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ABSTRACT

The study involving 105 neurologically impaired or learning disabled elementary school children examined the relative effectiveness of various word attack strategies for a reading disabled population. Children were taught with lessons over a 2 day period which provided direct instruction on a medial vowel sound, practice on monosyllabic words containing the sound, and specific transfer training on nonsense syllables. Word attack strategy was varied for the five treatment groups: (1) initial bigram training in which words were broken down into two components--the initial bigram and the final consonant; (2) final bigram training in which words were broken down into two components--the initial consonant and the final bigram; (3) letter by letter training in which words were broken down into individual phonemes; (4) initial-final bigram training in which words were broken down into individual bigram and final consonant on Day 1 and by the initial consonant and final bigram on Day 2; and (5) final-initial bigram training in which words were broken down first by the initial consonant and final bigram on Day 1, and then by the initial bigram and final consonant on Day 2. The initial bigram strategy yielded significantly better performance on transfer words. The strategy appeared to be differentially effective because it emphasized both left to right processing and reduced the number of units to be synthesized. This finding called into question approaches which emphasize rhyming patterns or letter by letter decoding. (Author/SE)

RESEARCH INSTITUTE FOR THE STUDY OF LEARNING DISABILITIES
Teachers College, Columbia University

THE RELATIVE EFFECT OF VARIOUS WORD SYNTHESIS STRATEGIES ON THE PHONICS ACHIEVEMENT OF LEARNING DISABLED YOUNGSTERS

Harriet R. Fayne and N. Dale Bryant

Technical Report #5

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Abstract

This study examined the relative effectiveness of various word attack strategies for a reading disabled population. Children were taught with lessons over a two-day period which provided direct instruction on a medial vowel sound, practice on monosyllabic words containing the sound, and specific transfer training on nonsense syllables. Word attack strategy was varied for the five treatment groups. Practice consisted of synthesis using initial bigrams and final consonants (c-og), initial consonants and final bigrams (c-og), a combination of initial and final bigram training, or letter-by-letter analysis and synthesis (c-o-g). The initial bigram strategy yielded significantly better performance on transfer words. This strategy appears to be differentially effective because it both emphasizes left-to-right processing and reduces the number of units to be synthesized. This finding calls into question popular approaches which emphasize rhyming patterns or letter-by-letter decoding.

The Relative Effect of Various Word Synthesis Strategies on the 'Phonics Achievement of Learning Disabled Youngsters

Practitioners and researchers have noted that many children with poor reading achievement lack adequate decoding skills. These reading disabled youngsters are forced to rely on their limited sight word recognition vocabularies and cannot exploit language regularities that would enable them to decode unfamiliar words. It is unfortunate that the literature on reading and reading instruction does not provide satisfactory answers concerning the most effective way to train children to exploit these regularities (Gibson & Levin, 1975).

There is, however, a common theme which runs through much of the research on reading and reading instruction: the beginning reader needs to learn to economize effort by grouping letters together in order to utilize processing capacity efficiently. Evidence from speech research (A. Liberman, Cooper, Shankweiler & Studdert-Kennedy, 1967; Savin & Bever, 1970) and linguistic analysis (Venezky, 1967, 1970) would lead to the conclusion that individual graphemes and phonemes are not particularly reliable or informative units. Regularities, such as consonant-vowel (CV) or vowel-consonant (VC) bigrams, provide more consistent information than the individual phonic element. Letter groupings, or patterns, appear to be more important clues in word perception and in word reading than individual letters (Gibson, Osser, & Pick, 1963; Kuenne & Williams, 1973; Santa, 1976). Clustering letters into units can reduce the number of elements to be blended when decoding words. Goldstein (1976) found that the more individual

units a child is expected to synthesize, the harder the task becomes.

