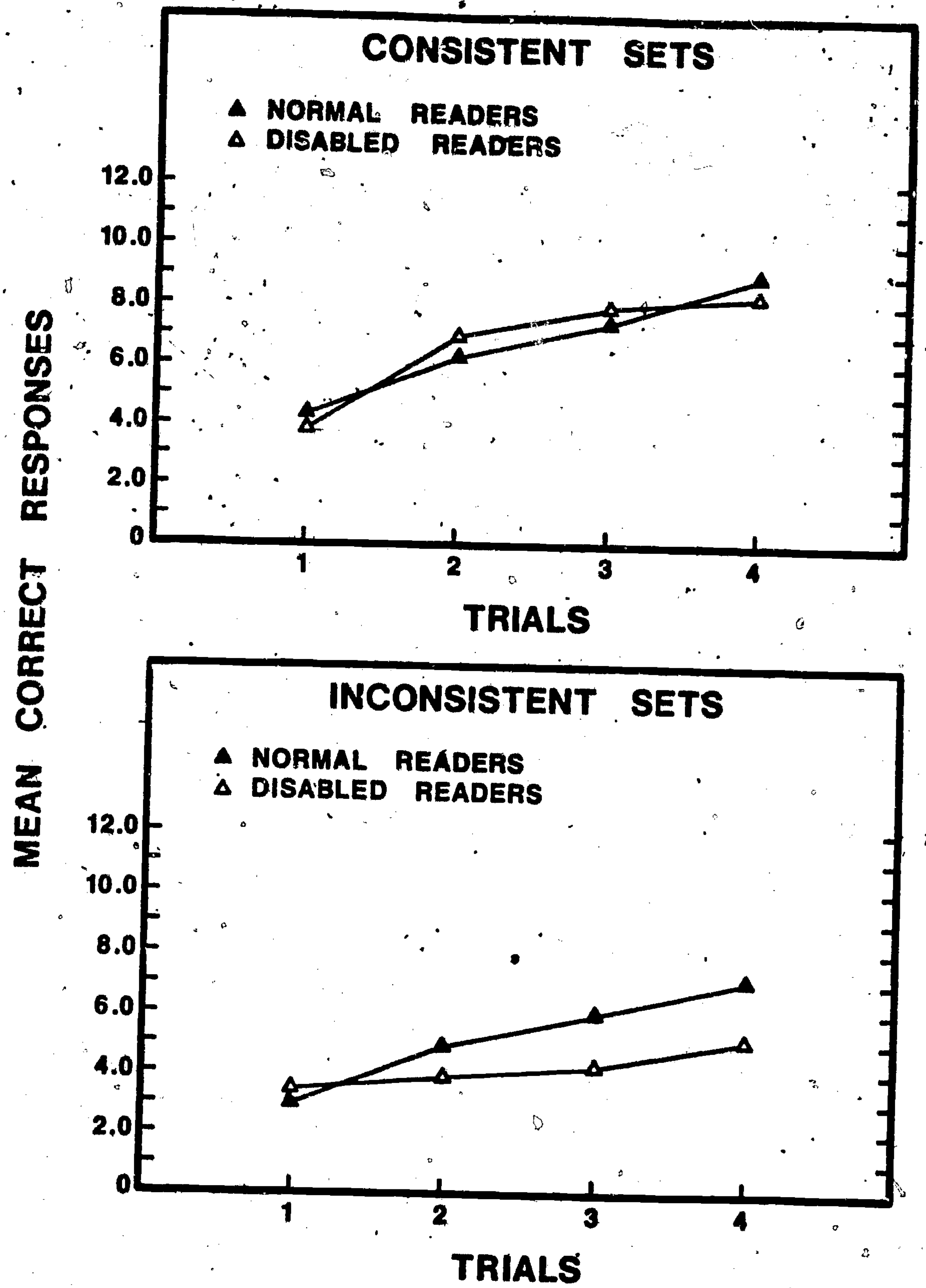
CONSISTENT SETS
▲ NORMAL READERS
△ DISABLED READERS
12.0
10.0
8.0
6.0
4.0
2.0
0
1
2
3
4
TRIALS
MEAN CORRECT RESPONSES
INCONSISTENT SETS
▲ NORMAL READERS
△ DISABLED READERS
12.0
10.0
8.0
6.0
4.0
2.0
0
1
2
3
4
TRIALS

