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The purpose of this study was to investigate how children who had been taught reading by different methods and who differed in reading achievement scan tachistoscopically-presented words.

Twenty second-grade children were grouped according to phonics or sight-recognition methods of initial reading acquisition and according to low or high reading achievement scores.

As four-letter stimulus words were presented tachistoscopically, electrooculograms (EOG's) were recorded for each subject. The EOG's were averaged by the use of a digital/analog minicomputer and this analog record was digitalized. Three dependent measures were obtained from these averaged records: total amount of eye movements evoked by the stimulus word, direction of the eye scan, and scanning time.

For the total amount of eye movements, it was found that both good and poor readers taught by a phonics method moved their eyes less than poor sight-recognition readers. However, good readers taught by a sight-recognition method moved their eyes less than any other group.

With reference to direction of the scan, the data shows that readers taught by a sight-recognition method initially look to the right part of the stimulus word, while those taught by a phonics system look at the left part. After this initial difference both groups scan in a left-to-right direction. No difference in scanning direction was found for reading ability.

Poor readers scanned the stimulus word longer (352 milliseconds) than good readers (224 milliseconds). No significant difference in scanning time was found for method of initial reading acquisition.

The results were discussed in terms of the differential training received under different methods of reading acquisition and the efficiency of different ability readers to find and recognize clues in reading words. Implications of the results were discussed with respect to the assessment of reading behavior.

THE DIFFERENTIAL EFFECTS OF PHONICS VERSUS SIGHT-RECOGNITION METHODS OF TEACHING READING ON THE EYE MOVEMENTS OF GOOD AND POOR SECOND-GRADE READERS

by

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CHAPTER I

INTRODUCTION

There presently exists in the United States many problems, difficulties, and confusion in the field of reading. Many problems center around the fact that, despite public education, many Americans are considered illiterate. The United States Department of Defense showed that of a sample of 20,000 men entering the Armed Forces who were high school graduates, 90% read below the eighth-grade level on standardized reading tests (Office of the Secretary of Defense, 1968). The Bureau of the Census (1963) defined as functionally illiterate "persons who were incapable of understanding the kinds of written instruction that are needed for carrying out basic military functions or tasks." In 1963 they estimated that over eight million Americans were functionally illiterate (Bureau of the Census, 1963). Harris (1970) has found that over 13% of Americans age 16 or older could not pass minimal measures of literacy. The variables contributing to the problems of reading difficulties have been much discussed.

Teacher variable. Many authors have analyzed the effect of the teacher variable in reading. Harris (1969) stated that research demonstrated that the teacher variable was by far most important in influencing the reading behavior in children. This influence outweighed even those variables of methods or materials used. The CRAFT Project (Comparing Reading Approaches in First-Grade Teaching with Disadvantaged Children), funded by the United States Office of Education, supported Harris' claim of the effect of the teacher in teaching reading. They report that "...the teacher is far more important than the method" (Harris & Morrison, 1969). Artley (1969) stated that the teacher is the most important variable in the teaching of reading, and, if reading achievement is to be improved, the emphasis must be placed on the training of reading teachers. Because of the problem of manipulating the teacher variable apart from other variables, research generally has not separated the effects due to the teacher from other confounded variables, nor has separately analyzed the teacher interaction with other variables.

Method variable. A second variable is that of the method used in initial reading acquisition. Although many methods and combinations of methods are available (cf. Chall, 1967), only two of these will be discussed in the context of the present study: sight recognition and phonics systems. The controversy over which of these two methods is more effective in teaching reading acquisition has proliferated much discussion.

The phonics method, as represented for example by the Lippincott Basic Reading Series (1962), emphasizes mainly grapheme-phoneme relationships. This approach teaches children to associate individual speech sounds (phonemes) with letters or groups of letters (graphemes). According to the phonics method, reading consists of learning these correspondences and blending them into words (Flesch, 1955).

One argument against this phonetic approach is that the English language is essentially unphonetic (Witty & Kopel, 1939). Flesch (1955) and others (Terman & Walcutt, 1958; Venezky & Weir, 1966; Wijk, 1966) counter by emphasizing that 87% of English words follow fixed phonetic rules. They state that the other 13% of phonetically irregular words can be memorized. Strang (1968) criticizes the phonetic approach because it decreases the child's curiosity about words and does not allow the child to discover the phoneme-grapheme relationship himself. She further states that the system may interfere later with the speed of reading and reading comprehension (Strang, 1968). Contradictory evidence (Bishop, 1964) has shown that people cannot induce phoneme-grapheme relationships very easily by themselves.

Sight-recognition approaches, as used for example by the Scott-Foresman Series (1965), use a "look-see" approach.

The child develops a basic vocabulary by memorizing, through constant repetitions, words that are meaningful to him in his environment. Phoneme-grapheme relationships are not specifically taught; the child must match whole words with their corresponding environmental objects or actions (Bond & Wagner, 1966).

One argument against the sight-recognition approach is that the necessity to memorize words burdens the child's memory and thus necessitates a limited vocabulary. This limited vocabulary restricts the number of words used in the basal readers of the sight-recognition series and in textbooks in other areas, producing reading material that can be basically boring.

The emphasis of the two approaches, i.e., learning phoneme-grapheme correspondences (phonics) versus learning whole words (sight recognition) has been the source of much research to determine which is more effective in initial reading acquisition.

Chall (1967) limited the effect of the teacher in reading achievement and postulated that the method used in initial reading acquisition was the most important variable. She states that the phonetic or code-emphasis approach is the most effective method when measuring phonics skills, spelling, word recognition, and oral reading. This superiority is evident as early as grade one and is maintained through at least grade four. She further reports that children at the end of first grade taught by the sight recognition approach are temporarily superior in measures of reading rate and comprehension. This superiority is lost, however, by grade two; after grade one phonetically taught children perform better on tests of comprehension, and there are no differences between children taught by the two methods on reading rate. However, even this temporary superiority by sight-recognition readers in first grade has not been substantiated by other researchers (Bliesmer & Yarborough, 1965; Bond & Dykstra, 1967), who find no significant differences on the two dependent measures of comprehension and rate for those taught by either a sight-recognition or phonetic approach.

Nelson (1972) compared the two approaches in initial reading acquisition using kindergarten children as subjects. Different children were taught reading by each of the two approaches. She found the phonics group was superior in grapheme-phoneme relationships, but the sight-recognition group was superior in word recognition. Her design permitted a separate analysis of the effect of the teacher variable. Significantly, she found no effects for the teacher variable or for the teacher variable in combination with the method variables.

Other results favor the superiority of the phonic approach over a sight-recognition approach on measures of word reading, paragraph meaning, spelling, and word study skills (Bliesmer & Yarborough, 1965; Bond & Dykstra, 1967; Dykstra, 1968).

Barr (1972) investigated the types of errors children taught by either phonics or sight-recognition methods made in word recognition. Using first-grade pupils as subjects, she found that those taught by the phonics approach made errors of non-responses or guessed words from those previously taught. Since phonics systems teach the phoneme-grapheme relationship, it appeared that the child knew those word sounds that he had been taught and did not guess as often. When he did guess, he guessed words that were similar in their phoneme-grapheme relationships to those words that he had perviously learned. Those taught by the sight-recognition method made errors by guessing from those words taught at the same time. This type of error would be expected from a child taught by a "look-guess" method (Trace, 1965). Barr concludes that her findings support the conclusions that "different instructional methods influence differentially the pattern of word recognition errors" (Barr, 1972).

Motivation variable. A third variable contributing to the reading problem is one of motivation (Staats & Staats, 1962). Whitlock and Bushell (1967) manipulated the type of reinforcement given contingent upon the reading response to determine if the motivational state of the subject could be varied. Using a six year old as a subject, they presented sentences as stimuli. Reinforcement was given by advancing a counter each time a correct response was emitted. During one phase of the study the counter alone was the reinforcer; during the second phase the subject could swap points on the counter for "back-up" reinforcers. Their results show that although the counter-alone condition produced an increase in reading responses initially, this increase was not maintained. When the back-up reinforcers were instituted the response increased greatly and was maintained throughout the remaining part of the experiment. The authors conclude that motivational states of subjects can be maintained by allowing each subject to choose his own reinforcers instead of using one chosen a priori to the experiment.

Whitlock (1966) attempted to increase the motivational level of a child considered "below normal" in reading performance by his teacher. By making reinforcement contingent upon correct reading responses, she was able to "change...his attitude toward reading" and have him return to a normal reading group in his classroom. Her results strongly suggest that the motivational state of a child can be changed by the addition of positive reinforcement for reading.

These results and others (Staats, Finley, Minke, & Wolf, 1964; Staats, Minke, Goodwin, & Landeen, 1967; Staats, Staats, Shutz, & Wolf, 1962) show that reading is affected by laws of behavior such as reinforcement and extinction. If a reader is not reinforced for reading or reinforced by reading, he will not be motivated to read. Neither the teacher variable nor the method variable will have significant effect upon his reading achievement if he does not have or is not provided with the motivation to read.