It is likely that many children can group letters into usable patterns without receiving direct instruction. However, learning disabled (LD) youngsters are unlikely to develop such a useful decoding strategy on their own, possibly because of processing deficiencies in working memory (Ellis & Miles, 1977), coding (Farnham-Diggory & Gregg, 1975; Shankweiler & I. Liberman, 1976; Spring & Capps, 1974), analysis-synthesis (Goldstein, 1976; I. Liberman, Shankweiler, Fisher, & Carter, 1974), and knowledge of the constituents of language (Shankweiler & I. Liberman, 1976). It is possible that direct instruction, which focuses on letter patterns, will help to compensate for these processing difficulties and allow LD children to use larger units with less blending in decoding.

Training children to decode words by providing instruction on common patterns has proven to be beneficial for normal and disabled readers (Fletcher, 1973; Silberman, 1964). However, the question of whether a specific type of pattern is optimal for transfer of either the pattern itself or specific phonic elements within the pattern has not been answered satisfactorily. Despite inconclusive research evidence, reading programs often emphasize a specific pattern type. The most popular technique is to focus attention on "word families" which share a common final bigram, or rhyming, pattern.

The present study investigated the relative efficacy of teaching methods emphasizing three different approaches to synthesizing letter sounds into words. It was designed to evaluate whether or not LD chil-

dren taught with alternate strategies differed in the amount learned and transferred on a word reading task which included learned as well as novel words. Specifically, the strategies employed included: letter-by-letter decoding (e.g., c-o-t), a strategy emphasizing the final bigram pattern (e.g., c-ot), and a strategy emphasizing the initial bigram pattern (e.g., co-t). It was hypothesized that a letter-by-letter decoding strategy, which did not encourage the child to group letters into larger units, would result in poorer performance on the word reading task than either of the pattern strategies. It was also hypothesized that an initial bigram strategy would yield better performance than a final bigram strategy because it not only focuses on patterns but also encourages the child to process the word in a left-to-right fashion.

Also included in the study is an examination of whether a mixed bigram teaching strategy, which encourages a child to recode and to store information in two ways, might enhance transfer. MacGinitie (1979) theorized that training with both bigrams might result in improved decoding because such a teaching approach could help to reduce the blending load. However, because many LD children seem to be easily overloaded and fail to develop automaticity with verbal material (Doehring, 1968; Spring & Capps, 1974), it is possible that a mixed strategy approach may not be effective for these children. Rather than processing both bigrams, they could become confused and fail to adopt a useful decoding strategy.

Method

Sample

One hundred and five children from a variety of socio-economic and ethnic backgrounds (67 boys, 38 girls) were randomly assigned to one of five treatment groups (n = 21 in each group). Children were distributed around a mean age of 112 months (SD = 20.5; Range = 84-166 months) and a mean WISC-R Full Scale IQ of 90.4 (SD = 13.2; Range = 67-131). Reading levels, based on teacher estimates, ranged from pre-primer to early second grade. There were no differences across groups for mean age, IQ, or reading level. In addition, sex distributions were approximately the same across groups.

Subjects were selected from populations of elementary school children enrolled in New York City Board of Education classes for the Neurologically Impaired or in Learning Disabilities Resource Rooms. These children exhibited at least a 50% discrepancy between reading achievement and general intellectual aptitude according to standardized measures administered by interdisciplinary teams responsible for classifying youngsters for special education class placement. No child with sensory deficits, gross neurological dysfunctions, or primary psychological disorders was included in the sample.

All children were given a screening measure before they were included in the sample. The measure consisted of 65 items, 45 of which contained the specific element used in the training (i.e., "short o"[1]). Mean scores for "short o" production and word recognition on the phonics screening measure were computed for the five groups. There were no

significant differences among the groups. The mean performance on the 45 "short o" items for the entire sample (N = 105) was 4.9 productions of the "short o" (SD = 5.1) and 2.0 words read correctly (SD = 2.8).

