DOCUMENT RESUME

ED 136 248 CS 003 308

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TITLE Effects of Grapheme Substitutions in Connected Text Upon Reading Behaviors.
PUB DATE 77
NOTE 19p.; Paper presented at the Annual Meeting of the American Educational Research Association (New York, New York, April 1977)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Context Clues; *Decoding (Reading); Failure Factors; Intermediate Grades; *Miscue Analysis; Oral Reading; *Reading Difficulty; *Reading Processes; *Reading Research; Semantics; Success Factors; Syntax; Word Recognition

ABSTRACT

It has been suggested that good readers make better use of semantic/syntactic information and use relatively less graphic information than do poor readers. To test these hypotheses, minor visual alterations were inserted in words in connected text. Fifteen good and 15 poor readers at the fourth-grade level read two of the altered passages orally. Results indicated that the good readers read at a faster rate and made fewer miscalls in overall word identification than did the poor readers. However, there were no differences in the ratio of textually acceptable miscalls, and poor readers' responses to altered words seemed less bound to graphic cues than did those of the good readers. These comparisons do not support the initial hypotheses. (Author/AA)

EFFECTS OF GRAPHEME SUBSTITUTIONS IN CONNECTED TEXT UPON READING BEHAVIORS[1]

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Paper presented at the annual meeting of the American Educational Research Association, New York, April 7, 1976.

Abstract

It has been suggested that good readers make better use of semantic/syntactic information than do poor readers and that the former group uses relatively less graphic information compared to the latter group (Smith, 1971). To test these hypotheses, minor visual alterations were inserted in words in connected text. Fifteen good and 15 poor readers at the fourth grade level orally read two of these altered passages. Results indicated the good reader's rate of reading was significantly faster and that this group made fewer miscalls in overall word identification. However, there were no differences in ratio of textually acceptable miscalls and poor readers responses to altered words seemed less bound to graphic cues than those of the good readers. Neither comparison supported the above hypotheses.

EFFECTS OF GRAPHEME SUBSTITUTIONS IN CONNECTED TEXT UPON READING BEHAVIORS

A variety of research studies have examined the utilization of the various cue systems available to a reader. The bulk of these address the issues surrounding the roles orthographic and non-orthographic information play in the word recognition and reading processes. Studies of word recognition in isolation seem to depict letter identification as a necessary prerequisite for word identification (Massaro, 1975). However, the validity of such studies in relation to reading is open to question (Gibson and Levin, 1975) since connected text provides a richer variety of available cues compared to presentation of a word in isolation. Studies which have examined the use of available information when reading connected text have long suffered from a naivete concerning "linguistic variables" (Weber, 1968) and from error patterns which are not experimentally manipulative (e.g. K. Goodman and Burke, 1973; Y. Goodman, 1971).

It has been demonstrated that the use and integration of orthographic and contextual information develops as reading fluency increases (Biemiller, 1970). However, a primary issue yet unresolved is the particular role that accessing graphic information plays in the development of fluent reading skills. Smith (1971, 1975) and Goodman (1969) suggest that as reading fluency develops relatively less graphic information is employed and as dependence on graphic ues decreases reliance on contextual cues increases. A correlate o this position is that good readers make better use of contextual nformation than do poor readers and that the latter group uses elatively more graphic information.

These hypotheses were examined in the present experiment using a technique originally reported by Pillsbury (1897) and recently employed by Rayner and Kaiser (1975) and Strange (1976). In each study letters within words were altered. However only the two more recent studies presented altered words in connected text. Position of alteration within the word (initial, medial, final) as well as type of alteration (similar vs. changed configuration) were manipulated in both studies. The results of each study demonstrated that altering configuration disrupted reading rate. However, Rayner and Kaiser were primarily interested in assessing the relative importance of different types of graphic information for word recognition in reading connected text. Therefore, subjects were made aware alterations existed and were told to try and ignore them and respond with "the words they thought should be there rather than the strange words (p. 302)". Additionally, 18 percent of the characters were altered. Thus, the directions for the task and the quantity of alterations seemed to ensure a rather disruptive effect. Strange (1976) on the other hand employed silent reading rate as the metric, thus eliminating a measure of word identification accuracy as an experimental variable.