Dependent Measures

Although previous studies consistently indicate the importance of motivation in reading performance, the importance of teachers and teaching methods is less clear. Practitioners who are in positions where they must assess teacher and method variables are faced with inconsistent and confusing data. One of the reasons for this confusion may be that the reading response is in fact a construct composed of multiple measures. In response to experimental manipulation, some components of a construct change and others do not. These multiple measures, such as phonics tests, tests of oral reading skills, and tests of comprehension, etc., have been shown to be differentially sensitive to various experimental manipulations (Farr & Tuinman, 1972).

One of the purposes of the present study was to investigate eye movements as a measure of reading skill and to demonstrate the generality of this measure across the variables of teacher, method of initial reading acquisition, and motivational state of the reader. Eye movements in response to reading words, sentences, and paragraphs have already been measured by other researchers, but not as a dependent measure of reading skill (Crovitz & Shiffman, 1965; Katz & Wickland, 1971, 1972; MacNaughton, 1971; Schissler & Baratta, 1972; Taylor, 1965). Taylor (1965) specifies the following classes of eye movements made while subjects read words and sentences: (1) fixations which are stops the eyes make while scanning; (2) regressions which are movements of the eyes in a reverse direction, i.e., right-to-left; and (3) saccadic movements which are jumps from one stimulus object to another. These movements are not under precise control but occur "unconsciously" in the act of reading (Taylor, 1965). Three other aspects of eye movements that have been investigated in relation to reading are scanning ability, amount of eye movements, and the directions of eye scans.

Katz and Wickland (1971) measured whether there were differences in scanning ability between good and poor readers. They defined scanning ability as the length of time needed to read the stimulus words. They hypothesized that differences in reading ability were partly due to differences in the ability to scan words. They presented a target word tachistoscopically followed by a sentence of either two, three, or five words in length. The fifth-grade subjects were to respond "yes" if the target word was in the sentence and "no" if not. They found that good and poor readers did not differ significantly in their ability to scan words. If indeed reading ability did determine how fast a subject could scan a word then a significant effect due to reading ability should be found for different length words. Their results suggest that scanning ability of words is not an effective dependent measure in differentiating good versus poor readers.

In a follow-up study (Katz & Wickland, 1972), letters were substituted for words as stimuli, to determine whether scanning ability of letters differed among good and poor readers. They presented eight stimulus letters in a row. Subjects were to scan the row and respond "yes" or "no" depending on whether a specified target letter was present. They measured errors made by their second- and fifth-grade subjects. It was found that there were no differences in scanning ability for good and poor readers on letters. The results support the hypothesis therefore that the ability to scan words or letters is not an effective measure for differentiating between good and poor readers.

A second aspect of eye movements is the total amount of eye movements made. The total amount of eye movements made by good first-grade readers (high reading achievement) as compared to poor first-grade readers (low reading achievement) while reading paragraphs of a standardized reading test was investigated by MacNaughton (1971). Using an electronystagmograph she found that poor readers moved their eyes significantly more than good readers.

A third aspect of eye movements is the direction of the scan. Tachistoscopic studies have shown that mature adult subjects generally scan patterns of letters in a left-to-right direction. However, children may not have yet learned to scan words in this way. To determine how subjects scanned, Heron (1957) presented letters tachistoscopically to the left, right, and both retinal fields successively and simultaneously. The college-sophomore subjects were to report the letter seen. Number of errors made were recorded. He found that significantly more letters were recognized in the left field when the letters were exposed in both fields. These results support the hypothesis that the subjects were scanning from left to right.

Harcum (1970) presented a series of stimuli tachistoscopically to college students and had them record the entire series. By analyzing the errors made, he concluded that the shape of the error curve showed that subjects scanned from left to right. He also noted that the shape of this curve was very similar to serial position curves of errors in rote learning (Deese & Kresse, 1952; Harcum & Coppage, 1965). He suggested in another paper (Harcum, 1967) that perhaps the same psychological mechanism that is used in rote learning is also used in scanning words. These results strongly suggest that subjects do scan series of words, letters, and stimuli in a left-to-right direction.

Although generally subjects scan in a left-to-right direction, further studies have shown that this direction of scan can be influenced by experimental manipulations. Harcum (1965) predicted that less errors would result around a stimulus element that was isolated. He suggested that manipulating the stimulus, i.e., placing a line over and under it, could influence the scan. He presented tachistoscopically 10 circles in a row. Five of the circles were darkened and the seventh from the left was isolated. The college-student subjects were to reproduce each presentation of the stimulus event. He found, as predicted, that there was an isolation effect. Subjects made significantly less errors around the isolated element. It is worth noting that this effect was found only when subjects were informed about the isolation manipulation.

Harcum and Filion (1963) attempted to influence scan direction by manipulating the method of presenting the stimulus. Sophomore college students were presented with eight-letter stimulus words. Either sequence of the letters or orientation of the letters were reversed to try to induce a different direction of scan. They found that for some of the subjects the orientation of the stimulus letters did determine the direction of the scan.

Harcum, Hartman, and Smith (1963) tried to determine whether adult subjects could effectively change their own scan direction. They presented a line of 10 circles of which five were darkened. Four conditions were presented. Subjects were told to: (1) scan from left to right (SL); (2) scan from right to left (SR); (3) scan from the center out (SO); or (4) use any scanning method they preferred (OP). They found that when the OP condition was presented subjects chose the SL condition. The results show significantly less errors for the SL and OP conditions. They concluded that this shows that scan directions can be manipulated by experimental requirements.

The previous results suggest that although scan direction can be manipulated the most effective and most widely used scan direction is from left to right. However, a further study (Schissler & Baratta, 1972) concludes that neither a left-to-right nor right-to-left scan could account for the data obtained. They presented tachistoscopically pairs of letters either right or left of the fixation point. One letter of the pair was designated as the target letter for which the subject was to search. The other letter was considered to interfere with the search and was designated as the noise letter. The noise letter was either outside or inside of the target letter. The subjects were required to report the target letters. The number of errors made were recorded for each subject. Their results show that some subjects made more errors when the noise letter appeared farther from the fixation point, either right or left. A left-to-right or right-to-left scan cannot account for their data. To account for these results, they propose two types of scanning mechanisms: (1) a left-to-right scan that is used by some subjects who can efficiently scan words; and (2) a more primitive scan (searching from the outside -- both left and right -- toward the center of the stimulus display) used by those subjects who are less efficient in scanning. They imply that good and poor readers would scan a stimulus display differently.

Statement of the Problem

The purpose of the present study was to gain further information as to how children tachistoscopically scan words by using a digital/analog computer to analyze eye movements (Smith, Schremser, & Putz, 1971). Total amount of eye movements made while scanning, direction of the scan, and total scanning time were measured.

Eye movements have been measured by the use of special cameras. These cameras record tiny beads of light reflected from the reader's eyes. The resulting photograph allows the experimenter to analyze the three types of movements by measuring the line made.

In 1971, a new method of recording eye movements was developed. When eyes move they produce small direct current potentials. By amplifying these potentials and analyzing them with a digital/analog computer, it is possible to record very fine movements made by the eyes (Smith, Schremser, & Putz, 1971).

Subjects were placed into groups according to reading ability (good versus poor) and method of initial reading acquisition (phonics versus sight recognition). The differential effects produced by reading ability and by method on eye movements were analyzed.

The hypothesis posited by MacNaughton (1971) was investigated by measuring total amount of eye movements of subjects. It was expected that good readers would move their eyes significantly less than poor readers. Although there is a lack of research in the area, method of initial reading acquisition should produce an effect on total amount of eye movements. Because of the training which phonics readers receive, they are expected to analyze each grapheme within the word which should cause a concomitant increase in the amount of eye movements. Sight-recognition readers, on the other hand, are trained to recognize the word as a whole and should move their eyes less.

The results of previous research (Harcum, 1970; Heron, 1957) suggest that scanning direction for adult readers is generally from left to right. Since other researchers have shown that scanning direction can be manipulated (Harcum, 1965; Harcum & Filion, 1963; Harcum, Hartman, & Smith, 1963), a difference in scanning direction may result from those trained in different methods of reading acquisition. Phonics readers have been trained to functionally analyze each grapheme of the word and blend them together and should thus scan in a left-to-right direction. However, those trained by a sight-recognition approach have not had specific training in scanning and a more erratic scan was expected.

From the conclusions of Schissler and Baratta (1972), a difference in scanning direction is expected for good readers versus poor readers. Good readers should more efficiently scan and thus a left-to-right movement was expected. Poor readers may not have learned this more efficient scan, i.e., left to right, and should therefore scan more erratically.

Scanning of the stimulus presentation must continue until the subject finds the relevant cues necessary to recognize the stimulus word. The results of Katz and Wickland (1971, 1972), showed that good and poor readers do not differ in scanning ability. Since scanning "ability" implies that relevant cues can be recognized equally well by good and poor readers, no difference in scanning time between good and poor readers is expected. However, contrary to the results of Katz and Wickland (1971) it may be expected that poor readers need more time to scan because they are looking for cues to recognize the word presented.

