DOCUMENT RESUME

ED 108 164 CS 001 952

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TITLE Learning and Transfer Effects of Systematic Variations in Word-Decoding Instruction.
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SPONS AGENCY Office of Education (DHEW), Washington, D.C.
REPORT NO SWRL-TM-3-71-07
PUB DATE Sep 71
NOTE 17p.

EDRS PRICE MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS *Decoding (Reading); Grade 1; Primary Education; Reading Ability; *Reading Achievement; Reading Comprehension; *Reading Instruction; *Reading Research; *Teaching Methods; Teaching Models

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SOUTHWEST REGIONAL LABORATORY
TECHNICAL MEMORANDUM

DATE September 7, 1971

NO TM 3-71-07

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This study investigated the effects of three different word-decoding instructional procedures: a single-letter (SL) approach, a letter-combination (LC) approach, and a procedure in which children receive several weeks' instruction in the SL method and then switch to the LC approach. Grade 1 pupils were assigned at random to the three treatment groups, and each group received a total of 28 days of instruction with its particular method. There were no significant differences between the three groups in achievement on the 32-item posttest measuring the ability to read words encountered during instruction and the ability to sound out and read new words, but each treatment group scored significantly higher on the posttest than did a control group receiving regular first-grade reading instruction.

LEARNING AND TRANSFER EFFECTS OF SYSTEMATIC VARIATIONS IN WORD-DECODING INSTRUCTION

One of the most important skills to acquire in learning to read is the ability to read new words composed of previously learned grapheme-phoneme correspondences. Yet, the available evidence indicates that this transfer-type task is very difficult for young readers to master, even when they are presented with printed one-syllable words in their normal speaking vocabulary and they can say each individual letter sound in the printed word (Silberman, 1964; Jeffrey and Samuels, 1967).

The difficulty that children experience in reading a word made by a sequence of individual letter sounds is hardly surprising. To figure out the word, the child presumably must remember each sound that he says or thinks in sounding it out and must overcome the distortion of the sounds pronounced individually, as contrasted with their pronunciation in the word itself. Even with relatively simple consonant-vowel-consonant (CVC) words, the child sounding out the word on a letter-by-letter basis must recall a sequence of three sounds and normally must overcome considerable distortion of one or two of the sounds.

Two techniques with potential advantages for teaching children to sound out and read new words, the single-letter approach and the letter-combination method, were investigated in a recent experiment by Sullivan, Okada, and Niedermeyer (1971). Under the single-letter approach, children were taught the sound of each individual letter and sounded out new words on a letter-by-letter basis. Under the letter-combination procedure, children were taught to pronounce common vowel-consonant (VC) and vowel-consonant-consonant (VCC) word endings as intact grapheme-phoneme units

both in isolation and in sounding out a word. Thus, the word bad would be sounded out as "b-a-d" by children using the single-letter approach and as "b-ad" by children using the letter-combination method. The primary advantage of the single-letter procedure is that the child presumably should be able to sound out and read a greater number of new words after learning the same number of grapheme-phoneme correspondences as the child using the letter-combination method, since a relatively small number of individual letter sounds combine with each other to form many common VC and VCC combinations. Potential advantages of the letter-combination method, on the other hand, are (1) the number of separate sounds that the child must recall in figuring out a new word is reduced, and (2) distortion in the VC or VCC combination is eliminated, thus resulting in much greater similarity of sound between the "sounded-out" version of the word and the actual word itself.

In the study by Sullivan, Okada and Niedermeyer, children under both the single-letter treatment and the letter-combination treatment made substantial pretest-to-posttest achievement gains (from 33% on the pretest to 68% on the 80-item posttest for both treatments) over a nine-week instructional period. Although the two treatments did not differ significantly in effectiveness when posttest achievement results were analyzed across all pupils, both a significant treatment-by-ability interaction effect and significant simple-effects differences related to pretest scores indicated that the two treatments were differentially effective depending on the ability level of the learner. Low-ability pupils (i.e., pupils scoring in the lowest third on the pretest) in the

single-letter treatment achieved significantly higher posttest scores than low-ability pupils in the letter-combination group. In contrast, the letter-combination approach was markedly more effective than the single-letter approach with high-ability pupils. A tenative conclusion reached on the basis of the study was that an approach that initially emphasized single-letter training but subsequently switched to the letter-combination procedure may be more effective than either the single-letter or letter-combination procedures alone. The presumed advantage of this transition approach is that early instruction with the single-letter method would be to the advantage of low-ability learners, while later emphasis on the letter-combination approach would give all learners practice with procedures similar to those effective with more advanced readers.