A primary assumption underlying the present study was that a similar strategy could be employed to assess a readers utilization of graphic information. However, while a similar strategy was employed a number of changes seemed necessary. First, all alterations would maintain the configuration of the original word since these had been shown to be the least disruptive. Second the ratio of alterations to unaltered text would be tremendously reduced. Third,

the subjects would not be alerted to the existence of alteration by experimenter. These procedural changes then provided a design which would allow an analysis of the relative utilization of graphic information by the subjects. Further, the design would also allow direct comparisons between good and poor readers relative to their utilization of graphic information. These analyses would be used to test the hypothesis that there is a difference in the use of available graphic information by good and poor readers.

Method

Subjects. All fourth graders in an elementary school were screened on reading ability during the fifth month of the school year, approximately two weeks prior to the initial experimental sessions. The screening instrument was the Word Identification subtest of the Woodcock Reading Mastery Texts, Form A. This is an individually administered achievement instrument which presents words in isolation for oral pronunciation. The computed correlation between this subtest and the total test score was .94 for fourth grade subjects, the highest correlation attained between any subtest and total test score.

Students with raw scores between 50 and 98 (2.0 to 3.6 grade equivalents) were classified as poor readers since their achievement lagged at least 1 year behind grade placement and 15 subjects were randomly selected from this pool. Students with raw scores between 108 and 127 (grade equivalents 4.6 to 7.0) were classified as good readers and 15 subjects were again randomly selected. The mean raw score of the poor readers was 79.0 (2.9 grade equivalent), while the mean of the good reader subjects was 112.2 (4.9 grade equivalent).

Following the random selection of subjects for each group a list of subjects, identified by group, was presented to the classroom teachers responsible for each subject's reading instruction. Teachers were asked to simply indicate (by drawing a line through the names) which, if any, subjects seemed to be placed in an inappropriate group. No subject was identified as inappropriately grouped.

The mean chronological age for both the good and poor reader groups was 9.6 years. Sex distribution for the poor readers was 10:5 male to female while for the good readers the male to female ratio was 7:8.

Materials: The experimental passages were developed by several graduate students following a set of written directions prepared by the investigators. These directions suggested that material suitable for students with a middle to high second reader level reading ability be selected, approximately 200 words in length. After the selection of a suitable passage grapheme substitutions were to be introduced following a series of constraints.[3] Briefly, approximately 5 percent, or single letter changes in ten words were to be introduced but each had to result in another real word (e.g. change a in came to o resulting in come, or change the m to n resulting in cane). The following alphabet characters were allowed to be interchanged: e, a, o, c; n, m, h, r; b, d, p; t, b, l. These letters were selected because

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[3] Though we chose to use the terms grapheme, or character alteration, it must also be noted that the constraint that text alterations had to result in another word in effect simultaneously created a semantic alteration. Thus, a subject who read the altered word as printed produced a response that agreed with the graphic cues but violated semantic constraints. This of course was the basis for the hypothesis we hoped to test.

of their high visual similarity according to several rankings (Dunn-Rankin, 1968; Niles, 1974). In one passage the developer ignored the constraints on a single occasion, substituting what for that however recent research (Allington, in press) has demonstrated that this pair of words is often confused on discrimination tasks and so this misalteration was not deleted. All other alterations followed the constraints presented. Figure 1 presents several example sentences drawn from the experimental materials. The altered word is underlined and the original words appears in parentheses to the right of the sentences. Note, however, that the altered words were not so marked in the experimental materials.

Insert Figure 1 About Here

A total of four passages were constructed, all of which had been selected from different basal reader series. Readability levels were determined by applying the Spache Readability Formula (Spache, 1953). All passages were rated between 2.5 and 3.0 grade level difficulty prior to the grapheme substitutions.

Procedure: One passage was randomly selected as the standard experimental passage and was administered to all subjects; one each of the remaining three passages was randomly assigned to each subject in an attempt to ensure greater generalizability of results (Coleman and Miller, 1974). Thus, two passages were administered to each subject with one passage being common to all subjects.

Subjects were tested individually in a small room by one of the authors. When the subjects entered the room, they were seated across from the experimenter at a flat top desk. Subjects were

told they were to read two passages orally. Since a microphone was conspicuously present on the desk, the subjects were told that a recording was being made for the experimenter to listen to later. No subject expressed undue concern about the presence of the microphone. Operation of the recording equipment was controlled by a foot pedal switch, thus making the mechanical operations unobtrusive.

Prior to beginning reading, each subject was given a brief introduction to the story which contained a general prelude to the passage. Several of the less skilled readers needed a word or two pronounced early in the passage. In no case was a word which immediately preceded an altered word pronounced for a subject. Every attempt was made to limit the number of words pronounced for subjects.