CHAPTER II

METHOD

Experimental Design

Subjects were assigned to one of four groups according to reading ability (good versus poor) and method of initial reading acquisition (phonics versus sight recognition). Subjects were nested in both reading ability and method. Four replications were done for each subject. Within each replication, measures were taken every 32 milliseconds. Dependent measures included the total amount of eye movements made, the direction of the eye scans, and the total scanning time.

Subject Selection

The subjects in this study consisted of 40 white, second-grade children from four private schools in the Greensboro, North Carolina area. In order to identify children who were good and poor readers, all of the children currently enrolled in the second grade of these schools ($N = 96$) were administered the New Developmental Reading Test (Lyons & Carnahan, 1965). This test consists of three parts: Word Recognition; Comprehension of Significant Ideas; and Comprehension of Specific Instructions. It was selected for the following reasons: (1) it tests a broad range of abilities so that a general reading score may be obtained; (2) the testing time required is suitable for second-grade children; (3) this test can be easily administered in a group situation; and (4) reviewers rate this test highly in Mental Measurement Yearbook -- Seventh Edition (Buros, 1972). The testing was carried out in the children's classroom by the author.

The four schools that participated in this study were selected because of the method used to teach the children initial reading acquisition. Two of the four schools used the sight-recognition method as represented by the Ginn 360 Series (1966) and the MacMillan Series (1961). The two other schools used the phonics method, as represented by the Lippincott Basic Reader Series (1962) and the Open Court Series (1967) (Chall, 1967). The four schools chosen were matched for geographical location and for religious affiliation, although there is no research to show the effect of these variables on reading achievement.

The New Developmental Reading Test (Lyons & Carnahan, 1965) produces three different scores, namely Word Recognition, Comprehension of Significant Ideas, and Comprehension of Specific Instructions. The average of the three grade scores gives the general grade norm of the child.

On the basis of this average score, children taught by each method were assigned high or low reading achievement levels. Of the 47 children taught by the phonics method and the 49 children taught by the sight recognition method, those scores greater than the 80th percentile were designated as high reading achievement, and those scores less than or equal to the 20th percentile as low reading achievement.

The parents of each selected child were contacted by letter, describing to them the study and requesting them to permit their child to participate in the study. The parents gave or refused their permission in writing [see Appendix A]. If a parent refused permission to include his child in the study, then the next highest (or lowest) score was used within the percentile range designated. Only one originally-selected subject was replaced due to lack of parental permission to include their child in this study. Initially there were eight subjects in the high-achievement phonics group (five females and three males), 12 subjects in the low-achievement phonics group (seven females and five males), seven subjects in the high-achivement sight-recognition group (four males and three females), and 13 subjects in the low-achievement sight-recognition group (seven females and six males).

From this pool, without restriction as to sex, five children were randomly selected for each of the final subject groups: phonics method and high reading achievement (three females and two males); phonics method and low reading achievement (three females and two males); sight-recognition method and high reading achievement (three males and two females); and sight-recognition method and low reading achievement (three females and two males).

Stimulus Materials

Stimulus slides were prepared by photographing with a Rolex 35mm single-lens camera, 20 words in black letters against a white background. These photographs were then developed and four copies of each stimulus word were printed. Sixty four-letter stimulus words of a consonant-vowel-consonant-consonant type were selected from the Lorge-Thorndike list (Thorndike & Lorge, 1944) of highest frequency in the English language (A and AA) and were judged by at least three of four raters to be meaningful to second graders [see Appendix B]. Four classroom teachers in the schools from which the subjects were chosen served as judges of the stimulus words. From this pool of 60 words, 20 were randomly chosen to be the stimuli. These can be found in Appendix C. These slides were back projected onto a square surface of translucent plastic that measured 20.3 centimeters by 7.6 centimeters and was 20 centimeters from the subject. A Kodak Carousel Constant

Illumination Tachistoscope model 750 was used to present the displays. This apparatus allowed the illumination level to remain constant and for the fixation point to go off when the stimulus presentation came on.

Each stimulus slide consisted of one four-letter stimulus word which when back projected would subtend a 3^{o} visual angle. This visual angle is within $\pm.5^{o}$ of that angle the child would encounter while reading his school books. The stimulus screen was 20 centimeters from the subject's eyes. A fixation point which was 1 centimeter in diameter was situated in the center of the screen.

Electrooculograms (EOG's)

Electrooculograms (EOG's) were recorded by two Grass gold disc electrodes placed paraorbitally on the temporal edge of the eye of each subject. The electrodes were placed to record only horizontal movements, which were most relevant to the task. The EOG's were amplified by means of a Grass Model #79 polygraph. The electrical potentials were initially amplified by a Grass D. C. low level pre-amplifier, Model #7P1 and then by a Grass D. C. driver-amplifier, Model #7DA. The high frequency attenuator was set at 35 cycles per second. After amplification the EOG's were recorded directly onto FM tape. The computer was triggered by an impulse on the tape made by electronic equipment as each word was presented. When an EOG is signal averaged, much of the error variance within the EOG, i.e., random electrical potentials, is reduced and allows the signal to emerge. This averaged signal is a composite of the EOG's obtained from presentations of each stimulus word.

Experimenters

The author and an assistant served as experimenters. The assistant, who was a female college graduate, conducted the preliminary sessions with each subject and sat beside each subject to insure that all directions were followed. The experimenter, a graduate student in psychology, managed the physiological equipment and ensured that eye movements were recorded from each subject.

Procedure

The subjects were brought to the laboratory by the parents. Initially, to allay the child's fears, a tour of the facility and of the equipment was given.

A preliminary session was run in order to ensure that the stimulus words were familiar to each child. In this session, each was asked to read the list of 20 stimulus words. Those words not known to the subject were taught by saying, "This word is ______." All the words were taught in this manner until the criterion level was reached. The criterion level was two correct recitations of the stimulus word list [see Appendix D]. Nearly all the subjects were familiar with the stimulus words, and with only one subject (poor sight-recognition group) was it necessary to recite the stimulus list a third time. When each subject reached the criterion level, he then proceeded to the experimental room.

Each subject was seated with electrodes attached paraorbitally; he was told to rest his chin on a pedestal and to hold it very steady. He was instructed not to move his head when the stimulus was presented but only to move his eyes. This instruction attempted to ensure that the child would remain the same distance from the projection screen during all four blocks; that all subjects would be equidistant from the projection screen thus subtending the same visual angle; and that each subject's head would remain steady during the stimulus presentation. The subject was then read additional instructions [see Appendix E]. He was again told to "look at" the black square in the center of the stimulus screen and to keep "as still as possible without moving his head."

Four practice slides, consisting of four-letter stimulus words of the consonant-vowel-consonant-consonant type, which were not included among the final stimulus words, were presented prior to the experimental session in order to familiarize the subject with the task and to confirm that the instructions were well understood. The experimental session then began. The stimulus slides were presented for 500 milliseconds with a 10-second interval between each display. Each subject was shown four blocks of stimulus words (20 words per block). The 20 words were presented four times in random orders to determine if there was an effect of repeated exposure to the words upon direction of eye movements, scanning time, and total eye movements. Five seconds after stimulus presentation, the subject was asked to report the word that had been presented. If the subject did not respond orally when asked, the experimenter would have told the subject the word and then presented the next word. All subjects were able to correctly report all stimulus words presented.

At the end of each block of 20 words, a 5-minute rest period was given to try to ensure that the subject would remain motivated and attend to the stimulus display. The experimental session lasted approximately 60 minutes.

Dependent Measures

The eye movements were averaged within each block across the 20 stimulus words by the minicomputer producing four averaged EOG records for each subject. Three dependent measures were obtained from these averaged records: total amount of eye movements evoked by the stimulus word, direction of the eye scan, and scanning time.

Total amount of evoked eye movements was calculated by taking the absolute integral of the averaged EOG record after the onset of the word for each observation for each subject. Integral measures were obtained for time intervals of (1) 0 to 128 milliseconds; (2) 0 to 224 milliseconds; and (3) 0 to 500 milliseconds. Each subject had four scores for each time interval considered.

Direction of the scan was calculated by the amplitude of the EOG record at 17 different times. The initial measure was at 0 milliseconds (baseline) and every 32 milliseconds thereafter. To determine changes in eye movements, these amplitude measures were transformed to difference scores by subtracting the previous amplitude from the next amplitude. This transformation gave direction of the eye movement at different times in the total reading scan.

Scanning time was determined by analyzing the EOG at the same 17 different latencies. When no more significant differences were found in the amplitudes of the EOG the subjects had stopped moving their eyes. At this point the scan of the stimulus presentation was completed.

