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ABSTRACT

The main purpose of this study was to assess whether matching teaching methods to the auditory and visual perceptual strengths of second and third grade disadvantaged children would facilitate the learning of unknown words. A secondary objective sought to evaluate the relationship between a number of auditory and visual perception tests and a measure of reading achievement. It was predicted that the use of such teaching would facilitate learning to recognize unknown words. The total subject pool consisted of 105 Negro boys. To identify children with different perceptual characteristics, each subject was administered a battery of twelve tests which measured perceptual components thought essential to the development of early reading skills. The subjects were divided into perceptual dominance groups. Attempts were made to teach each subject the recognition of 15 words by a "look-and-say" approach, and 15 by the phonic method. The comparisons involving the differences between perceptual dominance groups, methods of teaching, and order of teaching presentation failed to reach statistical significance. The conclusion is that disadvantaged Negro boys learn to recognize unknown words equally well under teaching procedures which match either their perceptual strengths or weaknesses; there is no relation between low perceptual test scores and reading performance. [Due to the marginal legibility of a small part of the original document, several pages will not be readable in hard copy reproduction.] (Author/JW)

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RELATIONSHIP OF AUDITORY AND VISUAL PERCEPTUAL STRENGTHS TO METHODS OF TEACHING WORD RECOGNITION AMONG DISADVANTAGED NEGRO BOYS

by

Robert H. Bruininks, Ph.D.

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1968

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Introduction

Many children encounter great difficulty in acquiring reading skills under the prevailing methods of teaching reading. Surveys of large school populations indicate that the prevalence of children with reading difficulty ranges between 10 and 30 per cent (Austin, Bush, & Huebner, 1961; Harris, 1961; Malmquist, 1958). The frequency of poor reading among low socio-economic status groups is about four to ten times the rate reported for the rest of the school population (Chandler, 1966; Deutsch, 1966; Shepard, 1962). In a large metropolitan school population, Eisenberg (1966) found the rate of reading difficulty three times greater among sixth grade Negro children in comparison to their Caucasian peers (36 vs. 12 per cent); the rate of reading failure among the Negro boys was 42 per cent. Deutsch (1965) has coined the term "cumulative deficit" to describe the tendency of disadvantaged children to fall increasingly behind in academic subjects with each successive grade level. The profuseness of reading failure, particularly among disadvantaged Negro boys, poignantly illustrates the inadequacies of current approaches to the teaching of reading.

Attempts to identify the factors related to early reading failure have been numerous (Johnson, 1957). Among the most persistently mentioned causes of reading deficiency are deficiencies in auditory and visual perceptual skills. Numerous studies report significant correlations between auditory and visual perceptual skills and measures of reading in the primary grades (Buktenica, 1966; Chall, Roswell, & Blumenthal, 1963; Durrell & Murphy, 1953; Dykstra, 1966; Gates, 1926; Goins, 1958; Mulder & Curtin, 1955; Shellenberg, 1963). At this level, skills in auditory and visual discrimination frequently produce higher correlations with reading achievement than mental age (Bryan, 1964; Harrington & Durrell, 1955; Smith & Dechant, 1961). Beginning with grades three and four, the correlations between perception and reading measures decrease, and appear to be attributable primarily to the influence of verbal intelligence (Ashlock, 1965; Bryan, 1964; Olson, 1966a, 1966b; Reynolds, 1953). The decline in the correlations between perceptual and reading measures with age may suggest that skills in auditory and visual perception are important more to the establishment of word recognition than to the subsequent development of reading comprehension.

Studies relating auditory and visual perception to reading have concentrated primarily on populations of good and poor readers. On tests of auditory perception, the evidence indicates that poor readers are inferior to good readers in auditory discrimination (Bond, 1935; Christine & Christine, 1964; Goetzinger, Dirks, & Baer, 1960; Monroe, 1933), auditory sound blending (Kass, 1966), and auditory memory (Graham, 1952; Hirst, 1960; Neville, 1961). In visual perception, studies disclose that poor readers are inferior to good readers on tests of visual discrimination (Kass, 1966; Malmquist, 1958), visual memory (Kass, 1966; Rizzo, 1939), perceiving embedded figures (Elkind, Larson, & Van Doornick, 1965; Stuart, 1967), visual closure (Kass, 1966), and visual-motor memory (Leton, 1962; Walters, 1961). Furthermore, poor readers have been found to exhibit inferior performance on tasks requiring the cross-modal matching of auditory and visual stimuli (Birch & Belmont, 1964).

Among disadvantaged children, poor reading skills may develop as a consequence of specific deficiencies in auditory and visual perception.

Current evidence reveals that disadvantaged children enter school with marked perceptual and linguistic deficiencies. In comparison to more advantaged peers, children of low socioeconomic status are inferior in the perceptual skills of auditory discrimination (Buktenica, 1966; Clark & Richards, 1966; Deutsch, 1964; Templin, 1957), auditory memory and sound blending (McConnell & Robertson, 1967), and visual discrimination (Buktenica, 1966; Covington, 1962). Furthermore, disadvantaged children are particularly deficient in manipulating the syntactical aspects of language (Bernstein, 1959; Deutsch, 1965; Irwin, 1948; Newton, 1964). Since the evidence consistently reveals the coexistence of a high prevalence of perceptual and reading problems among the disadvantaged, the difficulty they experience in learning to read may develop as a consequence of pronounced deficits in one or both of the critical sensory modes for the normal acquisition of language.

A method of teaching which ignores the perceptual strengths or deficits of disadvantaged children is likely to magnify the difficulty they encounter in attempting to develop skills in reading. Yet the relationship of perceptual strengths or weaknesses to varying methods of teaching reading has been largely ignored. In parallel studies, Bond (1935) and Hendrick (1935) studied the auditory and visual characteristics of good and poor readers. The reading groups were sampled from the second and third grades of four schools, and matched on the factors of chronological age, IQ, sex, school, and amount of exposure to school. In three schools, a sight-word method was used to teach reading, while the fourth employed a phonic program. Bond (1935) found that the differences obtained between reading groups on auditory measures were greatest under an instructional program in which the children had been taught principally through a phonic, in contrast to a sight-word, approach. Conversely, Fendrick (1935) found that the differences between good and poor readers on two visual perception tests were more predominant under the "look-and-say" approach. Fendrick concluded that the "sensory differences were probably a function of the teaching method employed (p. 51)." However, the extent of reading disability among the poor reading group could have resulted partially from neglecting to match the methods of teaching to the auditory or visual perceptual proclivities of the pupils.

In a post hoc analysis, de Hirsch, Jansky, and Langford (1966) explored the relative strength of 53 subjects on auditory and visual perception tests. Seven pupils with auditory strengths and three with visual strengths were identified. The three visual strength pupils were considered to be superior readers at the end of the second grade. Of the seven auditory strength pupils, five were considered good readers, while two failed a comprehensive battery of reading tests. Further investigation of the auditory strength pupils revealed that the successful readers learned to read primarily under a phonic approach, while the two reading failures had been taught by a visual or sight-word approach. The results led the authors to conclude that "exploration of modality strength and weakness is of more than theoretical interest and should largely determine teaching methods (p. 82)."

Bateman (1967) tested the efficacy of phonic and "look-and-say" oriented methods of teaching reading with first-grade children grouped by preferred learning modality (auditory or visual). Pupils were classified as auditory or visual learners on the basis of memory scores obtained on the two automatic-sequential subtests of the Illinois Test of Psycholinguistic Abilities. Auditory subjects had auditory memory scores which exceeded their visual memory scores by more than nine months. Pupils were designated as visual if the discrepancy between the two memory test scores was less than nine months. The visual and auditory strength children were placed into separate classrooms, and taught to read by a method of instruction consistent with their perceptual strength. In two other classrooms, auditory and visual strength children were placed into separate classrooms, and taught to read by a method of instruction which matched their perceptual weakresses. The method employed under the phonic approach was the Lippincott basal reading program; the "look-and-say" method classes used the Scott, Foresman reading series. At the end of the first grade, the results found the phonic method pupils significantly superior on reading achievement, regardless of the preferred perceptual modality.

Robinson (1968) contrasted a basal reading program and the Hay-Wingo phonic approach for pupils with different auditory and visual aptitudes. Two school systems were represented under each teaching approach. The basal reading approach was taught to 232 pupils, while 216 subjects participated in the Hay-Wingo program. Upon entering the first grade, all pupils were administered three tests of visual discrimination that had been found by Goins (1958) to be highly related to first-grade reading performance. Subjects with high and low visual perception test scores were also administered the Wepman Auditory Discrimination Test. The following groups were constituted within each teaching method: 1) high visual-high auditory, 2) high visual-low auditory, 3) low visual-high auditory, and 4) low visual-low auditory. The groups were contrasted on reading achievement at the end of the third grade. In general, the results failed to reveal any significant interaction between methods of teaching and perceptual abilities.

Harris (1965) tested the effects of kinesthetic and phonic instruction upon the reading achievement of first grade children, low in visual perception skills. Two visual perception tests and a test of rhyming from the Gates Reading Readiness Test, as well as the Bender Visual Motor Gestalt Test, were administered to a group of kindergarten children. From the test scores, four groups were established: 1) kinesthetic experimental (low visual perception, higher Bender), 2) kinesthetic control (low visual perception, low Bender), 3) phonic experimental (low visual perception, higher rhyming), and 4) phonic control (low visual perception, low rhyming). Each group contained four to seven subjects (IQs> 113). The teachers administered the prescribed teaching methods to each subject during periodic individualized reading conferences. The results were analyzed by measuring the disparity between obtained and predicted achievement grade, based on a regression equation between the visual perception and reading test scores. At the end of the first grade, no evidence was obtained to indicate that subjects responded to reading instruction according to pretest aptitudes.

A number of methodological weaknesses are inherent in the above studies. First, the criteria used to classify subjects according to perceptual dominance lacked rigor, and were seldom applied consistently across different sense modalities. Therefore, the use of inadequate selection procedures very likely resulted in the establishment of groups with inconsequential differences on basic auditory and visual perceptual skills. Second, most of the subjects in these studies were average or above average in verbal intelligence. Since most children of average mental ability also possess adequate auditory and visual perceptual skills, modality dominance might be less predictive of success in learning to read under varying approaches to reading instruction. Because choice of reading method is probably less important for children of high mental ability (Chall, 1967), the use of these subject populations probably precluded an adequate test of the efficacy of matching perceptual strengths to methods of teaching reading. Third, the teaching procedures and the influence of teacher effectiveness were uncontrolled. Harris (1965) reported observations that revealed the presence of considerable variation among the teachers in the procedures they used to implement the kinesthetic and phonic methods. Furthermore, recent evidence indicates that the teacher may be more influencial than the teaching method in the development of reading skills (Bond & Dykstra, 1967; Dunn, Neville, Bailey, Pochanart, Pfost, & Bruininks, in press). Finally, the teaching approaches in the above studies do not differ enough in instructional emphasis to test adequately the relationship of matching teaching methods to the perceptual characteristics of children.

An examination of research on perception and early reading performance suggests the feasibility of matching teaching procedures to the auditory and visual perceptual strengths of children. Since disadvantaged children appear predisposed toward perceptual and reading deficiencies, it might prove efficacious to group them for instruction according to auditory and visual perceptual strengths. Perhaps developmental and remedial reading experiences which match instructional emphasis to individual auditory or visual perceptual strengths would reduce materially the prevalence of reading deficiency among disadvantaged children. (A more detailed review of literature is contained in Appendix A.)