Procedure

Children were assigned randomly to instructional groups which ranged from three to six students and given 30 minute lessons on two consecutive days. The lessons focused on one of the following strategies:

1. Initial Bigram Training (Initial-Initial): Words are broken down into two components: the initial bigram and the final consonant (e.g., co-p).
2. Final Bigram Training (Final-Final): Words are broken down into two components: the initial consonant and the final bigram (e.g., c-op).
3. Letter-by-Letter Training (Letter-by-Letter): Words are broken down into individual phonemes (e.g., c-o-p).
4. Initial-Final Bigram Training (Initial-Final): Words are broken down into individual bigram and final consonant on Day 1, and secondly, by the initial consonant and final bigram on Day 2.
5. Final-Initial Bigram Training (Final-Initial): Words are broken down first by the initial consonant and final bigram on Day 1, and secondly, by the initial bigram and final consonant on Day 2.

All children received identical introductory activities which focused on the sound-symbol association for "short o." In all five treatment groups, children were exposed to direct instruction on their word synthesis attack strategies before they were expected to read the words for that day's lesson. Whenever children made errors on practice items, the teacher broke up the word into the elements dictated by the strategy being taught, then had the child repeat the parts and synthesize them.

The lessons were conducted by five experimental teachers who were graduate students in special education or remedial reading. Each teacher received training, which consisted of careful reading of prepared scripts and simulated activities for each part of the procedure, for one hour per day over a three day period. In addition, the five instructors were observed at least twice to insure that procedures were carried out according to the prescribed scripts.

The five teachers were randomly assigned to teaching groups, and each instructor taught children in all five of the treatment conditions.

Materials

All children received practice on three sets of words (three real words, two nonsense syllables per set) each day and were required to reach a criterion of one correct response per word. The nine real words used in the training were identical for all groups. The words which were selected met the following criteria: (1) they could be grouped by initial or final bigram, and (2) they were not likely to be in a child's sight word repertoire. The nonsense syllables varied

according to the strategy taught.

A child in the initial bigram strategy lesson practiced the training words grouped in three patterns according to the initial bigram (i.e., cop, cot, cog / lop, lot, log / top, tot, tog) with additional practice on nonsense syllables (e.g., cov, coj). A child in the final bigram strategy lesson practiced on training words grouped in three patterns according to the final bigram (i.e., cop, top, lop / cot, tot, lot / cog, tog, log) with additional practice on nonsense syllables (e.g., vop, rop). Pupils in the two mixed bigram conditions (Initial-Final and Final-Initial) received one day of instruction identical to the initial strategy group and one day of instruction identical to the final strategy group. The only difference in the instruction for the two mixed bigram groups was the order of introduction of the bigram strategies. Letter by letter training consisted of the nine real training words and six nonsense syllables from the pattern lists, mixed in such a way that pattern was no longer apparent in the training word list (e.g., cop, lot, tog) or the nonsense list (e.g., cov, rop).

Measurement

In addition to the screening test used to select children for the study, a 54 item posttest was administered to assess learning and transfer as well as a decoding test which tapped processing capabilities. Reliabilities reported below are based on a split-half technique adjusted for length using the Spearman-Brown prophecy formula.

Phonics Posttest. A posttest, designed to measure reading of monosyllabic words containing the "short o," was administered on an individual basis one day after the training. The test was composed of the nine training words, 12 Initial transfer words containing the three initial training bigrams (lo, co, to), 12 Final transfer words containing the final training bigrams (og, ot, op), 12 transfer words containing the "short o" without any of the specific bigrams taught (referred to subsequently as non-patterned words), and 19 non-"short o" words, which were used to break up response sets. Bigram transfer items consisted of equal numbers of meaningful words and nonsense syllables. These were divided equally between the initial and final patterns.

Children were exposed to one word at a time printed in Royal Litton Primary type on 5x8 canary yellow index cards for a maximum of six seconds. All subjects were shown the words in the same order, which was developed on a random basis. Responses were recorded in phonetic transcription by the examiners and taped on a Sony 110B recorder.