CHAPTER III

RESULTS

Total Amount of Eye Movements

One purpose of this study was to investigate the total amount of eye movements made by good and poor readers taught acquisition by either a sight-recognition method or by a phonics method. Four replications, using four different blocks of stimuli, were made for each subject. Within each replication, three separate time intervals, to be described below, were analyzed. For each interval, three-way analyses of variance (Method X Reading Ability X Blocks) were done. The effect of blocks was non-significant in each interval so the data were collapsed and reanalyzed as a 2x2 analysis of variance (Method X Reading Ability) for each interval. These results are reported below.

Data taken from each subject were analyzed at three different time intervals. It has been pointed out that very efficient readers take approximately 120 milliseconds to scan a word (Taylor, 1965). Thus the interval from 0 to 128 milliseconds was analyzed. Approximately another 100 milliseconds was then allowed for those not as efficient in scanning, and a second interval from 0 to 224 milliseconds was analyzed. A third interval of 0 to 500 milliseconds was analyzed as it was the total presentation time of each stimulus.

As can be noted in Table 1, the analysis of variance for time interval 0 to 128 milliseconds showed no significant differences between either method of initial reading acquisition or reading ability, or the interaction of these two variables. Figure 1 shows that although poor sight-recognition readers moved their eyes more than poor phonics readers during this interval of the scan, the difference was not significant.

Table 2 shows the results of an analysis of variance performed on the time interval 0 to 224 milliseconds. A significant difference was found in amount of eye movements both for reading ability ($F = 23.455$; $df = 1, 16$; $p < .01$) and for the interaction of reading ability and method of initial reading acquisition ($F = 11.052$; $df = 1, 16$; $p < .01$).

As can be noted in Figure 2, poor sight-recognition readers moved their eyes more than either good readers taught by either method or poor phonics readers. A Newman-Keuls post hoc analysis showed these differences to be significant ($p < .05$). The post hoc analysis further revealed that, for this time interval, good readers taught by either method did not significantly differ from each other or from poor phonics readers in total amount of eye movements.

Table 3 presents the results of an analysis of variance performed on the time interval 0 to 500 milliseconds. Significant differences were found for reading ability (F = 12.309; df = 1,16; $p < .01$) and for the interaction of reading ability and method of initial reading acquisition (F = 10.755; df = 1, 16; $p < .01$).

As can be seen in Figure 3 and as determined by a Newman-Keuls test, poor sight-recognition readers moved their eyes significantly more ($p < .05$) than good readers taught by either method or than poor readers taught by the phonics system. Post hoc tests also showed that the total amount of eye movements of good phonics readers was not significantly different than poor phonics readers; however, both groups showed more total eye movements than good sight-recognition readers.

Direction of the Scan

A second purpose of the study was to investigate the direction of the scanning movements made by good and poor readers taught initial reading acquisition by either a sight-recognition method or by a phonics method. An amplitude measure of the averaged EOG was taken at latencies of every 32 milliseconds from 0 to 500 milliseconds. These data were transformed into difference scores so that directionality could be assessed. Subjects were provided with a fixation point to enable them to focus at the center of each stimulus presentation. A movement of the eyes initially to the left meant the subject was moving to the left of the stimulus word. A leftward movement caused a positive change in the difference score. An initial rightward movement of the eyes meant that the subject was moving to the right part of the stimulus word. A rightward movement caused the difference score to move in a negative direction. Replications were again made for four different blocks of stimuli for each subject. There were no significant differences between blocks of stimuli at any of the 17 different latencies from 0 to 500 milliseconds; therefore, the data were collapsed across blocks. The 17 32-millisecond intervals were grouped into three larger time intervals as previously discussed. Three, three-way analyses of variance (Method X Reading Ability X Latency) were performed on the data.

Directionality from 0 to 128 milliseconds. Table 4 shows that during this period a significant difference was found for method of initial reading acquisition ($F = 8.03$; $df = 1, 16$; $p < .05$). A significant effect was also found for latency ($F = 5.05$; $df = 3, 48$; $p < .01$). A post hoc Newman-Keuls shows that at latencies 32 and 64 milliseconds, phonics readers moved their eyes significantly differently than sight-recognition readers. As can be seen in Figure 4 from 0 to 32 milliseconds, phonics readers moved their eyes to the left part of the word, while sight-recognition readers moved their eyes to the right part of the word. At 64 milliseconds, while phonics readers did not significantly move their eyes in either direction, sight-recognition readers moved their eyes significantly to the right. At latencies 96 and 128 milliseconds both phonics and sight-recognition readers moved their eyes to the left.

Directionality from 128 to 224 milliseconds. As can be noted in Table 5, during this period, significant differences were found for reading ability (F = 6.588; df = 1, 16; $p < .05$), latency (F = 4.224; df = 6, 96; $p < .01$), and for the interaction of reading ability X latency (F = 3.880; df = 6, 96; $p < .01$).

Newman-Keuls post hoc analysis revealed that significant differences were found at 160 and 192 milliseconds. Figure 5 shows that at 160 milliseconds poor readers moved their eyes to the right while good readers showed no significant movement. At 192 milliseconds poor readers moved their eyes sharply to the right while good readers slightly moved to the right.

Directionality from 224 to 500 milliseconds. Table 6 shows that during this period significant differences were found for reading ability (F = 5.349; df = 1, 16, $p < .05$), latencies (F = 2.987; df = 15, 240; $p < .01$), and for the interaction between reading ability and latency (F = 3.240; df = 15, 240; $p < .01$).

Newman-Keuls post hoc analysis shows that significant differences were found at latencies of 256, 288, and 320 milliseconds. Figure 5 shows that at 256 milliseconds good readers moved their eyes slightly to the left while poor readers moved sharply to the left. At 288 milliseconds, while good readers showed no significant movement, poor readers continued the movement to the left. At 320 milliseconds, while again good readers showed no significant movement, poor readers moved their eyes significantly to the right. From 320 milliseconds to 500 milliseconds neither good nor poor readers moved their eyes significantly.

In summary, it appears that phonics readers starting at fixation, initially move to the left, while sight-recognition readers, starting at fixation, move to the right and then both oscillate from left to right approximately every 100 milliseconds, as shown in Figure 6.

Total Scanning Time

A third purpose of the study was to determine total scanning time. As demonstrated by Tables 4, 5 and 6 and determined by Newman-Keuls post hoc analysis on the interaction, no significant differences were found for method of initial reading acquisition in scanning time. When there are no significant differences in difference scores then the eyes have stopped their scanning movements. Thus, an analysis of the EOG (Figure 5) and post hoc analysis of the amplitude difference scores showed that from 224 milliseconds to 500 milliseconds no significant differences were found in amplitude measures for good readers. It appears that good readers tended to scan the stimulus presentation within 224 milliseconds. Poor readers tended to scan the stimulus presentation for approximately 352 milliseconds, at which time no further significant differences were found in the amplitude measures.

CHAPTER IV

DISCUSSION

Total Amount of Eye Movements

It was expected that good readers would move their eyes significantly less than poor readers (MacNaughton, 1971). Also because phonics readers were taught to analyze each grapheme of the word and sight-recognition readers are taught to view the word as a whole, it was expected that phonics readers would move their eyes significantly more than sight-recognition readers. The results of this study are generally consistent with those expected. It was interesting that these results were obtained, however, only by measuring the amount of eye movements at different times in the reading scan.

It appears that during the first 128 milliseconds of the scan neither reading ability nor method of reading acquisition has any effect on the amount of eye movements made. However, from this latency onward differential effects are found for both variables.

By measuring from time of presentation to 224 milliseconds an effect due to method of initial reading acquisition and reading ability became evident. Phonics readers moved their eyes significantly less than poor sight-recognition readers; however, unexpectedly, there was no significant difference in total amount of movement between phonics readers and good sight-recognition readers. A possible reason may be that the eye movement of good sight-recognition readers was of a different waveform than that of phonics readers. Because the absolute integral was used to determine the amount of movement, it would not be sensitive to these different waveforms of the EOG and thus would show the same amount of movement. A second explanation can be posited in terms of the time interval measured. Good sight-recognition and poor and good phonics readers had scanned the word at least once by this time. Good sight-recognition readers looked at the word and knew it by shape or some other relevant clue. Since the sight-recognition approach is also called the whole word method, these readers were not trained to break each word into chunks and thus less movement was necessary. Poor and good phonics readers has also scanned the word, had noted the graphemes, and were attempting to match these with the corresponding phonemes. However, poor sight-recognition readers, after scanning, did not know the word and continued to scan, searching for further clues to identify it. This further scanning would lead to a concomitant increase in total amount of eye movements.

When the analysis was extended to include the entire presentation of the stimulus material, i.e., 0 to 500 milliseconds, the results were consistent with the earlier discussion except that good sight-recognition readers moved their eyes significantly less than good or poor phonics readers and poor sight-recognition readers. An extension of the above hypothesis can be posited to explain this new result. While poor sight-recognition readers continued to scan to obtain further clues, good sight-recognition readers had obtained all the clues needed to identify and had stopped scanning. Phonics readers, however, scanned the graphemes again to blend them into a word. This caused an increase in the amount of eye movements. However, after blending these graphemes into a word, it was no longer necessary to continue scanning; thus their amount of eye movements would not be as large as poor sight-recognition readers.

