DOCUMENT RESUME

ED 253 845 CS 007 915

AUTHOR Calhoun, Mary Lynne; Allegretti, Christine L.
TITLE The Processing of Short Vowels, Long Vowels and Vowel Digraphs in Disabled and Non-Disabled Readers.
PUB DATE 27 Mar 84
NOTE 17p.; Paper presented at the Annual Meeting of the Southeastern Psychological Association (30th, New Orleans, LA, March 28-31, 1984).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cognitive Processes; Elementary Education; *Language Processing; Males; *Phoneme Grapheme Correspondence; *Reading Difficulties; Reading Instruction; *Reading Research; Remedial Instruction; *Vowels

ABSTRACT

To test F. J. Morrison's conceptualization of reading disability as the failure to master the complex irregular system of rules governing sound-symbol correspondence in English (1980), a study investigated the speed with which disabled and normal readers processed short vowels, long vowels, and vowel digraphs. Subjects consisted of two groups of male students: (1) seven disabled readers in the third, fourth, and fifth grades having a mean IQ score of 103 and a mean word recognition grade equivalent score of 3.0; and (2) seven non-disabled readers in the second and third grades having a mean IQ score of 107 and a mean word recognition score of 3.1. Both groups were presented pseudoword pairs on slides and asked to identify a target word. Reaction time was measured with voice-operated relay and digital millisecond clock counter. The pseudoword pairs were formed such that each was matched with another that was identical except for one or two vowels in the medial position. When the effects of type of reader and type of letters in the medial position on reaction time were assessed, results showed no significant effects involving type of reader or type of pseudoword. An analysis of reaction times for individual words found significant differences. An inspection of the effects of practice on the reaction times found differences between disabled and non-disabled readers. The need for an empirically supported "complexity scale" is discussed. (Author/FL)

The Processing of Short Vowels, Long Vowels and Vowel Digraphs in Disabled and Non-Disabled Readers

by

Mary Lynne Calhoun
The University of North Carolina at Charlotte*
and
Christine L. Allegretti
Sacred Heart College

A poster presented at the 1984 meeting of the
Southeastern Psychological Association
New Orleans, LA
March 27, 1984

Running Head: PROCESSING OF SHORT VOWELS

* Department of Curriculum and Instruction
The University of North Carolina at Charlotte
Charlotte, North Carolina 28223

Abstract

The speed with which disabled and non-disabled readers process short vowels, long vowels, and vowel digraphs was investigaed in this study, an exploration of Morrison's (1980) conceptualization of reading disability as the failure to master the complex irregular system of rules governing sound-symbol correspondence in English. Seven disabled and seven non-disabled readers, all of average intelligence, were presented with pseudoword pairs, on slides, and asked to identify a target word. Reaction time was measured with voice-operated relay and digital millisecond clock counter. The pseudoword pairs were formed such that each pseudoword was matched with another that was identical except for one or two vowels in the medial position. The effects of type of reader (disabled or non-disabled) and type of letters in the medial position (long vowel, short vowel, vowel digraph) on reaction time were assessed. There were no significant effects involving type of reader or type of pseudoword. An analysis of reaction times for individual words found significant differences. An inspection of the effects of practice on the reaction times found differences between disabled and non-disabled readers. The need for an empirically supported "complexity scale" is discussed.

The Processing of Short Vowels, Long Vowels, and Vowel Digraphs by Disabled and Non-Disabled Readers