The posttest yielded two totals: the number of training words read correctly (Range 0-9) and the number of transfer words read correctly (Range 0-36). Reliabilities were .85 and .92 respectively on these measures. In addition, transfer words were analyzed according to the application of specific elements: production of "short o" in non-patterned words (Range 0-12), initial bigrams in Initial transfer items (Range 0-12), and final bigrams in Final transfer items (Range 0-12).

Reliabilities were .83 on "short o," .80 on initial bigrams, and .74 on final bigrams.

Decoding Test. The decoding test tapped both the children's ability to remember individual sound units and to blend these units into words. These two skills were expected to play a major role in performance on the phonics posttest. It was necessary to measure these two processes with a word sample which was independent of post-test items.

Children were given 20 CVG nonsense items which were composed of all the consonants with the exceptions of q and y and contained an equal number of five short vowels (a, e, i, o, u). If a child could not read an item within three seconds, the following procedure was followed: (1) the child was asked to produce the sounds which were first produced by the examiner; (2) the child was asked to repeat the sounds from memory; and finally, (3) the child was asked to blend the sounds into a word. Ten of these items were presented in a letter-by-letter format and ten in a bigram format (5 initial bigrams, 5 final bigrams). Children were provided with three practice items (one letter-by-letter, one initial, and one final bigram format) to insure that they understood the task. The order of items began with letter-by-letter, moved to patterned bigram presentations and ended with letter-by-letter.

Results from this test yielded two scores. First, children were scored on the number of items, out of a possible 20, that they could either read correctly within three seconds or integrate after the sound

units were presented by the examiner and repeated by the child. This score is referred to as the Blending Test score (reliability = .92). Second, the percentage of accurate memory productions of sound sequences out of a total number attempted in Step Two above was calculated as the Memory for Sounds score. The reliability of the Sound Memory measure (r = .87) was based on only those children who were asked to remember the sounds for all the items (n = 48).

Experimental Examiners. Five examiners were trained specifically on posttest procedures for four hours over two days and met a criterion for accurate administration. Examiners were not informed about the specific condition under which individual children were taught.

Results

Posttest Performance

Table 1 gives means and standard deviations on the posttest for the five equivalent groups. As expected, there were no significant differences on the mean number of training words read correctly. All children were exposed to these words over the two days of training and were required to read these words accurately on both days.

Table 1

Posttest Means and Standard Deviations for the Five Treatment Groups

					Specific Elements in Transfer Words					
	Training Words		Transfer Words		Short o in non-patterned words		Initial Bigrams		Final Bigrams	
	(n of items=9)		(n of items=36)		(n of items=12)		(n of items=12)		(n of items=12)	
Group[a]	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Initial-Initial	6.0	3.0	15.9	10.4	7.1	3.8	7.1	3.9	6.7	3.6
Final-Final	4.6	3.0	7.5	7.4	3.6	3.3	3.2	3.5	4.6	3.7
Initial-Final	4.6	2.6	8.5	7.6	3.6	2.8	3.7	3.1	4.8	3.7
Final-Initial	4.3	2.9	8.2	8.8	4.2	3.3	3.9	3.3	4.4	3.7
Letter by letter	4.3	2.7	9.5	8.7	4.6	3.5	4.1	3.3	4.7	3.7

[a] n = 21 in each group.

While there were no significant differences on training words among the five groups, the ability to read transfer words was markedly different, with the Initial-Initial group performing about twice as well as the other four groups. A one-way ANOVA on the number of transfer words read correctly (possible range = 0-36) indicated that there were significant differences among group means ($F = 3.28$ (4,100) $p < .05$). Newman-Keuls post-hoc comparisons revealed that the performance of the Initial-Initial group was significantly better than the other four groups ($p < .05$). Whereas the Initial-Initial group was able to read approximately 16 of the 36 transfer items, the other groups averaged only 8-10 words read correctly. There were no significant differences between means among the other four groups.