This hypothesis is consistent with the technique used by the two methods of individual reading acquisition. Phonics readers are taught to scan for graphemes, match these graphemes with phonemes, and to then blend the phonemes into a word. Readers taught this method would therefore move their eyes to search for graphemes, stop moving to match graphemes with corresponding phonemes, and then move their eyes again to blend the phonemes into words. This is what appeared to occur.

Sight-recognition readers however are not taught to scan for graphemes. They search for clues in the whole word that will allow them to recognize it. Good sight-recognition readers appear to find and recognize clues faster and thus stopped searching, resulting in a small amount of eye movements. In contrast, poor sight-recognition readers must continue to scan until a significant clue is found or recognized. This continued searching would account for the significant increase in amount of eye movements.

Direction of the Reading Scan

It was expected that because of the training phonics readers received, they would move their eyes in a left-to-right scan while sight-recognition readers who received no training in scanning would move their eyes more erratically. Also good readers were expected to use a more efficient left-to-right scan while poor readers who had not learned this more efficient scan would be more erratic (Schissler & Baratta, 1972). The results obtained with this dependent measure were generally consistent with these expectations. However, differential results were obtained by analyzing the data for different time periods. Subjects were initially fixating on the center of the stimulus presentation. An initial movement to the left meant the subjects were moving their eyes to the left part of the word. An initial rightward movement meant the subject was moving to the right part of the word.

From time of presentation to 128 milliseconds, there was no significant effect due to reading ability. Both good and poor readers generally scanned the word from left to right. However a significant difference was found for method of reading acquisition. Phonics readers and sight-recognition readers start the scan of the stimulus words differently. As expected, phonics readers initially moved their eyes to the left part of the word to begin the scan. Sight-recognition readers, however, initially moved their eyes to the right part of the word. These results are consistent with those of Marchbanks and Levin (1956). In their study, beginning readers were shown words tachistoscopically. They were then asked to pick a word from a list that was most like the stimulus word. Using this method, it was possible to determine which word recognition clues were most relevant. They found that the strongest clues used by the subjects were the first and last letters of the stimulus word. Subjects, therefore, initially scanned either the left or the right parts of the word. These results are also expected in terms of the training received by these two groups in reading acquisition.

Phonics readers must scan for graphemes. A left-to-right scan is the most efficient scan if the word is to be recognized. However, sight-recognition readers are not trained to scan in any specific direction and a right movement could produce as many clues as moving to the left. It was surprising that sight-recognition readers consistently searched to the right first. This may be explained in terms of a generalization effect. When reading lines of print, readers must go from the left part of the page to the right. Since no specific scanning mechanism has been taught then this learned behavior seemed to control the direction of the scan.

Initially fixating at the center of the word, sight-recognition readers moved to the right, secondly moved to the left part of the word and thereafter scanned the same as phonics readers, that is, from left to right, as in reading sentences.

An analysis of the data obtained from the remaining scan period found significant results for reading ability and latency. The effect of method of reading acquisition no longer affected the scanning mechanism. These results suggest that after an initial rightward movement, sight-recognition readers scan in a left-to-right direction, the same as phonics readers.

Total Scanning Time

Because reading ability does not exert a significant effect on the ability to scan words or letters (Katz & Wickland, 1971, 1972), which infers that relevant clues can be recognized equally well by good or poor readers, it was expected that no differences would be found in scanning time of the stimulus presentation due to reading ability. The results of this dependent measure are inconsistent with this expectation. Good readers did scan for much less time than poor readers. Good readers recognized the word earlier and very little further scanning was necessary. Poor readers were still searching the entire stimulus display for further information to identify the stimulus word. By 224 milliseconds, good readers no longer moved their eyes in any significant direction, while poor readers continued their left-to-right scan until 352 milliseconds. This would suggest that there is a significant difference in scanning time for good and poor readers contrary to Katz and Wickland (1971, 1972) who did not find this difference. Good readers stopped their scan of the stimulus word at 224 milliseconds, while poor readers continued to scan for 352 milliseoncds.

The hypothesis of Schissler and Baratta (1972), who suggested two types of scanning mechanisms, does not seem to be supported. Although good readers do scan in a left-to-right direction the results of this study suggest that poor readers do not scan differently but only longer.

Conclusions

Implications of this study are relevant to the assessment of reading behavior. Although total amount of eye movements made while reading words are sensitive to both method of initial reading acquisition and reading ability, direction of the scan is sensitive only to method of initial reading acquisition; and total scanning time, only to reading ability. Those taught by sight-recognition approaches did initially scan words differently than those taught by a phonics method. Poor readers took more time scanning words than did good readers.

One purpose of this study was to validate a dependent measure across variables of method of reading acquisition, teacher, and motivational states. The measure found in this study to be consistent across these three variables was total scanning time. More research is needed to replicate these results for good and poor readers taught by other methods of initial reading acquisition besides phonics and sight-recognition approaches. If it is found that total scanning time is sensitive to reading achievement, without interacting with method of initial reading acquisition, then it can be used as a dependent measure to assess the influence of other variables on reading achievement.

Limitations

The results of the present study are limited to the population of subjects studied, the stimulus words used, the methods of reading acquisition used by the schools, and the reading test that determined each subject's reading ability. More research is needed manipulating all of the above factors to determine the generalizability of the results obtained to other populations of school-age children, other stimulus words, other methods of teaching reading, and other reading achievement tests.

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APPENDIX A

Letter to Parents and Permission Form

September 17, 1973

(Name &
Address of
Parent)

Dear

Throughout the years there has been much controversy in the field of the teaching of reading. Educators have been trying to find those factors that effect both beginning reading and later reading achievement.

Many factors have been found to exert an influence in reading acquisition. One factor which has yet to be resolved is the specific method used to teach reading. What this project is trying to determine is the differential effectiveness of various methods used in reading programs.

With the great scientific technology present in the United States, a better measure of reading ability has evolved. Because of the great advances in computer technology, we now have an effective method to use in assessing your child's performance. This tool we are using is similar to those used by medical doctors when they measure brain functioning. The tool is called the electroencephalogram, generally abbreviated EEG. We are now using this same tool with normal children to assess their reading progress.

Your child   has been carefully selected to participate in this project because he is in a special group of readers. Because your specific child is invaluable to this study, we are encouraging you to cooperate by giving your permission for your child's participation.

The procedures we are using have been scientifically proven to be very valuable in assessing individuals in an effective manner. This procedure involves a presentation of a series of words on a screen for a short period of time. The only task requested of your child is that the words be said aloud. By letting the computer measure both the eye movements your child makes in reading each word and the response his brain makes to each word, we can achieve our goal and help in the assessment of your child's reading ability.

September 17, 1973
Page 2

The process is fairly short, taking no more than one hour at our facilities. We would like to stress that you are invited and encouraged to come with your child and watch the entire procedure.

Computers have been found to be very useful in our society. We hopefully have found a procedure in which computers can assist your individual child.

We will be in contact with you within the next few days to more fully explain the procedures we are using. As you wish, we could meet with you either at the school, the university, or at your home in order to discuss how this project will help your child.

We hope we can include your child in our study. We know it will be beneficial both to him and to other children in determining any reading difficulties which may exist. Thank you.

Sincerely,

Rosemery Nelson, Ph.D.
Assistant Professor

Arthur Peoples
Clinical Psychology
Intern

Parental Permission Form

Please check the appropriate box and return this slip to:

Mr. Arthur Peoples
Department of Psychology
UNC-G
Greensboro, N. C. 27412

_____ I am interested in this project and give permission to include my child ______________________________ in your study.

_____ I am interested in this project but would like further information. Please contact me. The most opportune time would be during the _____ day or _____ evening, at this phone number _______________.

_____ I don't wish to include my child in this project.

Signed ___________________________________

____

Address ___________________________________

APPENDIX B

Summary of Judges Report on Stimulus Words

	Number of Judges of Four That Rated Stimulus Meaningful to Second-Grade Pupils
BAND	4
BIRD	4
LAND	4
FIND	3
GIRL	3
FAST	4
FARM	4
SICK	3
DARK	4
SING	4
HURT	3
DESK	4
SALT	3
SAND	4
CAMP	3
CENT	4
MILK	4
REST	3
HARD	3
HAND	4

APPENDIX C

Stimulus Words and Sequence of Presentation

BLOCK I		BLOCK II		BLOCK III		BLOCK IV	
HARD	___	GIRL	___	MILK	___	SICK	___
HAND	___	BAND	___	FAST	___	HURT	___
BAND	___	LAND	___	CAMP	___	HARD	___
BIRD	___	FIND	___	SICK	___	LAND	___
LAND	___	FAST	___	DESK	___	DARK	___
FIND	___	SAND	___	DARK	___	DESK	___
GIRL	___	HARD	___	LAND	___	BIRD	___
FAST	___	FARM	___	SALT	___	SALT	___
FARM	___	BIRD	___	HAND	___	GIRL	___
SICK	___	HAND	___	REST	___	CAMP	___
DARK	___	SICK	___	FIND	___	FIND	___
SING	___	HURT	___	HARD	___	HAND	___
HURT	___	CENT	___	GIRL	___	SAND	___
DESK	___	REST	___	BAND	___	SING	___
SALT	___	MILK	___	SAND	___	CENT	___
SAND	___	DARK	___	CENT	___	FAST	___
CAMP	___	SING	___	HURT	___	MILK	___
CENT	___	SALT	___	SING	___	BAND	___
MILK	___	CAMP	___	FARM	___	REST	___
REST	___	DESK	___	REST	___	FARM	___

APPENDIX D

Data Sheet for Preliminary Session

NAME ____________________ DATE __________

INITIAL READING METHOD __________ SCHOOL __________

LEVEL OF READING ABILITY: GOOD _____

POOR _____

WORD	PRESENTATIONS	TOTAL
1. Hard		
2. Hand		
3. Band		
4. Bird		
5. Land		
6. Find		
7. Girl		
8. Fast		
9. Farm		
10 - 20...		