Purpose

The principal purpose of this study was to assess whether matching teaching approaches to the auditory or visual perceptual strengths of second and third grade disadvantaged Negro boys would facilitate the learning of words they were unable to read at the outset of the experiment. (Hereafter, the words the subjects were unable to read at the outset of the experiment will be referred to as "unknown" words.) A secondary objective of this investigation sought to evaluate the extent and nature of the relationship between a number of auditory and visual perception tests and a measure of reading achievement.

Hypotheses. The following hypotheses were tested:

I: Matching methods of teaching to the auditory or visual perceptual strengths of pupils will facilitate learning to recognize a list of unknown words.

A) Pupils with visual perception strengths and auditory perception weaknesses will learn to recognize significantly more words under a visual (or sight-word) method of teaching than by an auditory (or phonic) approach.

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B) Pupils with auditory perception strengths and visual perception weaknesses will learn to recognize significantly more words under an auditory (or phonic) method of teaching than by a visual (or sight-word) approach.

II: Matching methods of teaching to the auditory or visual perceptual strengths of pupils will facilitate the ability to retain recognition of a list of unknown words.

A) Pupils with visual perception strengths and auditory perception weaknesses will retain recognition of significantly more words under a visual (or sight-word) method of teaching than by an auditory (or phonic) approach.

B) Pupils with auditory perception strengths and visual perception weaknesses will retain recognition of significantly more words under an auditory (or phonic) method of teaching than by a visual (or sight-word) approach.

III: There will be no significant difference between the auditory and visual methods of teaching in either the immediate or delayed recognition of unknown words.

IV: Significant correlation ratios will be obtained between reading achievement and measures of auditory and visual perception.

V: Significant product moment correlation coefficients will be obtained between reading achievement and measures of auditory and visual perception.

VI: The relationship between auditory and visual perception tests with reading will be linear.

VII: Significant partial correlation coefficients will be obtained between reading achievement and measures of auditory and visual perception with the influence of verbal intelligence held constant

Method

Instrumentation for Measuring Perception

Each subject was administered a battery of six auditory and six visual perception tests. On the basis of research and theory in the area of early reading instruction, tests were selected which appeared to measure auditory and visual perceptual components essential to the development of early reading skills. Moreover, an attempt was made to match the tests across modalities so that they measured the same, or similar perceptual attributes. The tests and a description of the perceptual components they purport to measure appear in Table 1. A brief description of each test and the procedures used to administer them follow. The tests were administered to each subject in the order as they appear below. (Further information on each test is included in Appendix B.)

Visual-Motor Sequencing. Visual-Motor Sequencing is one of nine subtests of the Illinois Test of Psycholinguistic Abilities (McCarthy & Kirk, 1961). The test assesses the subject's ability to reproduce a sequence

Table 1

Tests Measuring Perceptual Components of Early Reading

Perceptual Abilities Measured	Names of Tests: Visual	Names of Tests: Auditory
1. Fine discrimination of likenesses and differences.	1. Perceptual Speed (Primary Mental Abilities Test)	1. Wepman Auditory Discrimination Test (signal only)
2. Perception of figure from ground; freedom from distraction.	2. Children's Embedded Figures Test	2. Wepman Auditory Discrimination Test (signal plus noise)
3. Sequential memory for discrete units.	3. Visual Motor Sequencing (Illinois Test of Psycholinguistic Abilities)	3. Digit Span (Wechsler Intelligence Scale for Children)
4. (a) Blending--ability to synthesize discrete units into a perceptual gestalt; or (b) Closure--ability to predict a whole from a part.	4. Visual Automatic	4. Roswell-Chall Auditory Blending Test
5. Ability to retain a perceptual gestalt (whole), or meaningful material.	5. Memory-For-Designs	5. Auditory Attention Span for Related Syllables (Detroit Tests of Learning Aptitude)
6. Ability to match auditory or visual temporal stimuli with visual stimuli arranged spatially.	6. Visual Integration Test	6. Auditory Integration Test

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of visual stimuli from memory. The test items consist of different pictures on form chips, first observed by the subject while on a tray in a prescribed sequence. The form chips include pictures of geometric figures, animals, and common objects. The subject is asked to reproduce each sequence from memory following a five second observation. Scores on the Visual-Motor Sequencing Subtest were collected on all subjects the previous year during the Spring of 1967. The scores were collected in conjunction with the final evaluation of an experimental reading and language development project.

Perceptual Speed. Perceptual Speed is one of five subtests from the Primary Mental Abilities Test, Grades 2-4 (Thurstone & Thurstone, 1963). The test measures the rapid visual recognition of likenesses and differences between objects and symbols. Each item contains four pictures of figures, two of which are identical, along with two distractors differing in only minor details. The subject is asked to mark the two identical figures.

Auditory Attention Span for Related Syllables. Auditory Attention Span for Related Syllables is a subtest of the Detroit Tests of Learning Aptitude (Baker & Leland, 1967). The test is a measure of short-term memory for sentences. The test consists of 43 sentences which range in length from five to 22 words. The subject is required to repeat from memory a sentence read to him by the examiner.

Visual Automatic Test. The Visual Automatic Test (Kass, 1962) is a measure of visual perceptual closure. The test consists of a series of 18 unfinished pictures of animals or common objects. The pictures for each item are placed on a sequence of four cards, with each card displaying progressively more detail. The fourth card depicts the completed picture.

The subject's score on each item is determined by how quickly he can name the completed object.

Memory-For-Designs. Memory-For-Designs (Graham & Kendall, 1960) is a measure of visual-motor memory. Administration of the test involves the presentation of 15 simple geometric designs, printed on small cards in black ink, and their reproduction from immediate memory. Each design is exposed to the subject for a period of five seconds. Following the withdrawal of a design, the subject is requested to draw it from memory on a blank sheet of 8 1/2 x 11 inch paper. The test protocols were evaluated independently by two qualified examiners.

Children's Embedded Figures Test. The Children's Embedded Figures Test (Karp & Kornstadt, 1963) measures the ability involved in perceiving a simple geometric figure embedded in a complex one. The child is instructed "to find the hidden figure." The test consists of two series of complex figures. If the child obtains one correct response out of the first series, he is permitted to complete the second series.

Digit Span. Digit Span is a subtest of the Wechsler Intelligence Scale for Children (Wechsler, 1949). It is an auditory measure of short-term memory of digits presented sequentially. The test consists of two forms: Digits Forward and Digits Backward. On each form, the subject is asked to reproduce correctly a series of numbers administered at a rate of one digit per second. The subject is given two trials to produce a correct response on each series.

Wepman Auditory Discrimination Test. The Wepman Auditory Discrimination Test is designed to measure the ability to distinguish between the fine differences that exist among the phonemes used in English speech (Wepman, 1958). The test includes two alternate forms, each containing 40 word-pairs (e.g., tub- tug). Thirty of the word-pairs differ only in a single phoneme, while 10 pairs are identical. In each form, the dissimilar word-pairs include 13 which differ only in initial consonants, 13 in final consonants, and four in medial vowels. The subject is required to indicate whether the words of each pair are the "same" or "different."

Each subject received the two test forms, one under a "signal only" condition, and the other under a "signal plus noise" condition. The "signal plus noise" condition was administered to assess the ability to discriminate between speech sounds in the presence of distracting background noise. The background noise for the "signal plus noise" test consisted of voices recorded in the Peabody College cafeteria. Certain high frequency peaks were removed to insure that the background noise was unintelligible. Under the "signal plus noise" condition, the intensity level of the test words exceeded the noise level by nine decibels. A signal-to-noise ratio of nine decibels is slightly higher than the dividing point between satisfactory and unsatisfactory communication (Licklider & Miller, 1951).

In order to insure uniformity of administration, test lists were pre-recorded on magnetic tape. The words were recorded by a female graduate student in speech pathology with good, clear, enunciation. The test lists were administered by a Wollensak Model T-1500 tape recorder through TDH-39 earphones mounted in MX 41/AR cushions. The lists were presented at an intensity of 70 decibels sound pressure level, which is slightly higher than average or normal conversational speech (Davis, 1961;

Hirsh, 1952). On each form, the word-pairs were separated by a ten second inter-trial interval in which the subject was requested to make his response ("same" or "different"). Test forms were counter-balanced across stimulus presentations so that the forms occurred within each stimulus presentation an equal number of times.

Perceptual Integration Tests. The Perceptual Integration Tests measure the ability to match a temporal code received via the sense modalities of audition or vision with a visual and spatially arranged dot pattern. Two tests developed by Sterritt and Rudnick (1966) were used to measure these skills: 1) the Auditory Integration Test, and 2) the Visual Integration Test. On the Auditory Integration Test, the subject was presented auditory temporal patterns of pure tones. In the Visual Integration Test, the subject was presented visual temporal patterns in the form of light flashes. Following the presentation of the stimulus pattern, the subject was instructed to choose from three sets of visual-spatial dot sequences the pattern which looked like the one which was just presented. Each test was preceded by detailed instructions and six practice exercises. (The instructions for the administration of the Perceptual Integration Tests appear in Appendix C.)

Different stimulus lists equated for pattern length were employed for each test. The test lists contained stimulus patterns varying from four to ten pulses, and were assigned randomly to lists from a complete master list containing all possible permutations of stimulus patterns. Distractors of the same or similar length were randomly assigned to the spatial dot pattern lists. The stimulus and spatial dot pattern lists appear in Appendix D.

Stimulus pulses of .2 sec. in length, interspersed with 1 sec. and .5 sec. intervals, were pre-recorded on magnetic tape. The Auditory Integration Test consisted of 1000 Hz pure tones presented at 70 decibels sound pressure by a Concord Model 727 stereo tape recorder, through TDH-39 headphones mounted in MX 41/AR cushions worn by both the examiner and subject. On the Visual Integration Test, tape recorded signals activated a series of six GE #313 lamps mounted behind a 1 3/8 x 1 7/8 inch translucent plexiglass window. The window and circuitry were mounted inside a 6 x 5 x 4 inch metal box. Following the presentation of each stimulus pattern, the circuitry was programmed to shut the apparatus off automatically. The examiner activated a switch to initiate the next trial. The Visual Integration Test was administered following the Auditory Integration Test.

Subjects

The total subject pool consisted of 105 Negro boys with a mean Stanford-Binet IQ of 90 (s=10.25), and a range of 70 to 110. According to Head Start medical examinations, school records, or teacher reports all subjects were reported to have possessed adequate auditory and visual acuity. Of the 105 subjects, 95 were enrolled in the third grade, while the 10 remaining subjects had been retained the previous year in the second grade. The subjects had a mean chronological age of eight years, seven months, and a mean grade equivalent of 2.74 (s=.82) on the three reading subtests of the Metropolitan Achievement Test.

The sample was selected from among 32 classrooms in eight schools of the Public Schools of Metropolitan Nashville-Davidson County. According

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to indices of socioeconomic status and ratings by school personnel, most of the subjects were considered to be economically disadvantaged (Dunn et al., in press). Socioeconomic status ratings, taken at the beginning of the first grade, were available on 95 subjects. The ratings indicated that: 1) 75.8 per cent of the families lived in fair to poor housing, 2) the mean self-reported educational level of the better educated parent was 11.3 grades, 3) the average number of persons per family was 6.8, and 4) 79.1 per cent reported incomes below $5999, with seven per cent of the families receiving public welfare payments.