A series of one-way ANOVA tests were performed on the application of specific elements taught in the transfer words. While there were significant differences between groups on "short o" production in the 12 non-patterned items ($F = 4.00(4,100) p < .01$) and on initial bigrams read correctly in 12 Initial transfer items ($F = 4.19(4,100)$ $p < .01$), there were no differences on final bigrams read correctly in the 12 Final transfer items. Groups who received specific training with final bigrams did not have a higher degree of accuracy with words containing these bigrams than did groups who had not received final bigram training.

Post-hoc comparisons on initial bigrams and "short o" production indicated that the Initial-Initial group demonstrated superior performance on both elements ($p < .05$). While the Initial-Initial group, on the average, could apply each of these elements to seven to twelve possible items, the other four groups were applying them to only four.

In summary, a series of analyses indicated that there were

significant differences among groups on transfer words but not on training words read correctly. Analyses of the three elements which were highlighted in the training ("short o," initial bigrams, and final bigrams) resulted in significant differences in "short o" production in non-patterned words and initial bigrams read correctly in Initial transfer words but no differences on transfer of the final bigrams emphasized in the training. Post-hoc comparisons demonstrated that differences among groups could be accounted for by the superior performance of the Initial-Initial group.

Performance on the Supplementary Decoding Test

Children were scored both on their ability to remember sound parts after a brief delay and their ability to blend these word parts into syllables. On the average, children in the sample demonstrated a high degree of accuracy on the sound memory portion of the decoding test. They were able to recall the word parts in 82% of the items.

Blending these word parts into syllables appeared to be a more difficult task than retrieving the isolated segments. In general, children achieved only 60% accuracy on the 20-item test. All five groups had comparable performance on this measure. There was a substantial relationship ($r = .59$) between blending ability and performance on posttest transfer items.

When the protocols of a representative subsample of 52 children were analyzed, certain patterns of performance emerged. Children were able to blend the word parts more accurately when items were

presented in a bigram format than when they were presented in a letter-by-letter fashion. Responses tended to be whole words which indicated that the children were attempting to blend, and errors were characterized by substitution of sounds (i.e., baf instead of bof). Since children were required to recall the word parts before blending, data was available for comparisons between memory for the word parts in isolation and retention of the parts in blended parts.

Although a comparison of isolated versus integrated sound retention was deemed to be a worthwhile line of inquiry, any findings based on this analysis must be viewed with caution. Comparisons are based on ratio scores which reflect the performance of individual children. Of necessity, scores were derived with baselines which differed with respect to the number of items and the specific items attempted. Nevertheless, tentative statements can be made regarding qualitative characteristics of performance for the subsample.

Percentage scores were computed for the number of word parts retained during blending. Ratios were calculated for bigram (two "bit") and letter-by-letter (three "bit") items separately, using the following formula:

$$\frac{\text{Number of Items in which No Memory Loss Occurred During Blending}}{\text{Total Number of Items Attempted}}$$