TOTAL = ____________

APPENDIX E

Additional Instructions to Subjects

(Child's name) I want you to look at that screen in front of you. There is a black square in the center. When we start I want you to keep looking at that black square and not look away. You will see it go out. When it goes out you will see a word. I want you to read the word to yourself. I will ask you the word. Do not say the word until I ask you. If you don't know what it is, say you don't know it.

Then we will do it again. The black square will come on again. You will look at it and when it goes out read the new word that you see. We will do this for a lot of different words.

I want you to sit as still as you can and not move around and keep your head steady without moving it. When the word comes on just move your eyes, not your head. If you get really tired tell me and we will take a rest. Your mom and dad will be right here with me, so do the best you can and don't worry.

Do you understand everything okay? Do you have any questions?

APPENDIX F

Tables and Figures

TABLE 1

Analysis of Variance for Amount of Eye Movements

from 0 to 128 Milliseconds

Source	df	MS	F
Between Ss			
Method	1	.1014E5	.932
Reading Ability	1	.1214E5	1.117
Method X Reading Ability	1	.1143E5	1.051
Error	16	.1087E5	

TABLE 2

Analysis of Variance for Amount of Eye Movements

from 0 to 224 Milliseconds

Source	df	MS	F
Between Ss			
Method	1	.2004E6	1.429
Reading Ability	1	.3143E7	23.455**
Method X Reading Ability	1	.1481E7	11.052**
Error	16	.1340E6	

**$p < .01$

TABLE 3

Analysis of Variance for Amount of Eye Movements from 0 to 500 Milliseconds

Source	df	MS	F
Between Ss			
Method	1	.1480E8	1.401
Reading Ability	1	.1300E9	12.309**
Method X Reading Ability	1	.1138E9	10.775**
Error	16	.1056E8	

**$p < .01$

TABLE 4

Analysis of Variance for Amplitude Differences (Directionality) from 0 to 128 Milliseconds

Source	df	MS	F
Between Ss			
Method	1	1264.05	8.03*
Reading Ability	1	110.45	.70
Method X Reading Ability	1	101.25	.6432
Error	16	157.42	
Within Ss			
Latencies	3	383.28	5.05**
Method X Latency	3	48.55	.64
Reading Ability X Latency	3	105.15	1.39
Method X Reading Ability X Latency	3	72.15	.95
Error	48	75.92	

*$p < .05$
**$p < .01$

TABLE 5

Analysis of Variance for Amplitude Differences (Directionality) from 128 to 224 Milliseconds

Source	df	MS	F
Between Ss			
Method	1	475.46	.214
Reading Ability	1	14647.31	6.588*
Method X Reading Ability	1	2889.26	1.299
Error	16	2223.41	
Within Ss			
Latency	6	4891.74	4.224**
Method X Latency	6	1841.42	1.590
Reading Ability X Latency	6	4493.70	3.880**
Method X Reading Ability X Latency	6	1967.31	1.699
Error	96	1158.14	

*$p < .05$
**$p < .01$

TABLE 6

Analysis of Variance for Amplitude Differences

(Directionality) from 224 to 500 Milliseconds

Source	df	MS	F
Between Ss			
Method	1	151.25	.221
Reading Ability	1	3645.00	5.349*
Method X Reading Ability	1	720.00	1.057
Error	16	681.50	
Within Ss			
Latency	15	2749.35	2.987**
Method X Latency	15	1166.79	1.268
Reading Ability X Latency	15	2982.19	3.240**
Method X Reading Ability X Latency	15	1449.60	1.57
Error	240	920.39	

$*p \leq .05$
$**p \leq .01$

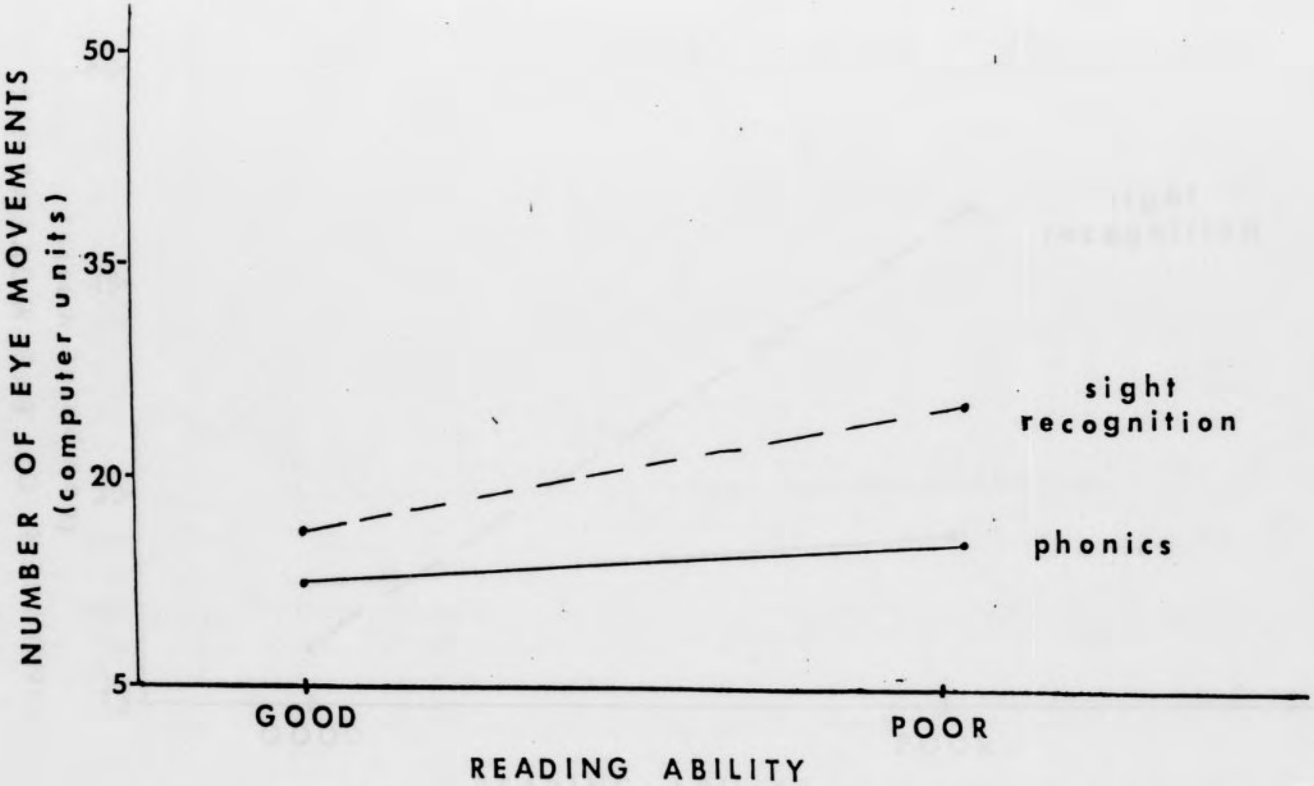

Figure 1. Total Amount of Eye Movements as a Function of Method and Reading Ability from Zero to 128 Milliseconds.