The present study was designed to investigate the effectiveness of the single-letter, letter-combination, and transition (single-letter training followed by letter-combination training) methods with an extended lexical sequence. Effectiveness of the three approaches was evaluated on the basis of subjects' performance in reading (1) new words composed of graphemes taught in the study (i.e., transfer) and (2) graphemes and words practiced in word-decoding instruction. Mean posttest achievement scores of the three treatment groups were compared to each other and to the mean posttest score of a control group that received only their normal first-grade word-decoding instruction during the study.

Experimental conditions during the study were established to closely simulate normal classroom conditions for reading instruction.

First-grade children received group instruction for three days a week in school/classrooms for an 11-week period. The letters taught during the study had previously been selected and sequenced by computer as the most appropriate graphemes for use in word-decoding instruction in a beginning program. Primary criteria used in selecting the letters were grapheme-phoneme regularity and the number of high frequency one-syllable words composed of the letters.

Method

Subjects

The Ss were first-grade pupils enrolled in four grade-one classrooms in a metropolitan Southern California elementary school. All pupils were pretested at the beginning of the study in early January of the 1970-71 school year. One class of pupils was designated the comparison group in order to provide an estimate of treatment effectiveness. Pupils from the remaining three classrooms were randomly assigned to one of the three treatment groups and to one of two experimenters. The data reported are limited to the 103 pupils of the original 119 pupils who continued throughout the term of the study.

Procedure

Pupils in each of the three classrooms were randomly assigned to one of three treatment groups and to one of two experimenters. Pupils assigned to a particular experimental condition and to a particular experimenter were combined to form a group of approximately 15 pupils for purposes of instruction. Each of the two experimenters taught

approximately the same number of pupils from each classroom under each of the three treatment conditions. All instruction was provided apart from the regular classroom. The order of instruction was counterbalanced between groups to compensate for time-of-day factors.

Two researchers were trained to provide instruction for each of the three treatment conditions. Extensive practice sessions employing videotapes were provided for the researchers prior to the beginning of the study to insure that the difference in instruction was exclusively in the length of the ending unit as pronounced in isolation and in sounding out words. Subjects receiving single-letter (SL) training were taught to say the sound of each individual letter both in isolation and in words, except for ending CC units (consonant blends, diagraphs and geminate consonants) which were taught as single phonemes. Ss receiving letter-combination (LC) training were taught all VC and VCC ending combinations as single grapheme-phoneme units to be pronounced as one unit both in isolation and in words.

The instructional content was divided into 13 lessons, with Lessons 12 and 13 constituting reviews of content from the first 11 lessons. The transition (T) group received single-letter training for the first five lessons, covering a total of 13 instructional periods, and letter-combination training for the final eight lessons. As shown in the Content Outline below, the lesson content for the three groups was the same except that Ss receiving LC training were taught each ending-letter combination used in the practice words, whereas Ss receiving SL training were not taught these combinations. A minor difference was the 4 CC

Word Attack Study Content

A. Treatments
1. Single Letter (SL)
2. Letter Combination (LC)
3. Transitional (SL in units 1-5; LC in units 6-11)

B.