Problem

Reading disability is defined as "failure to master reading at a level normal for age when this failure is not the result of a generally debilitating disorder such as mental retardation, major brain injury or severe emotional instability" (Gibson & Levin, 1975, p. 485). Most research on reading disability has explored various cognitive deficits including problems in perception, attention and memory. A single set of explanatory principles has eluded investigators (Morrison & Manis, 1982; Vellutino, 1979). An alternative conceptualization of reading disability has been suggested by Morrison (1980). This conceptualization suggests that the fundamental problem experienced by the disabled reader is the failure to master the complex irregular system of rules governing sound-symbol correspondence in English. There is some evidence that suggests that reading-disabled children have more difficulty than normal readers in pronouncing words with complex rules as opposed to those that follow simple rules. Shankweiler and Liberman (1972) found that disabled readers made more pronunciation errors on vowel units than on consonants while errors of above average readers were more nearly equal. Shankweiler and Liberman (1972) pointed out that vowels may be more difficult for disabled readers due to the complexity of the correspondence rules. Vowels commonly involve multiple correspondences (for example, a is pronounced differently in cat, cake, and call) while consonants and consonant clusters typically have only one or two alternative pronunciations. A recent study by Calhoun and Allegretti (1983) measured reaction time in processing vowels and consonants by disabled and non-disabled readers. Because of the number of rules governing vowel pronunciation, it was hypothesized that vowels would be more difficult to recognize than consonants, and that short vowels (e.g., "big") would be most difficult. Results, however, did not support this hypothesis. In processing three-letter words in which the sound in the medial position was either a long vowel, consonant, or short vowel, short vowel words were processed significantly faster than other words. The short-vowel words in this study all followed the consonant-vowel-consonant pattern.

A different definition of rule complexity may account for these findings. Guthrie and Seifert (1977) defined a rule as more complex if it required the processing of more than one letter or the processing of conditional features. Thus, short vowels (for example, "bag," "big") for which a single orthographic unit is mapped directly to a sound should be easier to learn than long vowels ("Pine," "cute") and vowel digraphs ("bait," "bread"). Guthrie and Seifert (1977) found that complexity scaled in this fashion was a strong predictor of the rate at which rules were acquired.

While both Calhoun and Allegretti (1983) and Guthrie and Seifert (1977) found differences in efficiency in processing different types of words for both disabled and non-disabled readers, neither study found significant differences between the two types of readers. These studies, then, fail to support the conceptualization of reading disability as difficulty in mastering the complex rules of sound-symbol correspondence. A methodological problem noted in the Guthrie and Seifert (1977) study applies equally to the Calhoun and Allegretti (1983) study. Since the stimulus words were familiar to all subjects, word identification may have been mediated by some process other than sound-symbol translation. It is possible that after the first few exposures subjects access a word's meaning directly from print rather than by phonological mediation (Smith, 1978). Using pseudo words as stimuli would minimize this problem.

This study tests the hypothesis that disabled readers have more difficulty with rule complexity in word recognition than non-disabled readers by making use of pronounceable pseudowords rather than recognizable vocabulary words. Since pseudowords have no meaning, subjects are required to make use of their knowledge of how word segments are pronounced. The hypotheses of this study were as follows:

(1) Pseudowords containing short vowels will be recognized faster than pseudowords containing long vowels or vowel digraphs by both disabled and non-disabled readers.

(2) Disabled readers will require more time to process

short vowels, long vowels, and vowel digraphs than non-disabled readers.

Method

Subjects: Seven disabled and seven non-disabled readers, all males, participated in this study. Disabled readers met the subject selection criteria established by Vellutino (1979) and Guthrie (1973): all have general intellectual ability in the average range and reading achievement two or more years below grade placement as measured by standardized reading tests. An additional criterion of at least 15 standard score points between academic aptitude and academic achievement was established. Academic aptitude (IQ) was measured by the Peabody Picture Vocabulary Test--Form M. The range of standard scores was 93-113, with a mean of 103. Reading achievement was measured by the word identification subtest of the Woodcock Reading Mastery Tests--Form B. Each individual in the disabled group achieved a word recognition score significantly below expected achievement levels. Word recognition grade equivalent scores ranged from 2.0 - 3.5, with a mean of 3.0. The seven boys in the disabled readers group ranged in age from 9-5 to 11-2 and were in the third, fourth, and fifth grades.

Non-disabled readers were males with average academic aptitude (standard scores $\overline{X}$ = 107, with a range of 98-114) and word recognition scores in the average range for their grade placement ($\overline{X}$ = 3.1, with a range of 2.2-3.9). All were in the second and third grades. Thus, the non-disabled reader comparison group was equated to the disabled reader group on IQ and word recognition level.