Subjects who made mention of the visual anomalies or to the fact that a word did not make sense, were simply told: "Read it the best you can." Such comments were also noted on the written transcription of the subject's performance.

Time required to read each passage was measured with a stopwatch during the experimental sessions. These sessions typically lasted less than 15 minutes, though the time for the good readers was typically less than that of the poor readers.

Scoring: A written transcription of the oral reading performance was made from the taped recordings. Particular emphasis was given to responses to the visual anomalies. In the case of multiple responses each was coded in the sequence of occurrence. The analysis that follows reports the responses to the anomalies in categories such as first response, second response, etc. Two responses were of particular interest; the first response which

ssemed to indicate the primary cue source employed by the subject, or the cue system to which the subject was attending, and the final response, which seemed to be indicative of the order imposed by the subject if an attempt was made to produce meaningfulness.

Results

Reading Time. Poor readers took considerably longer to read each passage than did the good readers. An analysis of the time data for the first passage indicated that the mean reading time for the good readers, 121.2 seconds, was significantly different ($F(1, 28)=9.43$, $p. < .01$) than that of the poor readers, 249.4 seconds. Similar differences existed on the reading time for the second passage with the mean of the good readers, 119.4 seconds, again significantly faster ($F(1, 28)=10.81$, $p. < .01$) than that of the poor readers, 243.3 seconds. There was no appreciable increase in reading rate from the first passage to the second for either group, the poor readers required approximately twice as long to read each passage as did the good readers. These longer times seemed not so much attributable to long isolated pauses as to simple word by word reading which was much more predominant in the poor reader group.

Responses to non-target words. The two groups exhibited significant differences ($F(1, 28)=12.87$, $p. < .01$) in general (non-target) word identification accuracy, the good reader group performing at a near perfect 99.5 percent accuracy level and the poor readers at 95.6 percent accuracy (remember the experimental materials were selected to approximate reading level of poor reader group). Poor readers then, exhibited less accurate word identification skills.

However, in addition to frequency, the misread words were evaluated for contextual appropriateness. These analyses indicated that while the poor readers exhibited a greater percentage of misread non-target words, there was no significant differences between groups ($F(1, 28)=1.23$, $p. < .27$) on the percentage of misread words which made sense in relation to the preceding contextual constraints. Thus, while the good readers were generally more accurate on the non-target words, the poor readers cannot be characterized as responding primarily to orthographic information but the data seem to point to a reliance by the poor readers on contextual information.

Responses to target words. Table 1 summarizes the data for initial responses to target words containing an altered character. Responses for each passage read were quite similar with overall performance indicating that good readers responded with the altered word 40 percent of the time (120 responses of 300 total responses) while the poor readers responded with the alteration only 27 percent of the time (83 of 300 responses). Both groups then at times ignored the semantic and syntactic constraints (assuming of course these cues were always strong enough to cue a prediction), responding instead to the graphic information.

Insert Table 1 About Here

Application of an analysis of variance found that while not reaching traditionally accepted levels of significance $F (1, 28) = 3.19$, $p < .08$ and $F (1, 28) = 2.92$, $p < .10$ the differences between groups on both passages suggested that good readers were more likely to be attending to graphic information than were poor readers. The

poor readers read what could logically have been expected based upon the contextual information. However, it should be noted that subjects in both groups were generally responding not to the graphic information in the altered words but more often supplied the contextually appropriate original word (the word in the passage prior to the alteration of a character). In fact both groups responded with the original word 56 percent of the time, thus all the available graphic information was ignored more than half the time by both groups of subjects. Poor readers, however, were more likely to respond with some other contextually appropriate word than good readers, ignoring graphic information to an even greater extent.

A second comparison was labelled attempts at meaning; this was a simple tally of the number of responses to the target words. That is, subjects often responded more than once to the altered words. For instance, a subject might have first read the target as printed (ignoring contextual constraints and responding instead to graphic information), reread again as printed after a regression and finally regressing once more rejecting graphic information and responding with the original word which was, of course, contextually appropriate. This sequence would have provided a score of two on the attempts at meaning, that is two attempts beyond the first response were elicited. The good readers had a mean of 8.33 attempts at meaning across both passages while the corresponding value for poor readers was 7.13. An analysis of variance indicated the groups did not differ on this characteristic ($F(1, 28)=.57, p. < .45$).