The subjects had participated recently in a two-year experimental reading program, designated as the Cooperative Reading Project (Dunn et al., in press). The Cooperative Reading Project tested the efficacy of three phonically oriented reading approaches and an oral language stimulation program in the first two elementary grades. The experimental reading approaches included: 1) the initial teaching alphabet Early-to-Read series by Mazurkiewicz and Tanyzer (1963), 2) the Words in Color program of Gattegno (1963), and 3) the Houghton Mifflin basal reading series (McKee, Harrison, McCowen, & Lehr, 1963), supplemented by the Reading with Phonics program of Hay and Wingo (1960). In addition, approximately two-thirds of the children in the experimental reading treatments received lessons from Levels #1 and #2 of the Peabody Language Development Kits as an oral language stimulation program (Dunn & Smith, 1965, 1966).

Auditory and visual perceptual dominance groups were established by administering to each subject the perceptual tests outlined in Table 1, during the months of February and March, 1968. For purposes of administration, the tests were grouped into four batteries, each consisting of two or three tests. The administration time for each test group was approximately 30 to 40 minutes in length. Test Group 1 included Perceptual Speed, Auditory Attention Span for Related Syllables, and the Visual Automatic test; Group 2 included Memory-For-Designs, the Children's Embedded Figures Test, and the Digit Span test; Group 3 included the Wepman Auditory Discrimination Test, the Wepman Auditory Discrimination Test (with noise), and the Roswell-Chall Auditory Blending Test; and Group 4 included the Auditory and Visual Integration Tests.

All tests were administered by female psychometricians, trained by the investigator. Except in the case of the perceptual integration tests, two examiners were assigned to each test grouping. Only one examiner was assigned to administer the Perceptual Integration Tests. The examiners were assigned randomly to schools with the limitation that they tested approximately an equal number of subjects on each test battery.

To identify subjects with auditory or visual perceptual strengths, the raw scores of each test were converted into standard scores. Negative scores were eliminated by applying a linear transformation to each standard score, using a mean of 50 and standard deviation of 10. The sum of standard scores for the auditory tests was subtracted from the sum of standard scores for the visual tests (i.e., V-A). Subjects whose difference scores were in the upper 25 per cent of the distribution were designated as subjects with visual perceptual dominance, while those whose differences were in the lower 25 per cent were classified as subjects with auditory perceptual dominance. Following this procedure, groups were established which had: (1) strengths in visual perception and auditory perception weaknesses, versus (2) strengths in auditory perception and visual perception weaknesses. The visual and auditory perceptual dominance groups each contained 26 subjects. Six auditory and two visual perceptual dominance subjects failed to meet the criterion established for the administration of the learning task, resulting in a reduction of subjects. A further deletion of subjects was made in the visual dominance group in order to satisfy the criterion of proportionality for the analysis of variance. The final sample size in each perceptual dominance group was 20 subjects.

Descriptive statistics and tests of significance between the perceptual dominance groups appear in Table 2. Inspection of Table 2 will indicate that the two groups did not differ significantly on mean reading grade equivalent scores of the Metropolitan Achievement Test, Stanford-Binet IQ, or chronological age. (It should be noted that the subjects in both perceptual dominance groups were slightly lower on IQ and reading achievement in comparison to the means reported for the total sample. The discrepancy resulted from the failure of the six auditory and two visual dominance subjects to qualify for administration of the learning criterion. The subjects who failed to miss the required number of words were slightly above the averages of the complete sample on IQ and reading achievement.)

Table 2 also contains a comparison of the perceptual dominance groups on auditory and visual perception test scores. The test scores were computed by adding separately the standard scores for the auditory and visual perception tests. As anticipated, both groups were significantly inferior on the perception test scores in their weak sense modality.

Table 2

Descriptive Statistics for the Perceptual Dominance Groups

Measure	Visually Dominant (N = 20)		Auditorily Dominant (N = 20)			
	$\bar{X}$	s	$\bar{X}$	s	t	$t_{.95}$
Reading Average[a]	2.30	.75	2.49	.57	.90	2.02
Stanford-Binet IQ	86.50	10.01	88.50	7.77	.71	2.02
Chronological Age[b]	102.55	4.61	104.30	6.28	1.03	2.02
Auditory Test Sum[c]	259.45	39.40	323.10	22.03	6.30*	2.02
Visual Test Sum[d]	313.45	38.50	273.80	25.04	3.86*	2.02

[a]Average grade equivalent of the three reading subtests of the Metropolitan Achievement Test.
[b]In months.
[c]Sum of transformed standard scores for the six auditory perception tests.
[d]Sum of transformed standard scores for the six visual perception tests.
* $p < .001$.

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Moreover, the visual dominance subjects were significantly superior to those in the auditory group on visual perception test scores ($p < .001$), while the auditory dominance subjects obtained significantly higher auditory perception test scores ($p < .001$).

Instructional Program

Each subject was taught to recognize 15 unknown words by a visual, or sight-word teaching procedure, and 15 words by an auditory, or phonic method. (The subjects were unable to read any of the 30 words at the outset of the teaching lessons.) The teaching procedures were taken primarily from the Mills Learning Methods Test (Mills, 1964). The Mills test consists of four sets of 2 x 4 inch picture-word cards (nouns)--one set each for the primer, first, second, and third grade reading levels. The words within only one grade level are administered to the child in order to identify a specified number of unknown words. The child is then taught to recognize a subset of these words according to four different standardized teaching approaches, two of which were used in the present study. The Mills Test was standardized on 30 subjects with a mean IQ of 90.1 on the Wechsler Intelligence Scale for Children. In the standardization, alternate forms of the test were constructed by selecting two lists of 40 unknown words from the same grade level of difficulty. Reliability coefficients were obtained for each of four methods by correlating the number of right responses for delayed recall on both test forms of each method of teaching. Test-retest reliability coefficients of .97 were reported in the manual for both the visual and auditory methods of teaching over a mean interval of 13.4 weeks (Mills, 1964).

In order to determine the difficulty level of the Mills Test for third grade disadvantaged Negro boys, a pilot study was conducted with 30 subjects from one of the control schools of the Cooperative Reading Project. (A more complete description of the pilot study appears in Appendix E.) The subjects in the pilot study were administered the 130 third grade words of the Mills Test. The number of unrecognized words and incorrect responses were recorded for each subject. After it was discovered that a few children failed to miss a minimum of 30 words, the difficulty level of the test was increased by adding two lists of words from the Thorndike and Lorge 30,000 word list (Thorndike & Lorge, 1944). In constructing the two lists, words were selected if they were: 1) nouns, 2) primarily phonetic, and 3) capable of being pictorally illustrated. (A complete listing of the test words appears in Appendix F.)

As a result of extensive field testing, it was decided to delete a few of the teaching procedures from the Auditory and Visual Methods of the Mills Test. (The procedures used to administer the Mills Test appear in Appendix G.) The final teaching procedures for the auditory and visual methods each included five different steps. Under the visual teaching method, each child was taught to read orally a set of unknown words according to procedures which stressed exclusively visual clues. The visual clues stressed association of the word with a picture, the configurational outline of the word, and other visual characteristics such as length, etc. In the auditory method, the subject was taught to read aloud a set of unknown words according to teaching procedures which stressed the phonetic qualities of each word. The teaching procedures of the auditory method attempted to teach the subject the sounds of the individual letters, as well as how to blend the individual sounds into a whole word.

Two female instructors were trained by the investigator to administer the Mills Test. One of the instructors had 14 years of experience as a supervisor and teacher in a parochial school kindergarten program. The other instructor received a degree in English and Speech and had taught in upper elementary and high school classes for approximately two years. Although the instructors had limited experience in teaching reading, both of them had training and background in the administration of standardized tests. The instructors saw each modality strength subject for a total of three or four sessions. On the first session, a pretest was administered to each subject in order to identify between 30 and 40 unknown words out of a possible total of 205 words. The unknown words were shuffled and a minimum of 15 to 20 words were assigned randomly to each of the two teaching approaches. Under both teaching methods, the subjects were then taught to recognize as many words as possible from one group of 15 unknown words in a 23 minute lesson, spending approximately one-and-one-half minutes on each word. Following the teaching lessons, the amount of learning was assessed by the administration of an immediate recall test over the study words. The second session took place one week later when a measure of delayed recall was secured for each method by testing again the ability of each pupil to read aloud the same list of 15 study words. Following the recall test, the second list of 15 words was then taught to the child using the remaining teaching procedure. (In a few instances, it was impossible to administer the second teaching lesson immediately following the measure of delayed recall. Thus, it was necessary in these cases to administer the second teaching lesson within a few days of the recall test.) Again, the amount of learning was measured by the administration of an immediate recall test over the study words. On both the immediate and delayed recall tests, the 15 study words were administered in a random order among 20 distractors. The learning criteria consisted of the number of study words read aloud correctly on the immediate and delayed recall tests. The order of the teaching sessions was randomized across subjects with the restriction that both orders were represented equally within each perceptual dominance group. Whenever it was feasible, the instructors were assigned randomly to schools with the restriction that they had to teach the same number of subjects within each order of presentation and teaching method combination. The administration of the Mills Test took place during the months of April and May, 1968.

Statistical Analyses

Statistical analyses on the immediate and delayed recall scores from the Mills Learning Methods Test were conducted by a mixed extended Lindquist type IV (Lindquist, 1953) analysis of variance (perceptual dominance x retention x method x order of teaching presentation). In addition to, the primary analysis, a secondary objective evaluated the extent and nature of the relationship which existed between each test of perception and a measure of reading achievement, using the sample pool of 105 subjects. The reading measure comprised the mean grade equivalent from the Word Knowledge, Word Discrimination, and Reading Subtests of the Metropolitan

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Achievement Test, Elementary Battery (Durost, Bixler, Hildreth, Lund, & Wrightstone, 1959). The Word Knowledge Subtest is a 50-item vocabulary test which measures the pupil's ability to understand the literal meaning of words. The Word Discrimination Subtest assesses the ability to select a given word from among several other words of similar configuration. The Reading Subtest consists of a series of passages followed by questions designed to measure several aspects of reading comprehension. The manual reports split-half reliability coeficients of: 1) .93 for Word Knowledge, 2) .92 for Word Discrimination, and 3) .90 for Reading. The Metropolitan Achievement Test was administered to each pupil during the months of March and April, 1968.

A number of analyses were used to evaluate the extent and nature of the relationship between each test of perception and reading performance. The strength of the relationship between the two attributes was ascertained by computing correlation ratios. In computing correlation ratios, the scores of each perception test were divided arbitrarily into conditional frequency distributions of six to nine intervals. Except in cases of extreme scores, an attempt was made to maintain equal score intervals. Furthermore, product-moment correlation coefficients between the perception tests and reading scores were computed. All correlation ratios and correlation coefficients were tested for statistical significance through the use of appropriate F ratios (Walker & Lev, 1953). The hypothesis that the regression is linear between each perception test and reading was also tested for statistical significance by comparing the difference between the magnitude of the correlation ratio and correlation coefficient. Finally, partial correlations between each test of perception and reading performance were computed and tested for level of significance, with the influence of Stanford-Binet IQ held constant. (The Stanford-Binet had been administered to each pupil during the spring of 1967 as part of the evaluation program of the Cooperative Reading Project.) The .05 level of significance was employed to evaluate the statistical significance of all comparisons.