	Words (used in 3 treatments)	Elements SL	Elements LC	Elements Transition
Lesson 1	sit, pit, lit, pin, tin, sin, lip, nip, sip, tip	i, n, t, s, p, l	i, n, t, s, p, l, it, in, ip	same as SL column
Lesson 2	sat, mat, pat, man, pan, tan, lap, nap, tap, map	a, m	a, m, at, an, ap	same as SL column
Lesson 3	net, set, met, bet, pet, pen, men, den, ten, red, led, bed, Ted	e, d, r, b	e, d, r, b, et, en, ed	same as SL column
Lesson 4	lid, did, hid, sad, mad, dad, bad, had, ham, ram, bam, Sam	h	h, id, ad, am	same as SL column
Lesson 5	lot, not, hot, dot, pop, top, hop, but, rut, hut	o, u	o, u, ot, op, ut	same as SL column
Lesson 6	sent, tent, bent, rent, rest, nest, pest, best, rust, dust, bust	nt, st	ent, est, ust.	same as LC column
Lesson 7	send, bend, lend, mend, melt, belt, felt, sell, bell, well	f, w, ll, nd, lt	f, w, ll, end, elt, ell	same as LC column
Lesson 8	fish, wish, dish, sink, pink, wink, sank, bank, tank, hunk, bunk, dunk	k, sh, nk	k, sh, nk, ish, ink, ank, unk	same as LC column
Lesson 9	sack, tack, rack, sick, lick, pick, sock, lock, dock, suck, duck, buck	ck	ack, ick ock, uck	same as LC column
Lesson 10	shut, shot, shop, shed, ship, shock, that, than, then, think, thank, spot, spin, spend, spent, spell, spank	th, sp	th, sp	same as LC column
Lesson 11	skin, skid, skip, slam, slap, slid, slick, stick, stack stuck	sk, sl	sk, sl, st LC column	same as

blends that were taught in isolation to SL Ss in Lessons 6 and 7 but only in the context of VCC combinations to LC Ss.

Each of the six groups was given 20 minutes of instruction for two days on each of the 13 lessons. Two days of pre-training was provided in figuring out the word "made by" given sounds, and a day for review was provided before each of two en route tests. Thus, there were a total of 30 instructional days and three testing days after the pretesting.

In each lesson, children were initially taught the sounds of the new letters and/or letter combinations for the lesson. Instruction and practice in sounding out and reading new words was then provided for the remainder of the lesson. All content was taught with flashcards and word list booklets in a prescribed sequence that was identical for all groups.

For sounding out and reading new words, all Ss were taught to respond to the oral stimulus, "Sound out and read this word" by first saying the sounds in the manner appropriate for their group and then saying the word. In three-letter words, the SL Ss sounded out each letter separately (C-V-C) before attempting to say the word, whereas the CL pupils sounded out each word as C-VC. In CVCC words, the SL group sounded out the word as C-V-CC, and the LC group sounded it out as C-VCC. In CCVC words the SL group sounded out new words as CC-V-C and the LC group sounded it out as CC-VC. In CCVCC words the SL group sounded out new words as CC-V-CC and the LC group sounded it out as CC-VCC. Thus, in sounding out three-, four-, and five-letter words,

the SL group always said three separate sounds, and the LC group always said only two separate sounds. These procedures are contrasted below:

Oral Stimulus	Printed Stimulus[1]	SL Response	LC Response
"Sound out and read this word"	sit	"s-i-t, sit"	"s-it, sit"
	nest	"n-e-st, nest"	"n-est, nest"
	skin	"sk-i-n, skin"	"sk-in, skin"
	spend	"sp-e-nd, spend"	"sp-end, spend"

Materials

Instruction for all treatment groups was conducted with flashcards and word-list booklets. Each lesson included a flashcard for each letter sound, letter combination (LC instruction only), and word-attack practice word taught in the lesson, as shown in the Content Outline. The individual word-list booklets contained one page per lesson listing the content for that lesson. Both the flashcards and word-list booklets differed for the two instructional treatment groups only in that letter combinations were included in the LC materials but not in the SL materials. The same prescribed sequence of instruction was employed in all groups with the instructional materials.

Criterion Measures

Four tests were administered during the study. Each test consisted of four subtests assessing Ss reading of the following content: 1. Word Elements: i.e., letters included in the training for both groups and

[1] Presented on a flashcard by the teacher or contained in word-list booklets used by each child under teacher direction.

letter combinations included in the LC training; 2. Practice Words: words practiced during word-attack instruction; 3. Transfer 1 Words: new words containing VC and VCC endings taught as single grapheme-phoneme units to the LC group; and 4. Transfer 2 Words: new words containing VC and VCC endings not taught as grapheme-phoneme units to the LC group. Thus, subtest 3 consisted of transfer words composed of an initial consonant learned as a single letter by both groups and an ending VC or VCC unit learned as a unit by the LC group, but as separate sounds by the SL group. Subtest 4 consisted of transfer words composed of an initial consonant learned as a single letter by both groups and an ending VC or VCC unit learned as separate sounds by the SL group but not directly taught to the LC group, although all individual letters in the ending unit had been contained in other VC and VCC combinations taught to the LC group.