Procedure. Twelve four-letter pseudowords were constructed. Four of the pseudowords followed each of these patterns: short vowel words; long vowel words; vowel digraph words. Within each group, word pairs were formed such that each pseudoword will be matched with another pseudoword that differed only in one or two vowels. Consonants and consonant placement will be identical, for example, "babe" and "bibe." (See Table 1 for word stimuli.) Slides were taken of each of the word pairs.

A slide projector equipped with voice-operated relay and digital millisecond clock/counter projected word pairs, one above the other, on to a screen. The experimenter read one of the two words presented visually, and the subject's task was to indicate which of the two alternatives is the target word. They responded vocally by saying "top" or "bottom"; the relay stopped the clock with a measure of reaction time.

Subjects were tested individually beginning with a training session and followed by 144 experimental test trials per subject. The order of the pseudowords, their position on the slide and their type were randomly determined.

Results

The reaction times for variables including type of reader (disabled or non-disabled), type of pseudoword defined by the sound in the medial position of the word (long vowel, short vowel, or vowel digraph), and individual words comprising each word type were analyzed using Repeated Measures Analysis of

Variance. There were no significant effects involving type of reader or type of pseudoword. A significant effect of reaction time for individual words comprising the long vowel, short vowel, and vowel digraph was indicated (F (9,9) = 2.29, p < .02). An analysis of reaction times indicated that while significant differences for short vowel and vowel digraph pseudowords was not found, there were significant differences in reaction times between the words comprising the long vowel condition (F (3,3) = 7.64, p < .0004). The Duncan's Multiple Range Test analysis indicated that reaction times for long vowel pseudowords fave and feve were each significantly longer than the reaction times required for the other two long vowel words bibe and bobe.

An inspection of the effects of practice on the reaction times of disabled and non-disabled readers found that non-disabled readers tended to require about the same amount of time (in milliseconds) at the end as at the beginning of the session while disabled readers required longer reaction times as the session progressed. Table 3 reports the mean reaction time (in msec) to pseudowords (by type) in six segments of the experimental sessions.

Discussion

Both this study and an earlier study by Calhoun and Allegretti (1983) did not find significant differences in reaction times between non-disabled readers and disabled readers, nor were significant differences in reaction times found for different types of words or pseudowords. In both studies, however, individual words were found to require significantly longer reaction times.

This study hypothesized that pseudowords with digraphs and long vowels would require longer reaction times than short vowel pseudowords because they require processing of more than one letter to identify the vowel sound. While these hypotheses were not supported, it should be noted that the two pseudowords that required significantly longer reaction times were long vowel words, "fave" and "feve."

It seems possible that a major issue in research exploring a rule-complexity explanation of reading disability lies in the definitional question of what is complex. The Calhoun and Allegretti studies explored both Shankweiler and Liberman's (1972) postulation that vowels are more difficult than consonants due to the complexity correspondence rules and Guthrie and Seifert's (1977) postulation that words are more complex if they require the processing of more than one letter or the processing of conditional features. Neither theory of complexity was supported in the Calhoun and Allegretti studies, although both studies did identify specific words that required significantly longer reaction times. An empirically supported "complexity scale" would seem to be an important contribution to research in this area. Once agreement is reached on which type of words involve more complex rules of sound-symbol correspondence, research on reaction-time differences between disabled and non-disabled readers may prove more fruitful.

Age differences between the experimental and comparision groups should also be noted in interpreting those results. While the groups were equated in intelligence and word recognition achievement, there was an age difference between groups. The disabled readers were in the 9-11 year age range while the normal readers were 7 or 8 years old. The absence of difference in the reaction time suggests the possibility that disabled readers' problems in phonetic coding identified in previous research (Liberman & Shankweiler, 1980; Liberman et al., 1977; Perfetti & Lesgold, 1976) may be a developmental lag in contrast to a long term deficit. Word recognition grade equivalent scores may be useful predictors of level of phonetic coding. Additional research with disabled and non-disabled readers with age controls would be helpful in addressing this question.