Results

It was predicted in hypotheses I and II that matching teaching methods to the auditory and visual perceptual strengths of disadvantaged Negro boys would facilitate the learning and retention of a list of unknown words (see p. 8). The means and standard deviations on Mills Test scores for the perceptual dominance groups appear in Table 3. The descriptive statistics for the immediate and delayed recall measures and the methods of teaching for the total group of 40 subjects appear in Table 4. The analysis of variance on Mills Test scores for the auditory and visual perceptual dominance groups may be found in Table 5. Examination of Table 5 will indicate that the predicted interaction between perceptual dominance and methods of teaching did not reach statistical significance. Thus, the prediction that matching teaching methods to the perceptual characteristics of disadvantaged Negro boys would facilitate the learning and retention of unknown words was not supported.

Hypothesis III predicted that no significant difference would be obtained between the two methods of teaching in the learning and retention of unknown words for the combined perceptual dominance groups (N = 40).

Table 3

Descriptive Statistics on Mills Test Scores

for the Perceptual Dominance Groups

Source	Visually Dominant (N=20) $\bar{X}$	Visually Dominant (N=20) s	Auditorily Dominant (N=20) $\bar{X}$	Auditorily Dominant (N=20) s	Mean Difference
Visual Method					
Immediate Recall[a]	7.10	5.17	9.00	4.60	-1.90
Delayed Recall[b]	5.65	5.59	7.95	4.70	-2.30
Total	6.38	5.25	8.48	4.57	-2.10
Auditory Method					
Immediate Recall[a]	6.65	5.29	8.30	4.31	-1.65
Delayed Recall[b]	5.50	4.88	7.25	4.44	-1.75
Total	6.08	5.02	7.78	4.27	-1.70
Totals	6.22	5.18	8.12	4.47	-1.90

[a]Recognition of unknown words immediately following instruction.
[b]Recognition of unknown words exactly one week after instruction.

Table 4

Descriptive Statistics for Retention Intervals and Methods of Teaching

Source	N	$\bar{X}$	s
Immediate Recall[a]	40	7.76	4.86
Delayed Recall[a]	40	6.59	4.94
Visual Method[b]	40	7.42	4.97
Auditory Method[b]	40	6.93	4.68

[a]Computed over both methods of teaching.
[b]Computed over both retention intervals.

As predicted, the difference between the auditory and visual methods was not statistically significant. However, inspection of the means in Table 4 indicates that the visual method of teaching resulted in higher performance scores ($p = .06$), irrespective of the child's perceptual characteristics.

Specific hypotheses were not advanced concerning differences between the retention intervals or orders of teaching presentation. The results in Table 5 reveal that the mean performance scores for the immediate recall test were significantly higher than those obtained on the one-week delayed recall test ($p < .001$). The other statistical comparisons involving the main effects of perceptual dominance and order of teaching presentation failed to reach statistical significance. Finally, none of the interactions between the attributes of perceptual dominance, methods of teaching, length of retention interval, or order of presentation approached statistical significance.

Table 5

Analysis of Variance on Mills Test Scores for the Perceptual Dominance Groups

Source	N	ss	ms	F	$F_{.95}$
Between Subjects	39	3457.600			
Perceptual Dominance (A)	1	144.400	144.400	1.58	4.11
CD	1	15.625	15.625	.17	4.11
ACD	1	15.625	15.625	.17	4.11
Error (b)	36	3281.950	91.165		
Within Subjects	120	389.500			
Retention (B)	1	55.225	55.225	18.86*	3.94
Method (C)	1	10.000	10.000	3.42	3.94
Order (D)	1	0.900	0.900	.31	3.94
AB	1	1.600	1.600	.55	3.94
AC	1	0.625	0.625	.21	3.94
AD	1	1.600	1.600	.55	3.94
BC	1	0.225	0.225	.08	3.94
BD	1	0.000	0.000	.00	3.94
ABC	1	0.225	0.225	.08	3.94
ABD	1	1.600	1.600	.55	3.94
BCD	1	1.225	1.225	.42	3.94
ABCD	1	0.025	0.025	.01	3.94
Error (w)	108	316.250	2.928		
Total	159	3847.100			

*$p < .001$

Secondary analyses included the computation of product moment correlations and correlation ratios to assess the extent and nature of the relationship between the perception tests and reading achievement for the total sample of 105 subjects. The means and standard deviations for the intelligence, reading, and perception measures on the total sample appear in Table 6. Correlation ratios and product moment correlations along with the appropriate tests of significance appear in Table 7. Hypothesis IV predicted the presence of a significant relationship between the perception tests and reading achievement. Examination of Table 7 reveals that the correlation ratios ranged in absolute value between .235 and .557. The following six perception tests produced significant relationships with reading achievement: 1) the Wepman Auditory Discrimination Test (E = .444), 2) Digit Span (E = .458), 3) the Roswell-Chall Auditory Blending Test (E = .516), 4) Auditory Attention Span for Related Syllables (E = .557), 5) the Children's Embedded Figures Test (E = .432), and 6) Visual Automatic (E = .399). Of these six tests, four were measures of auditory perception. Since only six of the correlation ratios between perceptual and reading performance were significant, hypothesis IV was only partially confirmed.

Hypothesis V predicted that significant product-moment correlations would be obtained between the perception tests and reading. The correlations between auditory and visual perception tests were low, ranging in absolute value between .007 and .460. Of the 12 tests, the following nine were significantly correlated with reading performance.

Table 6

Descriptive Statistics from Intelligence, Reading, and Perception Tests for the Total Sample (N=105)

Measure	$\bar{X}$	s
Stanford-Binet IQ	89.78	10.25
MAT Reading Average[a]	2.74	.82
Wepman Auditory Discrimination Test[b]	33.01	3.69
Wepman Auditory Discrimination Test (with noise)	25.81	4.05
Digit Span	7.48	1.41
Roswell-Chall Auditory Blending Test	16.11	7.07
Auditory Attention Span for Related Syllables	46.09	10.75
Auditory Integration Test	7.99	2.30
Perceptual Speed	18.69	5.70
Children's Embedded Figures Test	11.49	3.41
Visual Motor Sequencing	15.35	3.14
Visual Automatic	29.52	8.10
Memory-For-Designs	8.82	6.51
Visual Integration Test	7.99	2.41

[a]Mean grade equivalent for the three reading subtests of the Metropolitan Achievement Test.

[b]Means and standard deviations for all perception tests were computed on raw scores.

Table 7

Correlation and Correlation Ratio Analyses on Auditory and Visual Perception Tests

Perception Measure	N	E^a	r^b	F: $\eta=o^c$	$F_{.95}$	F: $\rho=o^d$	$F_{.95}$	F: $\eta^2=\rho^{2e}$	$F_{.95}$
<u>Auditory Perception Tests</u>									
Wepman Auditory Discrimination Test	105	.444	.386	4.00**	2.19	18.02**	3.94	1.17	2.30
Wepman Auditory Discrimination Test (with noise)	105	.331	.192	1.70	2.10	3.94*	3.94	1.32	2.19
Digit Span	105	.458	.372	5.24**	2.30	16.53**	3.94	2.22	2.46
Roswell-Chall Auditory Blending Test	105	.516	.460	4.36**	2.03	27.64**	3.94	1.03	2.10
Auditory Attention Span for Related Syllables	105	.557	.426	5.40**	2.03	22.82**	3.94	2.57*	2.10
Auditory Integration Test	105	.235	.077	.70	2.03	.61	3.94	.71	2.10
<u>Visual Perception Tests</u>									
Perceptual Speed	105	.372	.297	1.93	2.03	9.96**	3.94	.80	2.10
Children's Embedded Figures Test	105	.432	.367	3.74**	2.19	16.02**	3.94	1.24	2.30
Visual Motor Sequencing	105	.241	.123	.74	2.03	1.58	3.94	.63	2.10

Table 7 (continued)

Correlation and Correlation Ratio Analyses on Auditory and Visual Perception Tests

Perception Measure	N	E^a	r^b	F: $\eta=0^c$	$F_{.95}$	F: $\rho=0^d$	$F_{.95}$	F: $\eta^2=\rho^{2e}$	$F_{.95}$
Visual Automatic	105	.399	.352	3.10**	2.19	14.57**	3.94	.83	2.30
Memory-For-Designs	105	.357	-.270	1.76	2.03	8.10**	3.94	.86	2.10
Visual Integration Test	105	.257	.151	.98	2.10	2.40	3.94	.75	2.19

[a] Correlation ratio.
[b] Product moment correlation coefficient.
[c] Hypothesis that the correlation ratio is equal to zero.
[d] Hypothesis that the product moment correlation coefficient is equal to zero.
[e] Hypothesis that the correlation ratio and product moment correlation coefficient are equal (i.e., that the relationship is linear).
*$\rho < .05$
**$\rho < .01$

1) the Wepman Auditory Discrimination Test (r = .386), 2) the Wepman Auditory Discrimination Test, with noise (r = .192), 3) Digit Span (r = .372), 4) the Roswell-Chall Auditory Blending Test (r = .460), 5) Auditory Attention Span for Related Syllables (r = .426), 6) Perceptual Speed (r = .297), 7) the Children's Embedded Figures Test (r = .367), 8) Visual Automatic (r = .352), and 9) Memory-For-Designs (r = -.270). Of the nine tests with significant correlation coefficients with reading, five were measures of auditory perception. Therefore, the prediction that perception and reading would be significantly correlated received substantial confirmation.

The difference between the magnitude of the correlation ratio and correlation coefficient was used to test the hypothesis that the relationships between each perception test and reading would be linear (see hypothesis VI, p. 10). Inspection of Table 7 reveals that a departure from linearity occurred only in the case of the Auditory Attention Span for Related Syllables test. The relationship between the Auditory Attention Span for Related Syllables test and reading achievement is portrayed graphically in Figure 1. Examination of Figure 1 reveals the presence of a monotonic increasing sequence in mean reading achievement for score values on Auditory Attention Span for Related Syllables, up to the interval of 54 to 57. At and beyond this interval, increases in mean reading performance appear unrelated to increments in auditory test scores. Tests of significance between perception test score intervals revealed that the presence of curvilinearity was not attributable to the decrease