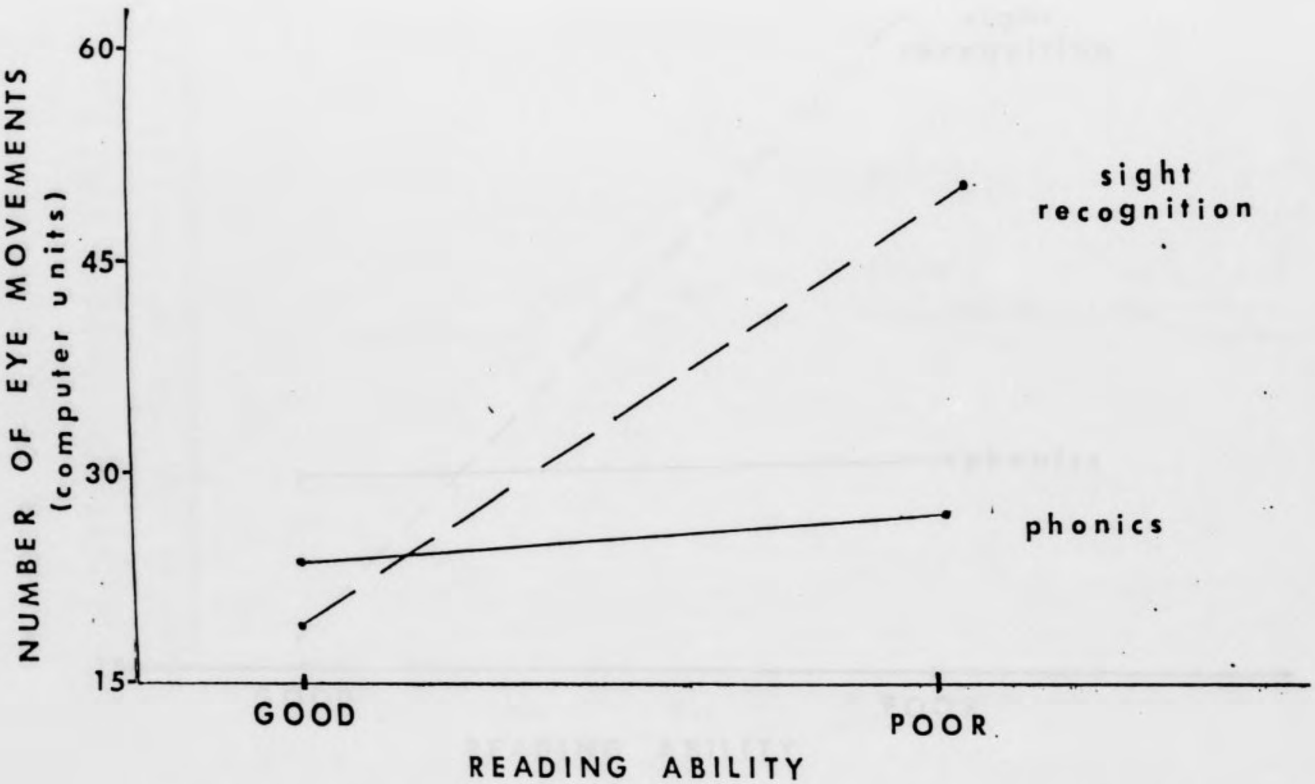

Figure 2. Total Amount of Eye Movements as a Function of Method and Reading Ability from Zero to 224 Milliseconds.

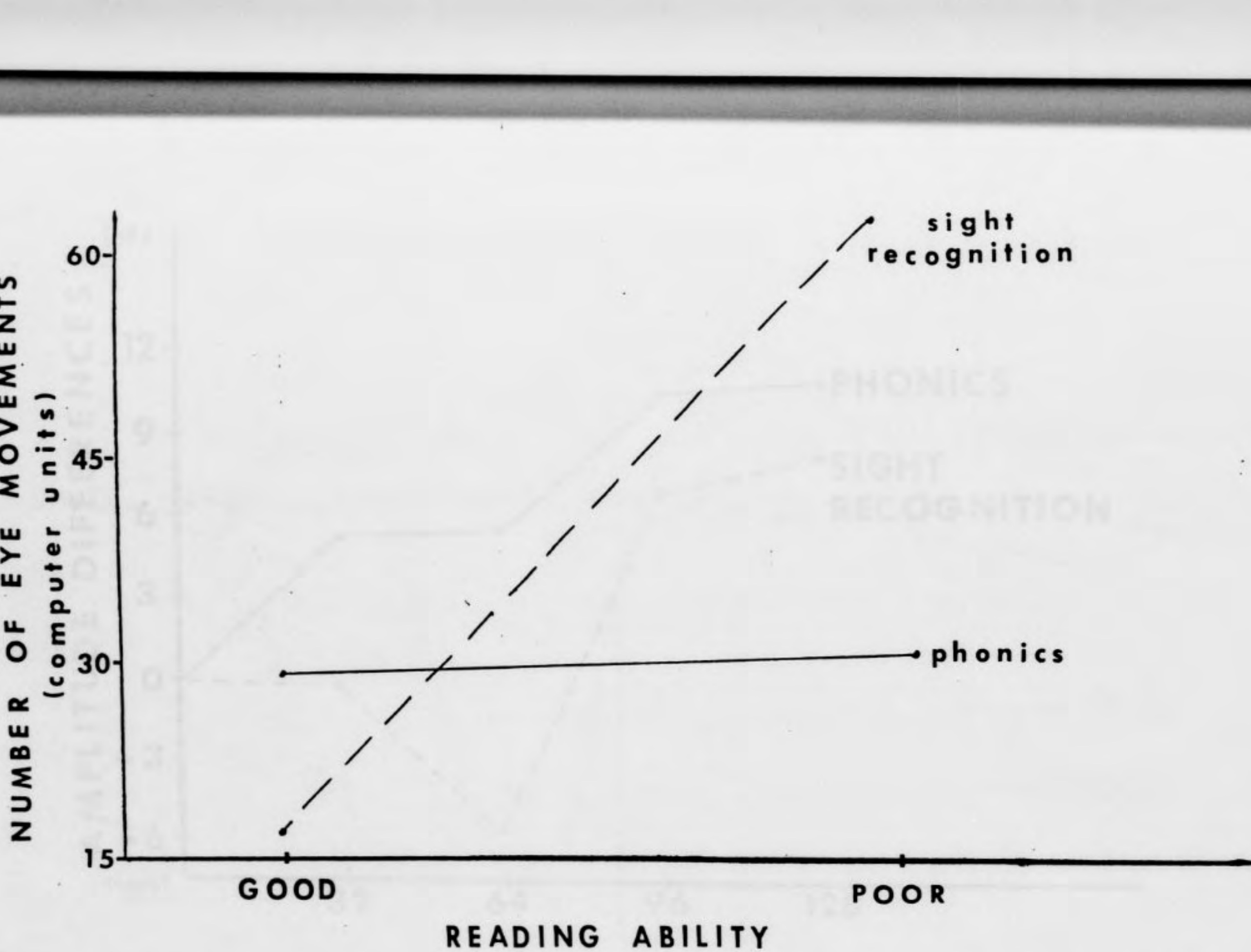

Figure 3. Total Amount of Eye Movements as a Function of Method and Reading Ability from Zero to 500 Milliseconds.

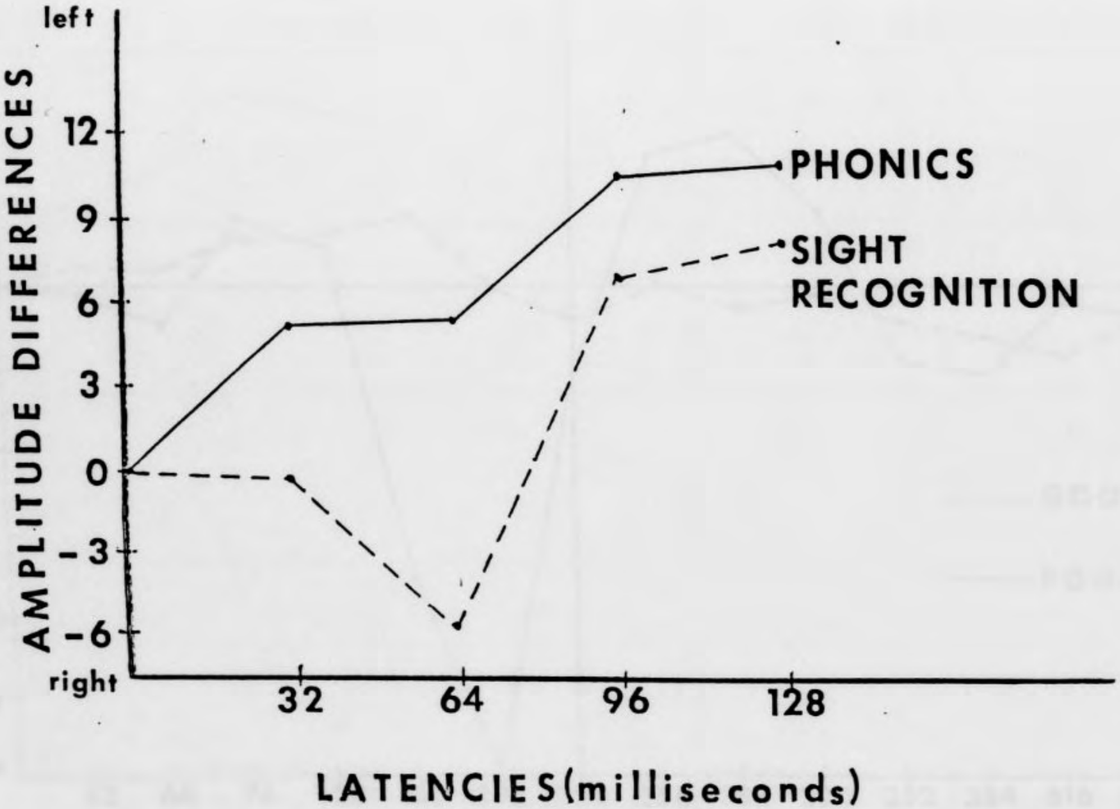

Figure 4. Direction of Eye Movements by Reading Ability from Zero to 128 Milliseconds.