Discussion

These results are highly congruent with those reported by Rayner and Kaiser (1975) who used somewhat older subjects (reported only as sixth grade, junior and senior high school students). Though a similar research paradigm was employed they reported no direct statistical comparisons for the more and less skilled readers. The several modifications of procedures and materials in the present experiment in addition to the statistical tests, seem to add to the generalizability of our data. The results are also quite similar to those of Kolers (1975), who assessed recognition memory for sentences read by good and poor readers. He concluded that "good readers were far more sensitive to typographic characteristics of sentences than poor readers were" (p. 284). Similarly, the poor readers in that study exhibited significantly slower reading times than the good readers and the less skilled group also made more word identification errors. However, like the subjects in the present study the two groups did not differ in substitutions which fit the contextual framework. These similarities are even more striking when one considers that the subjects in these two separate studies differed substantially on age ($\bar{x}$=12.3 vs 9.6), grade placement (7th vs. 4th), and reading abilities ($\bar{x}$=9.5 and 4.7 vs. 4.9 and 2.9). Furthermore, Kolers transformed text, as an experimental manipulation, presented the letters in reversed orientation as contrased with our technique of grapheme substitution. Both experimental paradigms required oral reading but Kolers (1975) employed sentences only, while we required subjects' to read two separate stories.

As noted at the beginning of this paper, it has been suggested (Smith, 1971; 1975; Goodman, 1969) that as reading ability develops relatively less use is made of orthographic information with the good reader attending relatively more to contextual information. Conversely, poor readers might then be depicted as making less effective use of contextual information while depending more heavily on orthographic cues. These data do not support such formulations of reading ability. In fact, the similarity of the data patterns to those of Kolers (1975) makes his statement that follows as apt a summary to our study as it was to his:

> The results of the present tests are not consistent with such a hypothesis, as shown by the finding that it was the good reader rather than the poor one who was more sensitive to features of typography...

However, while not wholly consistent with this hypothesis, the fact that more than half of the initial responses (to the target words) of both groups in the present study were the words which had been present prior to alteration indicates that contextual information is a powerful source of information in word recognition. This supports Weber's (1970) contention that "children no matter what their potential for acquiring literacy skills, bring to the task a fundamental linguistic ability" (p. 154). Reading is a language process but it is also a visual receptive process, thus necessitating attention to both sources of information; contextual and orthographic.

The data suggest complex interactions between the various cues within the reader and the cues, or information available in printed connected text (Pearson and Studt, 1974). The relative availability, accessability, and employment of information sources such as experience, background, oral vocabulary, contextual richness, word

frequency, etc., seem to play as an important role as a subject's reading ability. In fact, these results when combined with a variety of other recent data (Allington and Fleming, 1976; Samuels, Bugy and Chen, 1975; Kolers, 1975; Rayner and Kaiser, 1975; Guthrie, 1973) seem to suggest that the relative efficiency with which these sources are tapped integratively may be what distinguishes a "good" reader from a "poor" reader.

Limitations. Several limitations of this study must be noted. First, the experimental task was oral reading and while we feel that this ask is an infinitely more acceptable paradigm than tachistoscopic ecognition of words or letters, or recall of letters, figures, etc. or those who would investigate reading ability, oral reading does ot seem to be an identical process to silent reading. (Mosenthal, 976). Thus the generalizability must necessarily be viewed within model of oral reading ability.

Similarly, understanding is the ultimate goal of all reading but nderstanding, or comprehension of the printed message was not re- uired in this experimental setting.

Finally, the task demands may have influenced response patterns. hat is, each subject in this study had to individually decide what read it the best that you can" meant.

urther research. The letter substitution paradigm seems an effec- ive method to experimentally manipulate orthographic characteristics f text within a framework quite similar to the task demands normally equired when reading. That is, visual exposure time is not manipu- ted, nor is text orientation, nor typographic clarity. Thus, use f this strategy keeps the research in closer proximity to the natural

task demands. Our reduction of character alterations from the level used in the Rayner and Kaiser (1975) study to one letter alteration per 10 words seems to be less disruptive, allowing subjects in some cases to read without noting any of the anomalies.

However, future research should attempt to further constrain alterations. Some of the most promising, in terms of information about visual receptive functioning in reading, would seem to be; a) limit alterations to words of single grammatical function, b) alter characters in contextually varied situations, c) alter characters in relation to phrase boundaries, and d) vary directions as well as alterations (e.g. alert subjects to anomalies but tell them to attempt to ignore them).