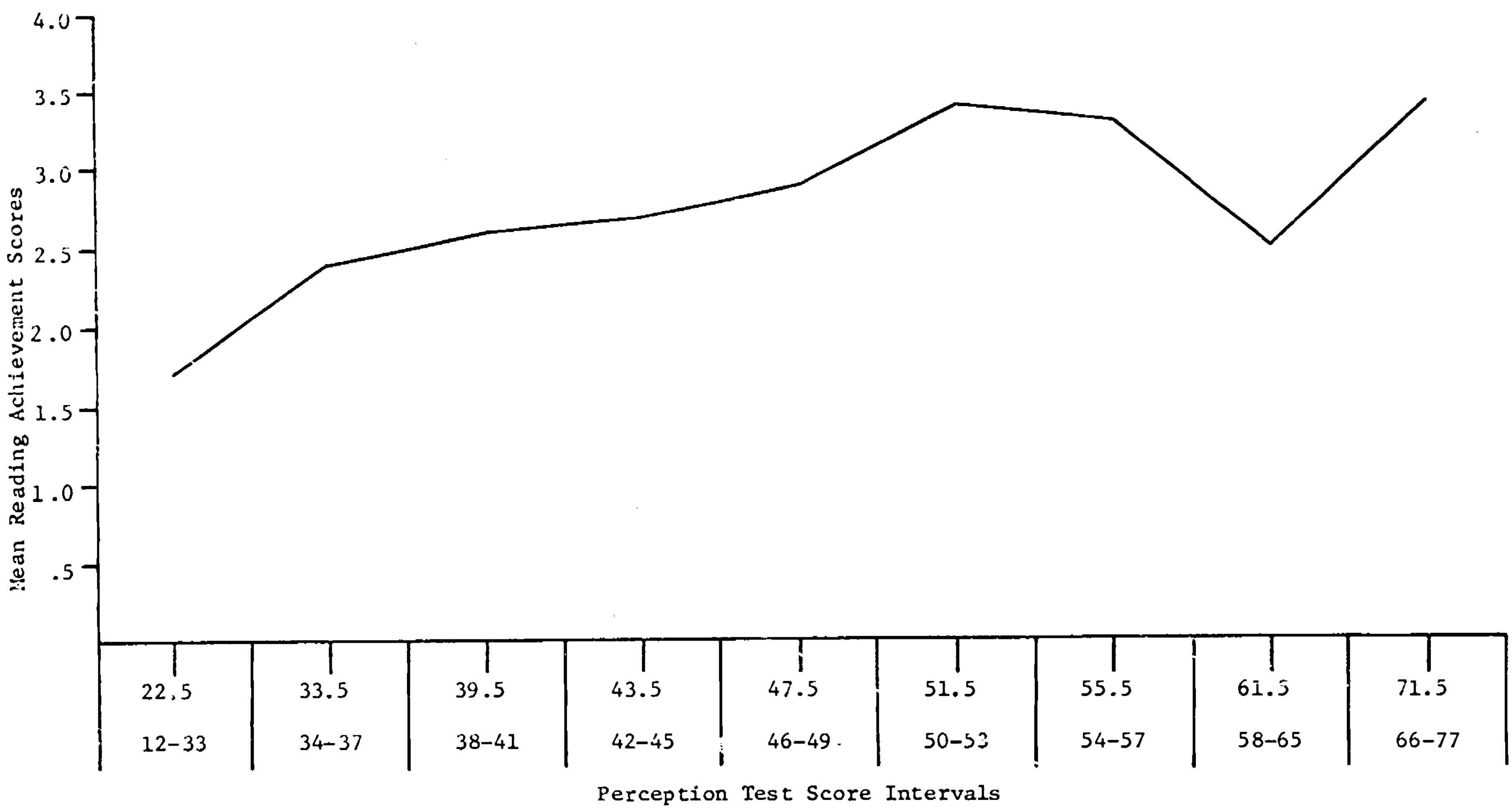

Figure 1. Relationship between Auditory Attention Span for Related Syllables and reading performance.

in reading performance for the score interval of 58 to 65. Since this interval included only eight subjects, the decrement in mean reading performance could be attributable to the operation of chance fluctuations, due to the sensitivity of the correlation ratio to the number of intervals and the number of subjects within intervals (Lewis, 1960). With the exception of this analysis, the relationship between perceptual and reading performance does not appear to depart significantly from linearity.

Partial correlations were computed in order to test the hypothesis that significant correlation coefficients would be obtained between the tests of perception and reading performance, with the influence of verbal intelligence held constant (see hypothesis VII, p. 10). Examination of Table 8 indicates that the partial correlations ranged in absolute value between .017 and .312. Of the 12 tests, the following seven produced significant partial correlations with reading achievement: 1) the Wepman Auditory Discrimination Test (r = .254), 2) the Wepman Auditory Discrimination Test, with noise (r = .171), 3) Digit Span (r = .195), 4) the Roswell-Chall Auditory Blending Test (r = .312), 5) Auditory Attention Span for Related Syllables (r = .246), 6) the Children's Embedded Figures Test (r = .297), and 7) Visual Automatic (r = .301). In every instance, the correlations between perception and reading performance decrease when the influence of intelligence is held constant. Moreover, the correlation between Stanford-Binet IQ and reading performance was appreciably higher than those obtained for any of the perception tests (r = .569). Thus, the prediction that significant correlations would be obtained between perceptual and reading performance, with the influence of verbal intelli-

Table 8

Partial Correlations Between Perception Tests and Reading Average

With the Effect of IQ Held Constant

Measures	Product Moment	Partial Correlation	t	$t_{.95}$
<u>Auditory Perception Tests</u>				
Wepman Auditory Discrimination Test	.386	.254	2.66**	1.66
Wepman Auditory Discrimination Test (with noise)	.192	.171	1.75*	1.66
Digit Span	.372	.195	2.01*	1.66
Roswell-Chall Auditory Blending Test	.460	.312	3.33**	1.66
Auditory Attention Span for Related Syllables	.426	.246	2.56**	1.66
Auditory Integration Test	.077	-.017	-.17	1.66
<u>Visual Perception Tests</u>				
Perceptual Speed	.297	.154	1.58	1.66
Children's Embedded Figures Test	.367	.297	3.15**	1.66
Visual Motor Sequencing	.123	-.018	-.18	1.66
Visual Automatic	.352	.301	3.19**	1.66
Memory-For-Designs	-.270	-.138	-1.41	-1.66
Visual Integration Test	.151	-.018	-.19	1.66
<u>Stanford-Binet IQ</u>	.569			

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

gence nullified, received only limited support.

Discussion

The results of the present study failed to support the prediction that providing teaching methods consistent with the auditory and visual perceptual strengths of disadvantaged Negro boys in the second and third grades would facilitate the learning and retention of unknown words. It appears that the subjects learned to recognize unknown words equally well under teaching procedures which matched either their perceptual strength or weakness. Failure to obtain an interaction between perceptual dominance and teaching approaches was consistent with the results of previous studies by Batemen (1967), Harris (1965), and Robinson (1968). Accordingly, extant evidence suggests that teaching to the perceptual strengths or weaknesses of children neither facilitates nor deters the development of word recognition skills.

Contrary to prediction, both perceptual dominance groups demonstrated a trend toward greater learning under the "look-and-say" teaching method ($p=.06$). The trend toward superior performance under this approach is particularly noteworthy, considering the subjects' history of systematic training in phonics. However, superior attainment under the visual presentation conforms with the results of recent studies dealing with the perceptual and learning characteristics of disadvantaged children. On a serial learning task, Katz and Deutsch (1964) found that a visual presentation was superior to both an auditory and alternating auditory-visual

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presentation for disadvantaged Negro boys. Moreover, current evidence indicates that disadvantaged children manifest marked deficiencies in auditory discrimination, memory, and sound blending (Deutsch, 1964; Clark & Richards, 1966; McConnell & Robertson, 1967). The superiority of the visually oriented method suggests that disadvantaged children may learn more efficiently under a visual rather than by an auditory presentation of verbal materials.

Although the present study instituted improvements in methodology over past studies, nevertheless it was subject to a number of limitations. First, as a consequence of three years of school experience, the subjects may have possessed confirmed reading habits which were more influential than perceptual characteristics in determining performance on the Mills Test. Moreover, the accumulated reading experience may have served to reduce the original auditory and visual perceptual differences among the subjects, thereby obfuscating any relationship between methods of teaching and perceptual dominance. Since performance on the Mills Test was confounded by the effects of reading ability, it may have lacked ample sensitivity to test adequately the presence of an interaction between perceptual dominance and methods of teaching word recognition. Second, current evidence indicates that the correlation between perceptual skills and reading decreases with age (Ashlock, 1965; Bryan, 1964; Olson, 1966a, 1966b). At the second and third grade level, the influence of auditory and visual perceptual abilities upon the development of reading skills may not be of sufficient magnitude to predict the learning of unknown words, under varying methods of presentation. Third, the identification of subjects was made by a rather comprehensive battery of auditory and visual perception tests. Yet these particular tests may not measure the most significant perceptual factors involved in learning to read. Perhaps instruments of higher validity could have predicted the interactive effects of modality dominance and methods of teaching word recognition. Finally, sampling procedures constituted the perceptual dominance groups on the basis of separate composite scores for the auditory and visual perceptual tests. Under this procedure, the subjects in the perceptual dominance groups did not demonstrate invariable inferiority on all tests in their weak perceptual modality. Perhaps the stringency of selection criteria could have been increased through requiring both consistent superiority on tests reflecting modality strength, and inferiority on those indicative of perceptual weakness. Furthermore, the identification of subjects with more extreme perception test scores, as well as the use of multiple regression weights to give greater emphasis to the most valid perception measures, might have led to the identification of subjects with greater disparity in auditory and visual perception skills.

Correlation coefficients and correlation ratios were used to assess the extent and nature of the relationship between each test of perception and a measure of reading performance. The prediction was not supported that each perception test would produce significant correlation ratios and product moment correlation coefficients with reading performance. Significant correlation ratios were obtained with reading achievement for six out of 12 tests, while nine of the product moment coefficients between perception tests and reading performance were significant. The magnitude of the correlation ratios and correlation coefficients were in the low to moderate range. The perception test with the highest correlation accounted for only 21 per cent of the differences in reading performance. Generally, the auditory tests yielded relatively higher coefficients than the visual perception measures with reading achievement. The differences in magnitude between the auditory and visual test coefficients may have resulted from either the measurement characteristics of the tests (i.e., reliability, validity, etc.), or the greater importance of auditory perception to the attainment of reading proficiency under a developmental reading program with a heavy phonic emphasis.

The first-order partial correlations between perception tests and reading performance decreased markedly when the influence of verbal intelligence was nullified. Moreover, Stanford-Binet IQ produced a higher correlation with reading achievement than any of the 12 perception tests ($r=.57$). Apparently, auditory and visual perceptual abilities contribute little to the influence of verbal intelligence in predicting reading performance at the upper primary grade level. Contrary to the relationship between intelligence and reading, the correlation between perceptual skills and reading appears to decrease with age (Neville & Bruininks, in press).

Past research on perception and reading performance appeared to suggest that a minimum level of auditory and visual perceptual ability is prerequisite to the attainment of normal progress in learning to read. The expected presence of a curvilinear relationship between perceptual measures and reading achievement was established only on the Auditory Attention Span for Related Syllables test. With this one exception, at the upper primary grade level the relationship between perceptual skills and reading performance does not appear to depart significantly from linearity.

<u>Implications for Future Research</u>

The present study represented a limited attempt to determine the value of matching teaching procedures to the perceptual proclivities of disadvantaged children. The selection of an inappropriate subject population may have been principally responsible for the failure to establish the value of teaching to the perceptual strengths or weaknesses of children. Therefore, efforts must be undertaken to research the value of teaching to the perceptual strengths and weaknesses of children. To test adequately the interaction of perceptual characteristics and teaching method upon learning to read, the present study should be replicated among nonreading, kindergarten-aged disadvantaged children. Use of preschool children would avoid confounding past reading experience with the criterion task of learning to recognize unknown words. Moreover, perceptual abilities at the preschool level are more highly related to later performance in reading. The selection criteria for constituting perceptual dominance groups should also be improved to reflect the demonstrated predictive validity of the perceptual measures. Accordingly, composite auditory and visual test scores could be determined through giving greater weight to the perceptual measures which demonstrate the highest correlations with reading performance.

In recent years, the diagnostic model of teaching has been recommended as an antidote for the amelioration of learning difficulties (Kirk & Bateman, 1962). Diagnostic or clinical teaching begins by a comprehensive assessment of deficit areas of behavioral functioning. Following the initial diagnosis, remedial exercises are instituted to ameliorate the areas of deficit. With respect to the domain of perception and reading, the validity of the clinical teaching model rests upon the questionable premise that the diagnostic devices truly reflect the critical correlates of reading performance. Unless diagnostic devices possess demonstrated validity, fundamental changes in reading performance will seldom accompany the remediation of deficit areas of perceptual functioning. A number of well controlled investigations are urgently needed to assess the value of clinical teaching approaches to dealing with learning difficulties. Furthermore, parallel efforts to develop improved diagnostic tests of perception, preferably with low intercorrelations with verbal intelligence, ought to continue.