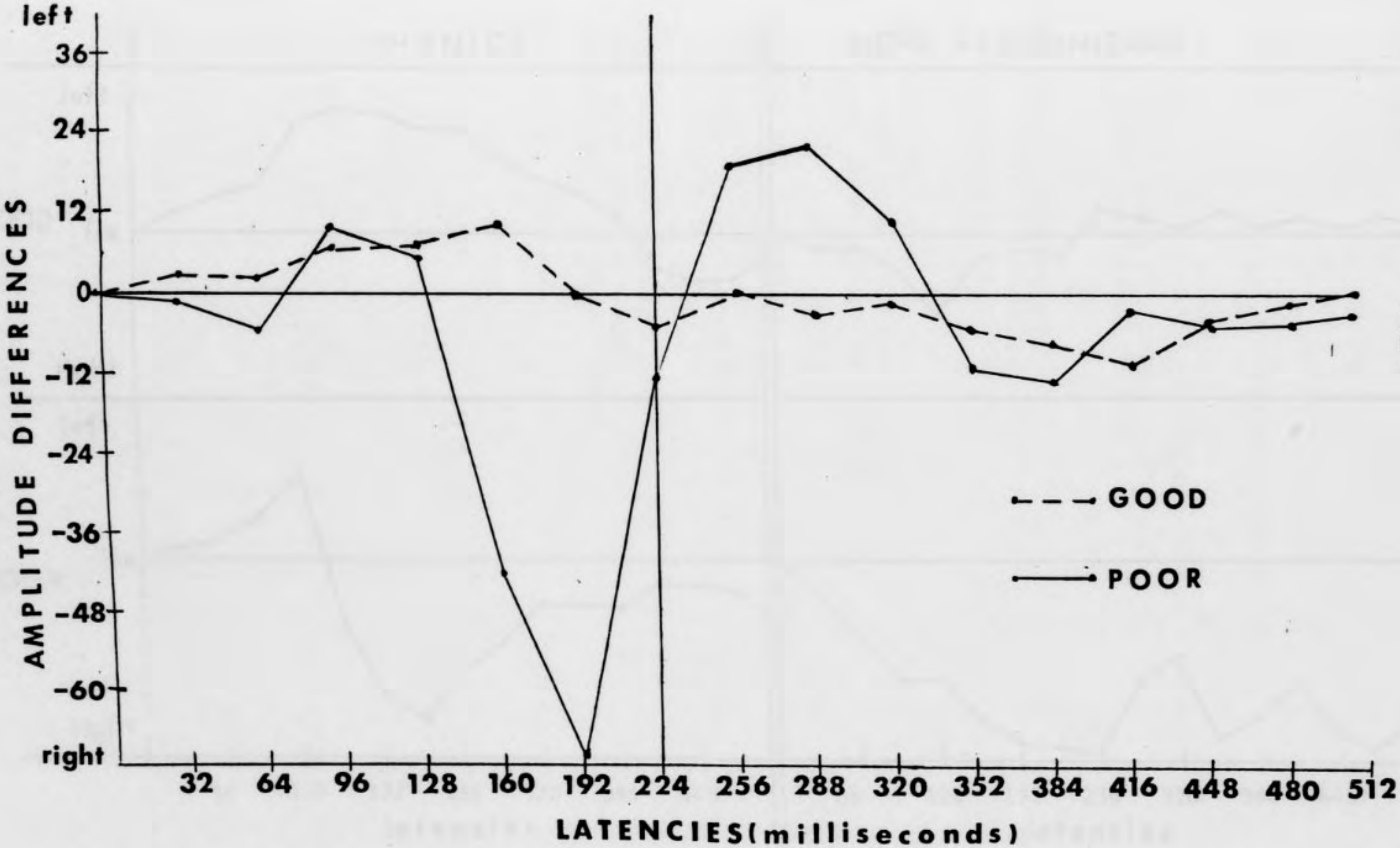

Figure 5. Direction of Eye Movements by Reading Ability from Zero to 500 Milliseconds.

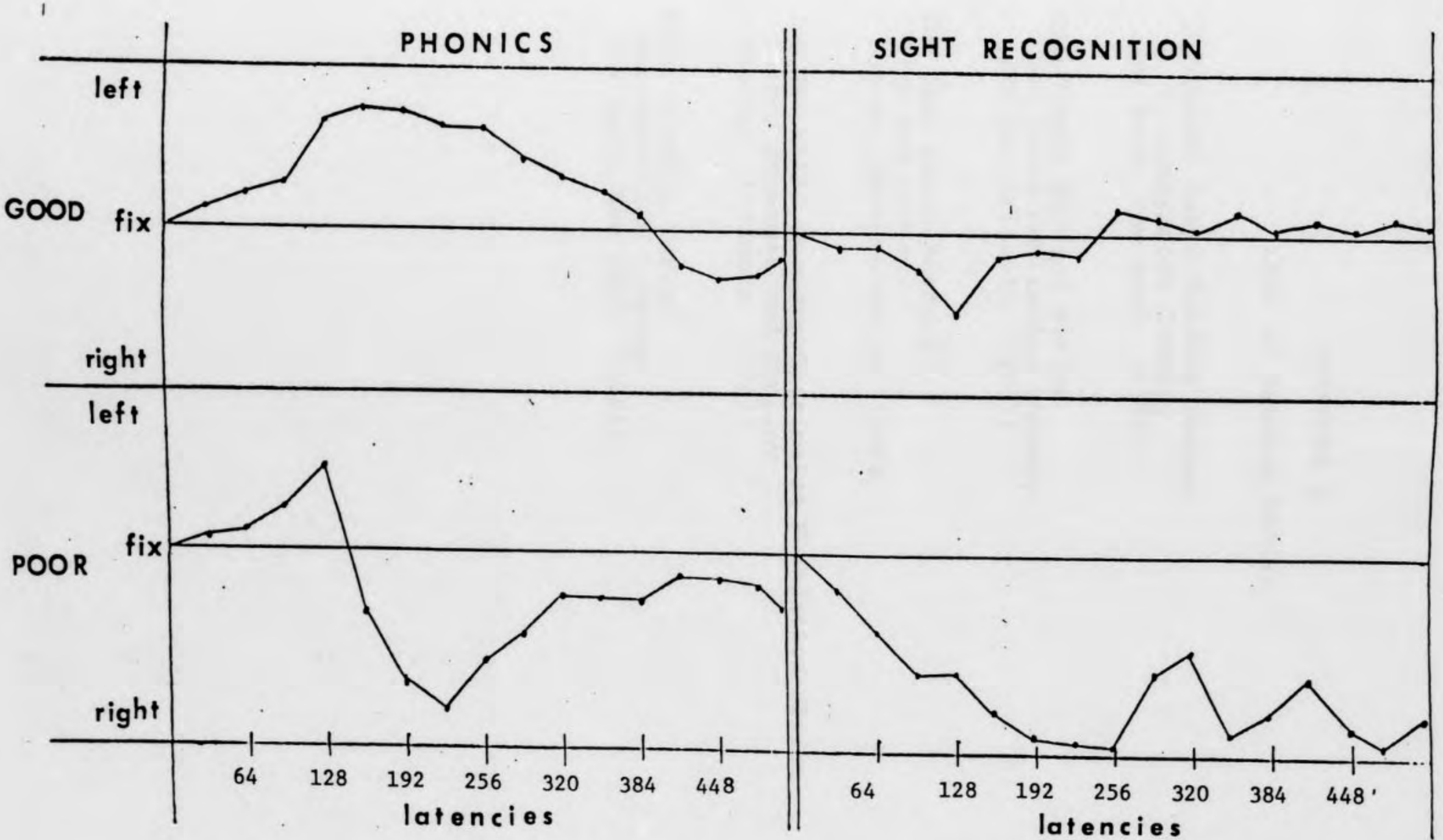

Figure 6. Direction of Eye Movements as a Function of Reading Ability and Method of Initial Reading Acquisition from 0 to 500 Milliseconds.

APPENDIX G

List of Reading Series

Lippincott Basic Reading Series
J. B. Lippincott Company
New York, New York (1962)

Open Court Reading Series
Open Court Publishing Company
LaSalle, Illinois (1967)

The Ginn Basic Readers
Ginn and Company
Boston, Massachusetts (1966)

The New Basic Readers Curriculum Foundation Series
Scott, Foresman and Company
Chicago, Illinois (1965)

Basal Reading Series
The MacMillan Company
New York, New York (1961)