The two intermediate tests and the posttest consisted of 32 items each, with each subtest containing 8 items. Intermediate Test 1 was administered following Lesson 5, and Intermediate Test 2 was administered following Lesson 8. The two intermediate tests were administered to permit an analysis of performance trends during the study and included only content taught up to the points at which they were administered. The comparison group did not receive the intermediate tests. The posttest was administered following Lesson 13 at the conclusion of all instruction in the study.

All tests were individually administered to all Ss and consisted entirely of constructed-response items. Each S was required to read the

letter combinations and words as presented on separate flashcards.

Design and Data Analyses

The experimental design was a pretest-treatment-posttest design with random assignment of Ss to the three treatment groups. The contrast between the control and treatment groups was performed using a one-way analysis of variance, and the data comparing the three treatment groups were analyzed using an unweighted means three-way (treatment x class x experimenter) analysis of variance.

Results

Figure 1 summarizes the total test score data for all groups. It can be seen that the pupils scored very low on the pretest, attaining an average score for all pupils of only 1.98 items correct on the 32 item test. The figure also reveals that the three treatment groups gained consistently during the course of the study, with minor variations in test performance among the treatment groups.

Posttest mean scores by treatment and subtest are shown in Table 1. As shown, the scores of the three treatment groups ranged from 14.0 to 15.2. The control group attained a mean posttest score of 7.2. The table also reveals that Ss in all groups performed best on the word elements subtest and progressively less well as the subtest task required a greater degree of transfer from the word-decoding training.

A one-way analysis of variance comparing the posttest scores of three treatment groups and the comparison group showed a significant difference between group means ($F = 4.71$, $p<.01$). A Newman Keuls test comparing pairs of ordered means revealed that each of the three treatment