The trend toward higher performance under the visual method of presentation, evidenced by both perceptual dominance groups, suggests a number of possible avenues for future research. An increasing accumulation of evidence indicates the existence of auditory perception deficits among disadvantaged children (Buktenica, 1966; Clark & Richards, 1966; Deutsch, 1964; McConnell & Robertson, 1967; Templin, 1957). Moreover, Katz and Deutsch (1964) found that normal and poor reading disadvantaged Negro boys learned verbal material more efficiently on a serial learning task under a visual or pictorial presentation. The least efficient learning occurred under the auditory mode of presentation. Hill and Hecker (1966), however, found no significant differences in learning performance under auditory and visual modes of presentation with a group composed largely of middle class children. The weight of evidence suggests that disadvantaged children learn more efficiently under a visual presentation of verbal material. The development of visual strengths among disadvantaged children may evolve from an environmental milieu in which the ratio of signal-to-noise is nearly equal (Deutsch, 1964). The excessive background noise of many low status homes undoubtedly encourages an orientation toward developing structure and order through concentration upon visual experiences. Future research should endeavor to focus upon determining the effects of environmental background upon the development of linguistic and perceptual abilities of children. Moreover, efforts should be undertaken to eradicate identifiable perceptual and linguistic deficits of disadvantaged children through systematic training, along with observing the effects of such training upon the development of reading performance.

Finally, the extensive prevalence of reading difficulty among elementary school children suggests the need to examine critically prevailing methods of reading instruction. According to the reviews of Chall (1967) and Gurren and Hughes (1965), a phonic or code emphasis approach to teaching reading is superior to a meaning emphasis, or sight-word approach. Yet the evidence seems to suggest the presence of marked deficiencies in auditory perception among disadvantaged children. The existence of auditory deficits among disadvantaged children undoubtedly interferes with the acquisition of early reading skills by means of a phonic approach. Perhaps disadvantaged children should be introduced to reading through emphasizing the visual characteristics of words, combined with systematic intervention efforts to ameliorate characteristic auditory perception deficits. Following the acquisition of a limited sight vocabulary and adequate auditory perception skills, systematic phonic training could then be phased into the reading sequence. The careful sequencing of reading and perceptual training experiences might lead to an appreciable reduction in the prevalence of reading failure among disadvantaged children.

Summary

The principal purpose of this study was to assess whether matching teaching methods to the auditory and visual perceptual strengths of second and third grade disadvantaged children would facilitate the learning of unknown words. A secondary objective sought to evaluate the extent and nature of the relationship between a number of auditory and visual perception tests and a measure of reading achievement. It was predicted that the use of teaching procedures in reading consistent with the perceptual strengths of children would facilitate learning to recognize and retain a list of words they were unable to read at the outset of the experiment.

The total subject pool consisted of 105 Negro boys with a mean Stanford-Binet IQ score of 90 and a range of 70 to 110. The mean chronological age of the sample was eight years, seven months. In terms of socioeconomic status, most of the sample would be classified as economically disadvantaged. To identify children with different perceptual characteristics, each subject was administered a battery of six auditory and six visual perception tests which measured perceptual components considered to be essential to the development of early reading skills. On the basis of perception test performances, the sample was divided into two perceptual dominance groups, each containing a total of 20 subjects. The pupils in one group demonstrated strengths in visual perception and auditory perception weaknesses, while the other group included subjects with auditory perception strengths and visual perception weaknesses.

An attempt was made to teach each subject to recognize 15 unknown words by a "look-and-say" approach, and 15 words by a phonic method in separate twenty-three minute lessons. The teaching procedures were taken primarily from the Mills Learning Methods Test. The learning criteria were the number of words recognized correctly immediately following the teaching lesson, and exactly one week after the lesson was taught. Within each perceptual dominance group, the order of teaching methods was counterbalanced across subjects.

Statistical analyses on the immediate and delayed recall scores of the two perceptual dominance groups were conducted by means of a 2 x 2 x 2 x 2 analysis of variance (perceptual dominance x retention x method x order of presentation). In addition, product moment correlations, partial correlations, and correlation ratios were computed to assess the extent and nature of the relationship between each test of perception and reading performance, using the original sample of 105 subjects.

The comparisons involving the differences between perceptual dominance groups, methods of teaching, and order of teaching presentation failed to reach statistical significance. Contrary to prediction, a trend was evidenced toward higher performance under the visual method of teaching ($p=.06$), irrespective of the child's perceptual characteristics. None of the interactions involving the attributes of perceptual dominance, methods of teaching, length of retention interval, or order of teaching presentation attained statistical significance. As expected, the mean performance scores on the immediate recall test were significantly higher than those obtained on the one-week delayed recall test. In the correlational analyses, significant correlation ratios with reading achievement were obtained for six out of 12 perception tests, while nine of the 12 product moment correlation coefficients between the perception tests and reading performance were significant. With the influence of verbal intelligence partialled out, the correlations between perception and reading test performance decreased markedly.

Apparently, second and third grade disadvantaged Negro boys learn to recognize unknown words equally well under teaching procedures which match either their perceptual strengths or weaknesses. The lack of diagnostic validity for the practice of identifying children with unique perceptual proclivities resulted from the low correlations between the auditory and visual perception tests and reading performance. At the second and third grade level, measures of auditory and visual perception appear to contribute little independent variance to verbal intelligence in the prediction of reading performance. Consequently, educational practices which tailor teaching methods to the perceptual proclivities of disadvantaged boys in the upper primary grades appear to possess minimal educational value.

Erratum----Page 15

Roswell-Chall Auditory Blending Test. The Roswell-Chall Auditory Blending Test (Roswell and Chall, 1963) measures the ability to synthesize individual and separate speech sounds into whole words. The test consists of 30 common words; the child is instructed to blend separate phonemes presented by the examiner into whole words (e.g., s-i-t = sit).

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APPENDIX A

REVIEW OF LITERATURE

Review of Research

Introduction

Reading is regarded as a developmental process whose essential characteristics change with age. In early reading, children are confronted primarily with an emphasis upon recognition, discrimination, and retention of printed symbols representing speech (Bond & Tinker, 1967; Harris, 1961; Smith & Dechant, 1961). The instructional emphasis in the primary grades is concerned predominately with seeing differences in printed words through the use of experiences designed to develop word recognition. Toward the end of the third grade, the instructional program shifts in emphasis away from the mechanics of "learning to read" toward "reading to learn" (Smith & Dechant, 1961).

The mastery of reading fundamentals is contingent upon adequate verbal intelligence, and auditory and visual perceptual ability (Goins, 1958; Smith & Dechant, 1961; Wepman, 1967). Perception is defined as the reception, retention, and interpretation of stimuli (Kimble & Carmezy, 1963). Within the context of reading, however, perception denotes the ability to: 1) analyze and synthesize speech sounds and visual symbols, 2) distinguish between the minute details of visual and auditory stimuli, 3) retain auditory and visual stimuli presented sequentially, or as "wholes," and 4) integrate perceptual impressions across primary sense modalities.

Many children encounter great difficulty in acquiring initial reading skills under traditional methods of teaching reading. Surveys of large school populations indicate that the prevalence of reading difficulty varies from 10 to 30 per cent (Austin, Bush, & Huebner, 1961; Eisenberg, 1966; Harris, 1961; Malmquist, 1958). The prevalence of poor reading among low socioeconomic status groups is about four to ten times the rate reported in the rest of the school population (Chandler, 1966; Deutsch, 1966). Moreover, statistics reveal that boys greatly outnumber girls in the incidence of reading failure (Bentzen, 1963). The pervasiveness of reading failure, particularly among socially disadvantaged children, poignantly illustrates the inadequacies inherent in the current approaches used to develop early reading skills.

The high prevalence of reading failure among elementary school, children may result from a failure to match the unique perceptual learning styles of children to an appropriate instructional emphasis. Prevailing approaches to teaching reading vary on the relative degree of auditory and visual emphasis. The "look-and-say" approach to reading concentrates upon the visual aspects of words (Russell & Fea, 1963). Under the phonic method, auditory cues in the form of the sounds of single letters, or groups of letters, are used to develop word recognition (Russell & Fea, 1963). The "look-and-say" method relies almost exclusively upon the eye as the receptor, whereas the phonic approach places greater emphasis on learning through the auditory modality. Little accommodation, however, is made for children with wide individual differences in auditory and visual perceptual abilities in modern approaches to the teaching of reading. Consequently, children with auditory perceptual dominance, and visual perceptual weaknesses, may be taught to read under teaching approaches which employ a visual emphasis.

Likewise, children with visual perceptual dominance, and auditory perceptual weaknesses, may be introduced to reading through instructional approaches using a heavy auditory, or phonic emphasis. With some children, an inappropriate match between perceptual characteristics and the method used for reading instruction may act as a deterrent to the normal development of early reading skills.

The following review of research seeks to examine the tenability of matching teaching procedures to the auditory and visual perceptual strengths of children. In the sections below, research literature pertaining to the following areas is discussed: 1) the teaching of word recognition, 2) perceptual and reading characteristics of socially disadvantaged children, 3) auditory perception and reading, and 4) visual perception and reading.

The Teaching of Word Recognition

Few aspects of the elementary school curriculum have evoked as much acrimonious debate as the issue over what constitutes the most efficacious method to develop early reading skills. The protagonists of the debate have usually championed the efficacy of either: 1) the "look-and-say," or 2) the phonic method. Under the "look-and-say" or analytic reading approach, instruction is initiated by introducing words or "wholes" as units of meaning (Russell & Fea, 1963). Later, the child learns to analyze these words into their constituent auditory and visual elements. In contrast, the synthetic or phonic approach to reading is based upon the premise that children should be taught to read by learning to recognize the individual auditory and visual components of words. In this instructional orientation, children first learn the common letter-sound associations and are taught later to synthesize these units into words (Bliesmer & Yarborough, 1965).

While there has been a recent increase in the use of the synthetic method, the analytic emphasis is still the predominant approach to early reading instruction. During the 1950's, surveys covering a large number of states and local school districts found that approximately 90 per cent of extant reading instruction employed predominately an analytic, or sight-word approach (Staiger, 1958; Stewart, 1957). Most of the current approaches to teaching reading, however, include substantial components of both the sight-word and phonic approaches (Chall, 1967).

A number of studies have compared the efficacy of the sight-word and the phonic approaches to initial reading instruction. Chall (1967) found that most of the studies which compared the "look-and-say" and phonic method were conducted before, or during the 1930's. In an analysis of nine studies, Chall (1967) concluded that the children taught phonics were superior to those under the sight-word approach in both word recognition skills and oral reading. The findings on the factors of reading rate and comprehension were less conclusive.

Most of the research on methods of teaching initial reading skills after 1930 compared programs employing varying degrees of phonic instruction (Russell & Fea, 1963). In recent studies (Bear, 1964; Bliesmer & Yarborough, 1965; Henderson, 1955), the synthetic approach, in comparison to analytically oriented methods, led to superior reading achievement in the first grade. In the Bear (1964) and Henderson (1955) studies, the synthetic groups maintained their superiority even at higher grade levels. Gurren and Hughes (1965) reviewed the results of 22 studies which contrasted reading programs containing either gradual or intensive phonics instruction. The intensive phonics programs resulted in superior reading achievement in 19 out of 22 comparisons. None of the comparisons favored the gradual phonics groups. Further evidence for the value of systematic phonics is provided by Chall (1967). After reviewing 25 studies, Chall (1967) concluded that "systematic phonics at the very beginning tends to produce generally better reading and spelling achievement . . ., at least through grade 3 (p. 114)."