Summary. Using a research paradigm which was felt to more closely approximate the "natural" task demands of reading it was demonstrated that good and poor readers seem not to differ in their use of contextual information when reading in connected text contrary to hypotheses suggested by various researchers. Further, good readers seemed to attend to graphic information more than the poor readers even though they processed text significantly faster. Finally, it was suggested that the data point to a complex interaction of cue sources and that a major difference between good and poor readers may be the efficiency with which the cue sources are integratively employed.

BIBLIOGRAPHY

Allington, Richard L. "The confusability of high frequency words" Journal of Learning Disabilities (in press).

Allington, Richard L. and Fleming, James T. "Misreading of high frequency words", paper presented at New England Educational Research Organization, May 9, 1976, Provincetown, Massachusetts.

Biemiller, Andrew. The development and use of graphic and contextual information as children learn to read, Reading Research Quarterly, 1970, 6, 75-96.

Coleman, Edmond, B. and Miller, Gerald R. The simplest experimental design that permits multiple queralizations, Journal of Reading Behavior, 1974, 6, 31-40.

Dunn-Rankin, P. The similarity of lower case letters of the English alphabet, Journal of Verbal Learning and Verbal Behavior, 1968, 7, 990-995.

Gibson, Eleanor J. and Levin, Harry. The Psychology of Reading, Cambridge, Mass.: MIT Press, 1975.

Goodman, Kenneth. Analysis of oral reading miscues: applied psycholinguistics, Reading Research Quarterly, 1969, 5, 9-30.

Goodman, Kenneth and Burke, Carolyn Theoretically based studies of patterns of miscues in oral reading performance, U.S. Office of Education Final Report for project 9-0375, 1973.

Goodman, Yetta Longitudinal study of children's oral reading behavior. U.S. Office of Education Final Report for project 9-E-062, 1971.

Guthrie, John T. Models of reading ability and disability, Journal of Educational Psychology, 1973, 65.

Kolers, Paul. Pattern-analyzing disability in poor readers, Developmental Psychology, 1975, 11, 282-290.

Massaro, Dominic W. Experimental Psychology and Information Processing. Chicago: Rand McNally, 1975.

Mosenthal, Peter. Psycholinguistic properties of aural and visual comprehension as determined by children's abilities to comprehend syllogisms, Reading Research Quarterly, 1976, 12, 55-92.

Niles, Jerome. The use of featural and letter dependency information in word recognition by elementary school children, unpublished doctoral dissertation. The State University of New York at Albany, 1974.

Pearson, P. Daivd and Studt, Alice. Effects of word frequency and contextual richness on children's word identification abilities, Journal of Educational Psychology, 1975, 67, 89-95.

Pillsbury, W. B. The reading of words: A study in apperception, American Journal of Psychology, 1897, 8, 315-393.

Rayner, Keith and Kaiser, Jacqueline. Reading mutilated text, Journal of Educational Psychology, 1975, 67, 301-306.

Samuels, S. Jay; Begy, Gerald; Chen, Chaur. Comparison of word recognition speed and strategies of less skilled and more highly skilled readers, Reading Reserach Quarterly, 1975, 11, 72-86.

Smith, Frank. Understanding Reading, New York: Holt, Rinehart, Winston, 1971.

Smith, Frank. The role of prediction in reading. Elementary English, 1975, 52, 305-311.

Spache, George. A new readability formula for primary-grade reading materials, Elementary School Journal, 1953, 53, 410-413.

Strange, Michael. The effect of orthographic anomalies upon good readers behavior, unpublished doctoral dissertation, University of Minnesota, 1976.

Weber, Rose-Marie. The study of oral reading errors: A survey of the literature, Reading Research Quarterly, 1968, 4, 96-119.

TABLE 1: Initial responses to target the altered words.

		PASSAGE 1		PASSAGE 2		BOTH PASSAGES	
Read alteration first response		Good	Poor	Good	Poor	Good	Poor
	<	64	42	56	41	120	83
	$\bar{X}$	4.26	2.80	3.73	2.73	8.0	5.53

FIGURE 1: Illustration of experimental materials.

He leaned too fan over the edge of the well.	(far)
A green frog came hopping oven the snow.	(over)
Just them an owl came down.	(then)
Each stands on its back logs and leans on its tail.	(legs)
Bill jumped off the bus and ram to the river.	(ran)