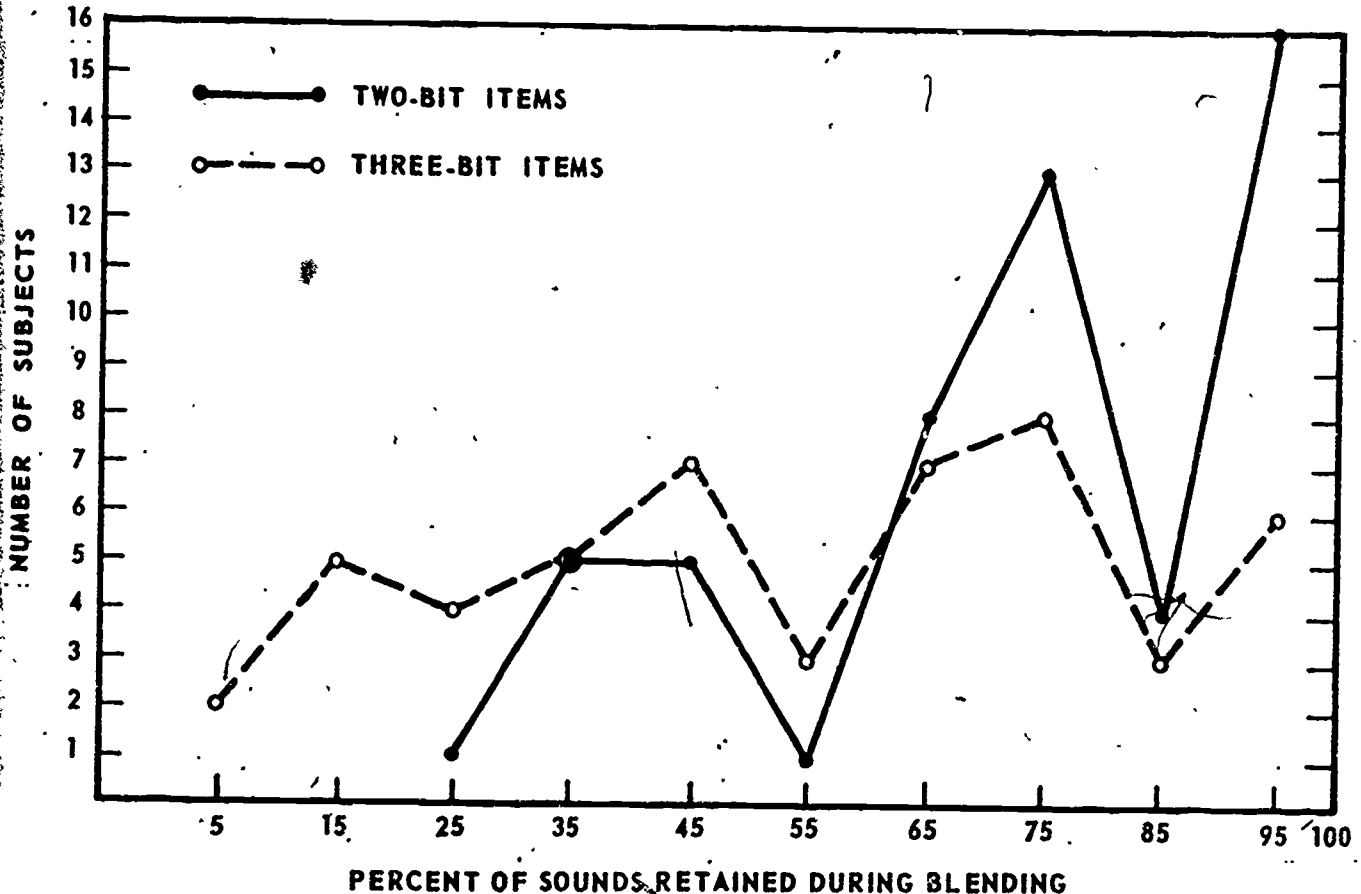
Any items on which the child was unable to remember two word parts in isolation was not scored because blending would have been impossible.

Fortunately, there were very few responses that fell within this category.

Figure 1 gives curves of performance on the two and three "bit" items. Whereas children retained approximately 56% of the sound parts in three "bit" items, on the average, they held on to 76% in two "bit" items. Although there was a higher degree of retention with two "bit" items, substantial loss of specific sounds occurred during blending for both types of items.

Figure Caption

Figure 1. Retention of "Two Bit" and "Three Bit" Items on the Blending Test. (n = 52).


TWO-BIT ITEMS
THREE-BIT ITEMS
NUMBER OF SUBJECTS
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
5
15
25
35
45
55
65
75
85
95
100
PERCENT OF SOUNDS RETAINED DURING BLENDING

Discussion

While the literature would indicate that instruction emphasizing letter clusters or patterns should help the beginning reader to process words efficiently (Fletcher, 1973; Fries, 1963; Gibson & Levin, 1975; Pick, 1978), it appears that the effectiveness of training for LD children is dependent on the salience of the "chunk" or pattern that the child is expected to use when decoding novel words. In the present study, the group trained to approach monosyllabic words using an initial bigram strategy demonstrated superior performance on transfer items when compared with groups trained to use alternative strategies. The Initial-Initial group was able to read 44% of the 36 transfer items correctly after two sessions of instruction, whereas the other four groups averaged between 21-26% accuracy. Considering the fact that children were reading an average of only two of the words correctly on the screening measure, all groups made substantial gains. However, the achievement of the Initial-Initial group was certainly more impressive than that of the other groups in that they read twice as many transfer items as the other groups.