Figure 1

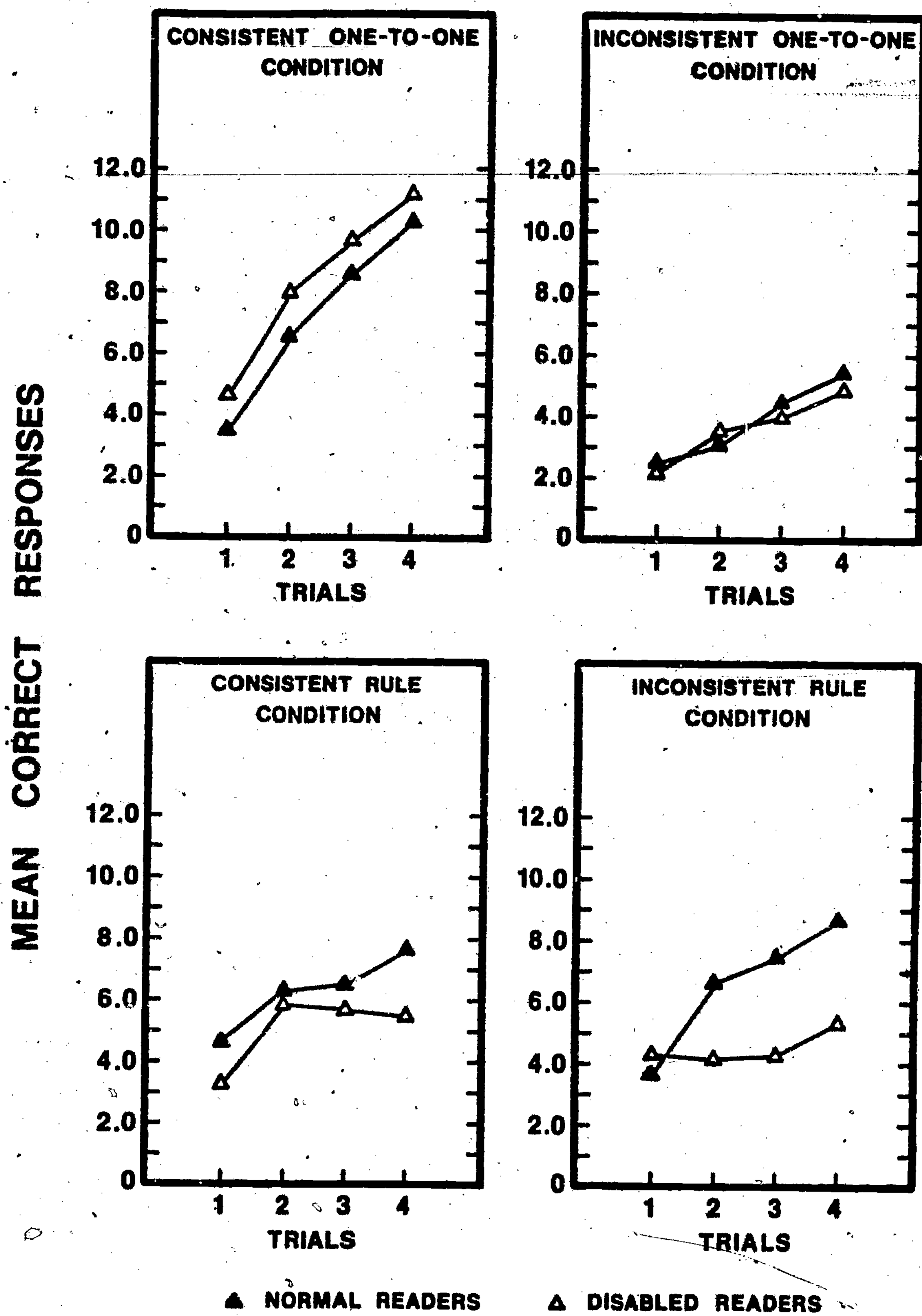
MEAN CORRECT RESPONSES
CONSISTENT ONE-TO-ONE CONDITION
INCONSISTENT ONE-TO-ONE CONDITION
CONSISTENT RULE CONDITION
INCONSISTENT RULE CONDITION
12.0
10.0
8.0
6.0
4.0
2.0
0
1
2
3
4
TRIALS
▲ NORMAL READERS
△ DISABLED READERS

Figure 2