The value of phonics instruction is given additional support by the results of the U. S. Office of Education first grade studies on reading instruction. Bond and Dykstra (1967) concluded, from an analysis of four studies, that a basal reading program supplemented with training in phonics was superior to the use of just basal method materials alone.

The results of some studies have perpetuated the notion that phonics instruction is less effective for children of lower mental ability (Anderson & Dearborn, 1952; Dolch & Bloomster, 1937; Garrison & Heard, 1931). More recent findings, however, appear to refute this widely held assumption. Naeslund (1955), cited by Harris (1961), conducted a study in Sweden which compared synthetic and analytic methods of teaching reading to pairs of twins. While no significant differences between methods emerged for children of normal or superior ability, the synthetic method resulted in superior achievement for children of lower mental ability. The results of a number of other studies appear to support Naeslund's findings (Chall, 1967; Gurren & Hughes, 1965).

Dispite results favoring phonics instruction, studies concerned with the efficacy of different approaches to teaching early reading have produced rather disappointing results. To date, none of the current methods of reading instruction has been successful in reducing appreciably the prevalence of reading disability (Stauffer, 1967). The failure to substantively reduce reading difficulties may be the result of concentrating upon "method" differences, while concomitantly ignoring the individual differences among children. Perhaps reading difficulties could be reduced by tailoring initial reading instruction to the unique learning styles of children (Wepman, 1967). Since auditory and visual perceptual skills are highly related to performance in early reading (Smith & Dechant, 1961), it might be profitable to group children for instruction according to their strengths in these areas. The matching of instructional procedures in reading to auditory or visual perceptual aptitudes might facilitate the acquisition of reading skills, while concomitantly reducing the high prevalence of reading disability found among elementary school children.

Perceptual and Reading Characteristics of Disadvantaged Children

The environmental milieu of the culturally disadvantaged child offers few opportunities to develop the prerequisite skills to master early reading. Auditory and visual stimuli in the slums are restricted, unorganized, and qualitatively inferior to the stimulation provided to children of higher socioeconomic groups (Deutsch, 1963). Thus, the disadvantaged child typically comes to school with marked perceptual and

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cognitive deficits which interfere with the normal development of reading skills (Deutsch, 1963; Deutsch, 1964).

Evidence from a number of studies indicates that socially disadvantaged children are inferior on several facets of perception in comparison to children of higher socioeconomic status. The perceptual deficiencies of the disadvantaged appear to be most evident on measures of auditory perception (Jensen, 1966). Templin (1957) found low socioeconomic status pupils (CA 6 to 8) significantly inferior on tests of auditory discrimination when compared to children of higher social status. Clark and Richards (1966) found preschool deprived children made significantly more errors than a group of non-deprived children on the Wepman Auditory Discrimination Test. Buktenica (1966) found first grade disadvantaged children significantly inferior to middle class subjects on verbal and non-verbal tests of auditory discrimination.

Weaver and Weaver (1967) studied the psycholinguistic profiles, as measured by the Illinois Test of Psycholinguistic Abilities, of three groups of preschool Negro disadvantaged children. For the combined samples, the subtest scores dealing with the auditory and vocal channels were significantly lower than those involving the visual and motor channels of communication. The authors also noted the similarity between the psycholinguistic profiles of disadvantaged and mentally retarded children.

Deutsch (1964) maintains that disadvantaged children grow up in noisy environments which mitigate against the development of adequate auditory discrimination. In a study of disadvantaged good and poor reading Negro children in grades one, three, and five, Deutsch (1964) found the poor readers significantly inferior on the Wepman Auditory Discrimination Test. The differences between reading groups were particularly pronounced at the youngest age levels. The absence of higher socioeconomic status and ethnic control groups, however, limits the direct generalization of these results to Deutsch's cultural deprivation hypothesis. Some confirmation of the Deutsch (1964) hypothesis is provided in a recent study by McConnell and Robertson (1967). Tests of auditory discrimination, auditory memory, and sound blending were administered to preschool groups of low socioeconomic status Negro and middle socioeconomic status Negro and Caucasian children. The disadvantaged Negro children were significantly inferior on all three auditory tasks. The middle socioeconomic status Caucasian children were significantly superior to the Negro group on the test of sound blending.

Although considerable evidence exists to indicate the presence of an auditory discrimination deficit among disadvantaged children, few studies have investigated the visual perceptual skills of children from different socioeconomic status backgrounds. Bukenica (1966) compared the auditory and visual perception skills of first grade middle socioeconomic status Caucasian, and lower socioeconomic status Negro and Caucasian children. Several verbal and non-verbal auditory and visual discrimination tests were administered. The lower socioeconomic status subjects were inferior on all auditory and visual perception tests. Moreover, the Caucasian children tended to perform better than the Negro children on all tests. Among the middle class children, the auditory perception tests tended to produce higher correlations with reading. The correlations between perception tests and reading for the lower class children did not reveal any distinctive pattern.

Covington (1962) contrasted upper and lower status kindergarten children on a visual discrimination test of abstract forms. The upper status group obtained significantly higher scores. Following the initial test, Covington (1962) administered a perceptual training program for 13 consecutive days to a random sample of children in each of the social status groups. The results of the study revealed that the low status subjects made significantly greater gains in comparison to the upper status children. The children in the control groups failed to make any appreciable gain during the experimental treatment period. Covington (1962) concluded that low status children were more likely to benefit from perceptual training.

In addition to perceptual deficits, disadvantaged children display marked deficiencies in linguistic abilities. Bernstein (1959) compared the linguistic patterns of the lower and middle class groups. In comparison to the middle class subjects, the language of the lower class group was informal, syntactically inferior, and focused primarily upon concrete needs and immediate circumstances. Irwin (1948) found significant differences in language maturity between infants of working class and white collar workers. The frequency of phonemes, the onset of true speech, and the rate of speech development all favored the white collar groups. Newton (1964) found that lower class children frequently mispronounced words, and used monosyllabic words, simple sentences, and sentence fragments.

The pervasive deficiencies of disadvantaged children in linguistic and perceptual abilities undoubtedly act as predisposing factors to the development of poor reading. Epidemiological surveys find that poor reading is about four to ten times more common among low socioeconomic status groups in comparison to the prevalence reported for the rest of the school population (Chandler, 1966; Deutsch, 1966; Eisenberg, 1966). In one study, only 36 per cent of 6,000 culturally disadvantaged primary school children were found to be reading at the appropriate grade level (Shepard, 1962). Eisenberg (1966) found the rate of reading difficulty in a large metropolitan area three times greater among sixth grade Negro children in comparison to their Caucasian peers (36 versus 12 per cent). The rate of reading failure among Negro boys was 42 per cent. The pervasiveness of reading failure, particularly among disadvantaged Negro boys, poignantly illustrates the inadequacies inherent in the current approaches used to develop early reading skills.

Few studies have investigated the reading characteristics of disadvantaged children. Hanson and Robinson (1967) contrasted the performances of Negro disadvantaged children to groups of children from average and advantaged socioeconomic status backgrounds on tests of reading achievement and reading readiness. The authors concluded that "in comparison to advantaged children, the disadvantaged evidently enter the primary grades less ready to learn to read, and the difference between the two reading groups appears to increase at each grade level (p. 56)."

Characteristics of the mentally retarded subjects may be illustrative of the pattern of reading abilities found among disadvantaged children of higher mental ability. Dunn (1956) studied the reading characteristics of mentally retarded and normal boys of the same mental age (MAs between 8-0 to 10-0). The retarded subjects were rated significantly poorer on home conditions and other indices of socioeconomic status. In comparison to the normal controls, the reading abilities of the retarded boys were characterized by inferior ability in the use of context clues, deficiency in phonic word attack skills, and slower speed of recognition for words and phrases.

Current evidence reveals that socially disadvantaged children come to school with marked perceptual and linguistic deficiencies. Children of low socioeconomic status are poorer in auditory discrimination, in manipulating the syntactical aspects of language, and in the recognition of perceptual similarities (Deutsch, 1965; Weaver & Weaver, 1967). The environmental backgrounds of disadvantaged children appear to predispose them to the development of perceptual styles and habits which are inadequate, or irrelevant to the development of reading skills (Gordon, 1965). Deutsch (1965) has coined the term "cumulative deficit" to describe the tendency of disadvantaged children to fall increasingly behind in academic subjects with each successive grade level. The coexistence of a high prevalence of perceptual and reading deficiencies among these children suggests the urgent need to alter the traditional approaches to teaching reading. Perhaps remedial procedures which match instructional emphases to individual learning styles would reduce

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materially the prevalence of reading difficulties found among disadvantaged children.

Auditory Perception and Reading

The term auditory perception is being used to refer primarily to the skills of auditory discrimination, auditory sound blending, and auditory memory. Auditory discrimination is defined as the ability to distinguish between closely related speech sounds (Weiner, 1967). Sound blending refers to the facility to synthesize phonemes or speech sounds into whole words. Auditory memory is defined as the ability to retain a related, or unrelated sequence of orally presented symbols, such as digits or words.

A number of studies have examined the correlational relationships between auditory discrimination and reading. Durrell and Murphy (1953) investigated the correlation between the ability to identify sounds in spoken speech and reading with a group of 891 pupils in grades one through three. The correlations between these two variables ranged between .52 and .56. Using the same tests, Harrington and Durrell (1955) found a similar relationship with a large population of primary grade children ($r = .54$). Moreover, pupils with high auditory discrimination scores were significantly superior on reading achievement in comparison to a group with low scores. With a large sample of first grade children, Dykstra (1966) found correlations between seven auditory discrimination measures, from established reading readiness tests, and reading varied from .18 to .43. Most of the correlations ranged between .30 and .40.

Buktenica (1966) administered the Wepman Auditory Discrimination

Test and a non-verbal measure of auditory discrimination to 342 first grade children. The correlations of the Wepman and non-verbal auditory discrimination tests with reading total (average of two word recognition tests) were .46 and .51, respectively. Correlations were also computed separately for middle and low socioeconomic status pupils. The correlations between the tests of auditory discrimination and reading were found to be lower for the low socioeconomic status pupils.

The correlations between tests of auditory perception and reading appear to decrease with chronological age. Reynolds (1953) investigated the correlations between several tests of auditory perception and reading with a sample of 188 fourth grade pupils. In general, the correlations between the perception tests and reading achievement were low. With the effect of MA held constant, the relationships between tests of auditory perception and reading failed to reach statistical significance. Reynolds concluded that auditory measures did not add significantly to MA in the prediction of reading. In another study of intermediate grade children, Wheeler and Wheeler (1954) found correlations between auditory discrimination tests and reading varied between .31 and .40.

Few correlational studies have examined the relationship between auditory sound blending and reading. Mulder and Curtin (1955) found a significant correlation between sound blending and reading with fourth grade pupils ($r = .44$). Chall, Roswell, and Blumenthal (1963) studied the relationship between the Roswell-Chall Auditory Blending Test and reading among a group of Negro pupils, mostly of low socioeconomic status.

The sound blending measure, administered in the beginning of the first grade, correlated moderately with reading achievement in the third grade (r = .51). Contrary to the results of Reynolds (1953), the correlation increased when the influence of IQ was removed statistically (r = .64). Finally, significant correlations between sound blending and reading were also reported by Balmuth (1966) in a study which included children in grades one through six.