It is interesting to note that, while the group trained on initial bigrams demonstrated superior transfer of these bigrams to novel words, the final bigram group did not demonstrate an advantage on transfer items containing the final bigrams included in the training. The notion that initial bigrams have greater transfer value than final bigrams confirmed earlier research findings. Pick (1978) found that the CV pattern in monosyllabic words was transferred more often than the VC

pattern. Swenson (1975) also noted that, in visual and bimodal tasks, the CV bigram was a more salient cue in word matching.

Why should an initial bigram - final consonant strategy be successful for learning and transfer? One reason might be that word reading is a left-to-right perceptual activity. Children appear to focus on initial consonants in words without specific training (Marchbanks & Levin, 1965) and to produce them with a high degree of accuracy (Venezky, Chapman, & Calfee, 1972). Therefore, it is likely that a strategy which reinforces left-to-right processing and takes advantage of the salience of the initial consonant is easier to apply than one which encourages the child to focus at the end of a word.

Findings also supported the value of a consistent word attack strategy. Results of the present study indicate that the mixed bigram training was less effective than a single strategy emphasizing the initial bigram. It is possible that a switch in strategies over two days of instruction was confusing and that the strategies interfered with one another. It can also be argued that neither strategy received sufficient practice or review. However, posttest means indicated that the performance of the two mixed strategy groups was certainly no worse and, in fact, slightly better than the single strategy group trained with final bigrams. Therefore, even though insufficient practice on either bigram approach may have contributed to the relatively inferior performance of the mixed groups, it is also possible that the introduction of final bigrams into the training diminished the effectiveness of the initial bigram strategy.

The initial bigram strategy applied consistently appeared to increase disabled children's ability to attack new words more effectively than a letter-by-letter decoding strategy. The major difference between the Initial-Initial and Letter-by-Letter conditions was the number of units which the child is required to blend. Results on the blending measure administered in the present study, as well as Goldstein's findings (1976), indicated that two units are easier to integrate than three. Unit reduction alone does not appear to offset the importance of a left-to-right strategy. Therefore, the group trained with a letter-by-letter strategy did not perform poorly relative to all bigram groups.

While it would be premature to assume that all instruction for LD children should utilize an initial bigram strategy for CVC words, results of the present study suggest that instruction should provide some degree of consistent practice with initial bigram patterns. A survey of existing phonics materials revealed that few popular programs emphasize the initial bigram. However, it would be possible for teachers to construct word lists using initial bigram patterns and to provide students with structured, focused practice with these lists.

As teachers work with children on rhyming patterns, or phonograms (e.g., mat, fat, cat, etc.), they need to consider what the child is actually gaining from the instruction. Such an approach may be, in fact, an adequate way to teach sight words (Rubin, 1979). However, if a teacher is interested in the child's ability to apply a strategy to novel words and to produce medial short vowels correctly in non-patterned words, rhyme may not be the optimal strategy for accomplishing these goals.

The effectiveness of the initial bigram strategy in CVC words should not be downplayed. Since vowels are particularly troublesome for beginning readers (e.g., Monroe, 1932; Weber, 1970) and mastery of basic CVC patterns would give children a repertoire of 500 words and a much larger number of closed syllables in multi-syllabic words (Fries, 1963), an instructional technique which helps the child both to utilize medial vowels and to internalize patterns is very useful in remedial instruction.

Footnotes

[1] In order to simplify the discussion of methodology and data, the specific element taught (such as the vowel sound in cot) will be referred to subsequently as "short o." Although there are other terms which linguists apply to this type of phoneme, it seems reasonable to use the widely used term, short vowel.

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