It is interesting to note a difference between disabled and non-disabled readers in their reaction times through the course of the 40-minute individual sessions in the experiment. While the reaction times of normal readers remained fairly constant, reaction time of disabled readers lengthened as the session progressed. Problems with fatigue and selective attention may indeed be the contributing factors to the special problems of disabled readers (Keogh & Margolis, 1976; Ross, 1976).

In their review of cognitive processes of reading disability, Morrison and Manis (1982) suggest that the severity and specificity of reading disability can be attributed to the difficulty of three tasks that are developmentally linked or dependent on one another; developing sophisticated reading and comprehension skills depends on having automated word-decoding operations, which in turn comes about through mastery of the symbol-sound correspondence rules. Further research on the theme of rule complexity will be needed to explore this important theoretical framework. A strong need to resolve definitional issues in rule complexity is apparent.

Table 1

Word Stimuli

Type of Pseudoword	Pseudoword Pairs
Short Vowels	namm nimm
	dess duss
Long Vowels	bibe bobe
	fave feve
Vowel Digraphs	nuit nait
	toap teap

Table 2

Mean Reaction Times (MSEC) for Disabled

Readers and Non-Disabled Readers

Pseudowords		Mean
Long Vowel		
bibe	1	1448
bobe	2	1450
faye	3	1708
feve	4	1657
Short Vowel		
dess	5	1711
duss	6	1725
namm	7	1589
nimm	8	1671
Vowel Digraph		
nait	9	1606
nuit	10	1586
teap	11	1538
toap	12	1631

Table 3

Mean Reaction Times of Disabled and

Non-Disabled Readers Over Trials
(MSEC)

	Disabled Readers	Non-disabled Readers
1	1549	1540
2	1501	1567
3	1563	1615
4	1628	1546
5	1644	1677
6	1882	1606

References

Calhoun, M. L. & Allegretti, C. (1983, March). The processing of vowels and consonants in disabled and non-disabled readers. Paper presented at the annual meeting of the Southeastern Psychological Association.

Bigson, E. H. & Levin, H. (1975). The psychology of reading. Cambridge, Mass: MIT Press.

Guthrie, J. T. (1973). Models of reading and reading disability. Journal of Educational Psychology, 65, 9-18.

Guthrie, J. T. & Seifert, M. (1977). Letter-sound complexity in learning to identify words. Journal of Educational Psychology, 69, 686-696.

Keogh, B. K. & Margolis, J. (1976). Learn to labor and wait: attentional problems of children with learning disorders. Journal of Learning Disabilities, 9, 276-286.

Mayzner, M. S. & Tresseltz, M. E. (1965). Tables of tetragram frequency counts for various word-length and letter-position combinations. Psychonomic Monograph Supplements, 4, 79-143.

McNutt, G. 1980). Perspectives in reading, language arts, and learning disabilities. Learning Disabilities Quarterly, 3, 3-9.

Morrison, F. J. (1980). Reading disability--toward a reconceptualization. Paper presented at the annual meeting of the Psychonomic Society, St. Louis.

Morrison, F. J. & Manis, F. R. (1982). Cognitive processes and reading disability: a critique and proposal. In C. J. Brainerd and M. Pressley (Eds.), Verbal processes in children. New York: Springer-Verlag.

Ross, A. O. (1976). Psychological aspects of learning disabilities and reading disorders. New York: McGraw-Hill.

Shankweiler, D. & Liberman, I. Y. (1972). Misreading: a search for causes. In J. Kavanaugh & I. Mattingly (Eds.), Language by ear and by eye. Cambridge, Mass. MIT Press.

Smith, F. (1978). Understanding reading. New York: Holt, Rhinehart & Winston.

Vellutino, F. R. (1979). Dyslexia: theory and research. Cambridge, Mass. MIT Press.