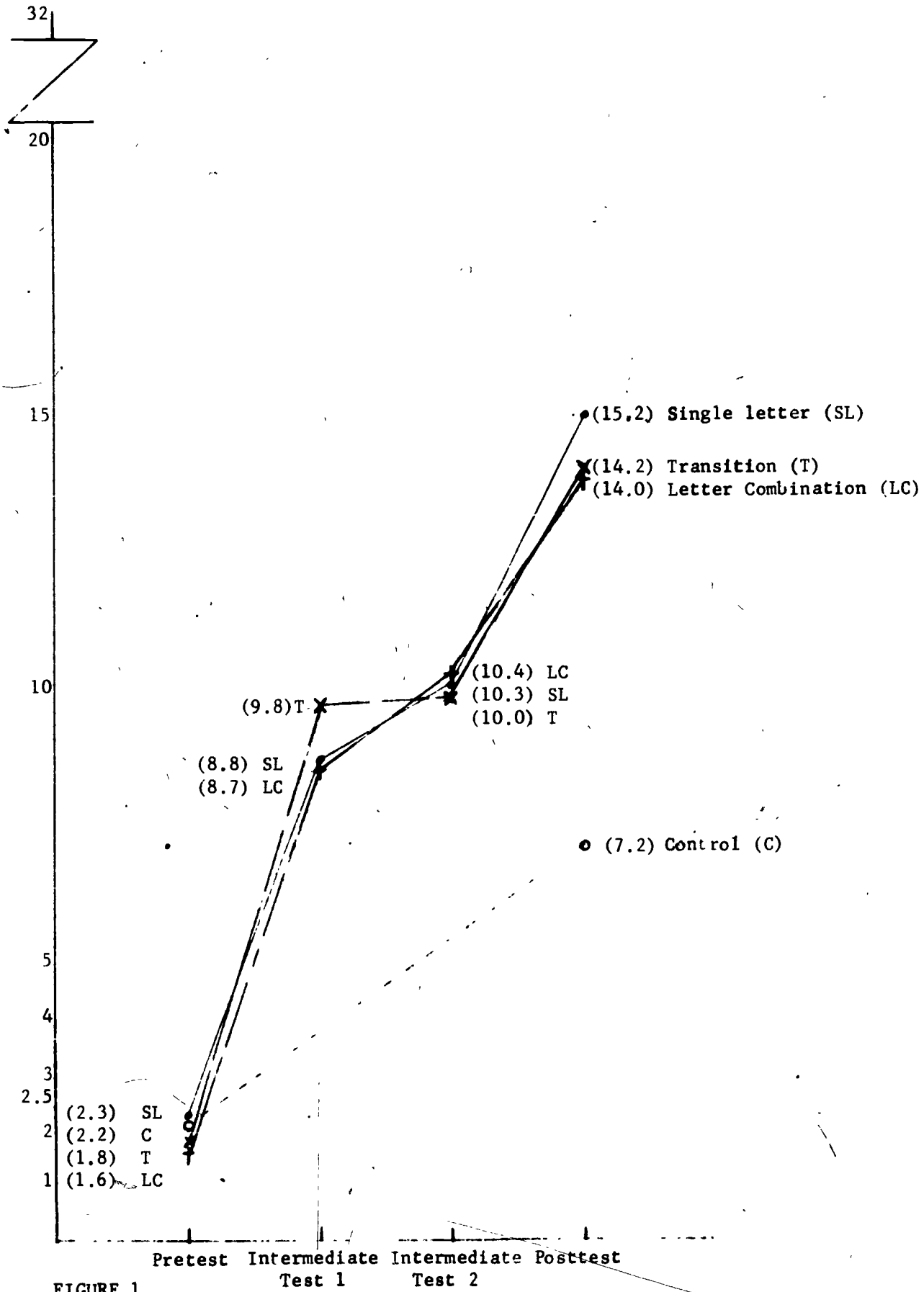

FIGURE 1

TOTAL TEST SCORES

TABLE 1

Posttest Mean Scores by Treatment and Subtest

Treatment	Subtest: Word Elements	Practice Words	Transfer 1 Words	Transfer 2 Words	*Test Totals
(Number of Items)	(8)	(8)	(8)	(8)	(32)
Single Letter	5.9	4.2	3.0	2.1	15.2
Transition	5.2	4.1	2.8	2.1	14.2
Letter Combination	5.6	4.1	2.9	1.4	14.0
Control	4.0	1.7	.8	.7	7.2

groups performed significantly better on the posttest than did the comparison group ($p<.01$ for the SL group, $p<.05$ for the T and LC groups.) However, the three treatment means did not differ significantly from one another.

Because of the low pretest scores of all Ss, no treatment by ability (with ability being defined as level of pretest score) analyses were performed. However, since virtually all Ss showed low ability on the pretest, and there were no reliable posttest differences between treatment groups, it is clear that the earlier Sullivan, Okada, and Niedermeyer (1971) finding regarding the superiority of the single-letter treatment with low-ability pupils was not confirmed in the present study.

DISCUSSION

The primary purpose of the present experiment was to determine the effects of three different procedures for teaching word-decoding skills using the grapheme-phoneme correspondences and lexicon from the planned SWRL Mod 2 reading program. Results indicated that each of the three procedures was superior to the regular word-decoding instruction offered at the participating school. Thus, it seems likely instruction using a version of one of the three procedures from the present study should promote better pupil attainment of decoding skills than is typically achieved in the schools.

There was no reliable evidence from the study that any one of the three experimental treatments was superior to the other two. Speculation concerning the possible superiority of the procedure combining the single-letter and letter-combination techniques was not confirmed. The single-letter method, which had been significantly more effective with low-ability learners in an earlier study (Sullivan, Okada and Niedermeyer, 1971) showed only a slight, non-significant advantage over the other two procedures. However, while the combined results of the earlier study and the present one certainly are not conclusive, they appear to slightly favor use of the single-letter method of instruction.

Although each of the three experimental methods guided superior results to the participating school's regular program, mean posttest achievement scores of the experimental groups were low when considered on an absolute basis. The low entering ability level of the subjects and the difficulty of the transfer type tasks, as indicated by the lower achievement on these tasks, were two factors that undoubtedly contributed to the low scores. It should be noted, however, that the planned word-decoding content from a year-long reading content was taught over a period of only 11 weeks in the study. Children who receive instruction and practice on this content embedded in the context of a complete reading program over an entire year can be expected to acquire much greater decoding skill than subjects from the present study.

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