Studies of the relationship of auditory discrimination, sound blending, and memory to reading have concentrated primarily on populations of good and poor readers. In a definitive study, Monroe (1933) contrasted first grade readers and non-readers of normal IQ on several psychological tests. Non-readers were found to be significantly inferior on tests of auditory discrimination and sound blending. Bond (1935) compared the performances of 64 matched pairs of good and poor readers of average intelligence in the second and third grades. Poor readers were significantly inferior on tests of auditory memory, sound blending, and auditory discrimination. Goetzinger, Dirks, and Baer (1960) found poor readers (CA 10-7 to 12-9) significantly inferior to carefully matched good readers on the Wepman Auditory Discrimination Test and another test of speech sound perception. A correlation of .56 was found between Wepman Test scores and reading performance. Christine and Christine (1964) found average readers significantly superior both to groups of poor readers and children with articulation problems on the Wepman Auditory Discrimination Test. Sonnenberg and Glass (1965) found that, among a group of poor readers referred to a reading clinic, 80 per cent had deficiencies in auditory discrimination. Other studies have also provided supporting evidence concerning the inferior performance of poor readers on tests of auditory discrimination (Thompson, 1963; Wepman, 1960; Wolfe, 1941), sound blending (Kass, 1966), and memory (Graham, 1952; Hirst, 1960; McDonald, 1964; Neville, 1961; Robeck, 1964).

The act of reading also requires efficient liaison and integration between the sense modalities of vision and audition (Vernon, 1959). In reading, children are asked to associate an aural language repertoire with spatially arranged printed words (Birch & Belmont, 1964; Vernon, 1957). A number of recent studies have attempted to assess the contribution of cross modality perception to the development of reading. Most of these studies have dealt with the ability to match an aurally presented temporal pattern to a visual, spatially arranged dot pattern.

Birch and Belmont (1964) tested the ability of good and poor reading boys (CA 9-4 to 10-4) to match a temporal set of auditory tap patterns to visual-spatial dot patterns. The subject was presented auditory patterns produced by pencil taps, and then was asked to choose from three spatial dot patterns the one that looked like the pattern he had just heard. The performance of poor readers on this task was significantly inferior to that of a good reading group.

In a later study, Birch and Belmont (1965) used the same task to study the interrelationships among the auditory-visual integration test, IQ, age, and reading with a group of 220 subjects in kindergarten through grade six. The correlations between auditory-visual integration and reading decreased markedly with age from .70 in the first grade to .42

in the second grade. The correlations could not be explained by memory factors. Birch and Belmont concluded that auditory-visual integration was a more important component to the acquisition of reading skills than to the development of reading comprehension.

Kahn (1965), using the Birch and Belmont (1964) task, essentially replicated the above results with a group of 350 boys in grades two through six. Kahn found significant correlations between auditory-visual integration and age (r = .51), reading (r = .37 to .57), and IQ. The correlations with reading retained their level of significance, even after the influence of intelligence had been statistically removed. Furthermore, the factors of visual discrimination, auditory memory, and auditory rhythm discrimination did not account for the results.

Sterritt and Rudnick (1966) developed an experimental apparatus which avoided the confounding of vision in the presentation of auditory temporal stimuli through presenting pure tones to the subject via headphones. Sterritt and Rudnick used the Birch and Belmont test along with tests requiring both the matching of auditory-temporal tone patterns to visual-spatial dot patterns, and visual-temporal light patterns to visual-spatial dot patterns with 36 fourth grade boys (mean IQ = 128.4). Correlations between reading comprehension and the three tests ranged from .50 to .66. Only the auditory-temporal to visual-spatial test contributed significant variance (23 per cent) to MA in a multiple regression equation with reading. The two tests accounted for 69 per cent of the variability in reading scores. In a later replication (Rudnick, Sterritt, & Flax, 1967), both the auditory to visual-spatial and the visual to visual-spatial tests contributed significant variance to mental age in predicting reading, with a group of third grade boys. The two perceptual integration tests also contributed variance to each other in predicting reading. The Birch and Belmont test, however, did not add significantly to the prediction of reading scores when it was used in combination with mental age.

In summary, research evidence involving unselected children and groups of poor readers demonstrates the importance of adequate auditory discrimination, memory, and sound blending to early reading progress (Dykstra, 1966; Monroe, 1933). The relative contribution of auditory perception skills to the development of reading seems to decrease with chronological age. Poor readers, however, perform poorly on measures of auditory perception even at the intermediate grade level. Furthermore, perceptual skills which require the cross-modal matching of auditory and visual stimuli appear to be of considerable importance to the development of reading skills. Deficiencies in auditory perception may be causally linked to the development of poor reading, particularly under teaching methods which emphasize a phonic approach.

Visual Perception and Reading

Printed symbols in the form of Standard English words are visual shapes extended spatially in an invariable left-to-right order (Vernon, 1957). In reading, the child must be able to distinguish between shapes that possess many common details (e.g., in the case of was and saw). This requires the ability to discern similarities and differences between symbols, as well as the capacity to retain their perceptual configurations over time.

The earliest comprehensive studies of visual perception and reading were conducted by Gates (1922, 1926). Gates (1926) administered a number of different visual perception tests to 310 pupils in grades one through six. Discrimination of words in grades two and three produced substantial correlations with reading, but low relationships were found between material using digits and geometric designs and reading performance. Gates concluded that perception is not a unitary capacity and that tests which used words as material were more highly correlated with reading. Barrett (1965), in a comprehensive review of literature, has cited some confirmatory evidence to support Gates' position. Since tests using words confound reading skill with the measurement of perception, their usefulness as independent predictors of reading performance is limited.

Goins (1958) used 14 non-verbal tests of visual perception to predict first grade reading achievement. Total perception (the sum of all test scores) correlated moderately with reading ($r = .50$). A Pattern Copying Test produced the highest correlation ($r = .52$). In a factor analysis of the perception test scores, two factors emerged: 1) the ability to hold in mind a perceptual gestalt during rapid perception (P_1), and 2) the ability to keep in mind a configuration against distraction (P_2). The tests in factor P_2 yielded the highest correlations with reading achievement.

Buktenica (1966) administered two tests of visual discrimination and a measure of geometric form copying to 342 first grade children. The visual discrimination tests produced low correlations with a measure of reading achievement (.26 and .33). Ability to copy geometric forms produced a correlation of .50 with reading. In another study, Ashlock (1965) correlated visual discrimination tests of alphabetic, geometric, and digital symbols with reading achievement in grades one through three. The correlations between the visual discrimination tests and reading decreased with chronological age.

A number of investigators have studied the relationship of the Frostig Developmental Test of Visual Perception to reading (Bryan, 1964; Olson, 1966a, 1966b; Schellenberg, 1963). These studies have found moderate correlations between Frostig scores and reading only in the first two grades. The relationships become negligible at higher grade levels. The decrease in the correlations might be purely an artifact of an insufficient ceiling of the Frostig test. Along with the results of Ashlock (1965), however, the results may suggest that visual perception is an important component in the establishment of reading fundamentals, but not to the later development of reading comprehension. The trend of the relationship between visual perception and reading is opposite to the one found between reading and measures of intelligence (Neville & Bruininks, in press).

A number of studies have contrasted groups of good and poor readers on tests of visual perception. Fendrick (1935) studied the visual performance of matched pairs of good and poor readers in the second and third grades, using optometric tests and nine measures of visual perception. The groups differed significantly on only two of the visual perception tests. Malmquist (1958) found poor readers significantly inferior to both good and average readers on tests of visual perception. Kass (1966) found a group of poor readers of normal intelligence in the early elementary grades (CA 7-0 to 9-11) significantly inferior to test normative groups on the Perceptual Speed Subtest from the Primary Mental Abilities Test, and on the Visual-Motor Sequencing Subtest of the Illinois Test of Psycholinguistic Abilities. Elkind, Larson, and Van Doornick (1965) found poor readers significantly slower than good readers, matched on CA and IQ, in learning to extract hidden figures from more complex ones. Rizzo (1939) found poor readers inferior to good readers on a visual memory span test of unrelated letters. Finally, Katz (1967) tested the hypothesis that perceptual deficits among poor readers were due primarily to the factor of stimulus meaningfulness. Good and poor reading Negro males in grades two, four, and six were contrasted on their ability to discriminate auditorily and visually presented English and Hebrew word pairs. Poor readers were significantly inferior on all perceptual tasks, but no interaction was found between stimulus meaningfulness and reading performance.

A few studies have examined the importance of visual-motor memory to reading performance, using the Memory-For-Designs Test (Graham & Kendall, 1960). Kendall (1948) found no relationship between performance on Memory-For-Designs and reading, using a small sample of subjects who were highly heterogeneous on chronological age. In contrast, Walters (1961) and Leton (1962) found significant associations between reading and Memory-For-Designs performance, using groups of good and poor readers. Kass (1966) found poor readers significantly inferior to the test normative population on Memory-For-Designs performance. Perhaps the failure to find a relationship between visual-motor memory and reading in the Kendall (1948) study can be attributed to the factor of chronological age. All of the other studies used children in the primary grades; in contrast, the subjects in the Kendall (1948) study covered an age range of six to 16 years.

In summary, the research literature appears to substantiate the importance of visual perception and visual memory to early reading performance. Visual perception appears to be less related to success in reading at the intermediate grade level. It is important to note, however, that poor readers are found consistently inferior on visual perception measures even at upper grade levels. Thus, deficiencies in visual perception undoubtedly interfere with the development of early reading skills, particularly under instructional procedures which emphasize primarily a visual approach.

Sense Modality Dominance and Reading

Research has demonstrated the relevance of adequate visual and auditory perceptual skills to the development of reading. Furthermore, an examination of research evidence pertaining to the socially disadvantaged reveals the existence of a high prevalence of perceptual and reading problems. With many disadvantaged children, learning difficulties may develop as a consequence of pronounced deficits in one or both of the critical sensory modes for the normal acquisition of language. A method of teaching which ignores the perceptual deficits of disadvantaged children is likely to exacerbate the difficulties they encounter in attempting to develop skills in reading.

The relationship of sense modality strengths or weaknesses in perception to the efficiency of acquiring reading skills has been largely ignored. Several investigators, however, have contrasted the efficiency of learning verbal materials presented via the sense modalities of vision and audition. In one study, Katz and Deutsch (1964) contrasted poor and normal readers on a serial learning task under visual, auditory, and combined auditory and visual presentations. The test stimuli consisted of common nouns presented either aurally or visually. The subjects were Negro males in grades one, three, and five, mostly from low socioeconomic backgrounds. The good readers were significantly superior on all tasks, particularly under the aural presentation. With both reading groups, the visual presentation resulted in the most efficient learning, followed by the combined and auditory presentations. The performance differences between the reading groups were most pronounced at the youngest age levels.

Budoff and Quinlan (1964) tested the ability of 56 second grade children to learn three and four letter nouns and verbs under auditory and visual presentations. The aural presentation resulted in significantly greater learning efficiency. Hill and Hecker (1966) used line drawings instead of printed words as a visual stimuli in a replication of the Budoff and Quinlan (1964) study. Hill and Hecker (1966) found no significant differences in learning efficiency between the auditory and visual modes of presentation.

A review of verbal learning studies which vary mode of presentation reveals a number of general trends. The results of these studies indicate that an auditory presentation is more effective than a visual presentation of materials with young children. Conversely, a visual presentation results in a greater learning efficiency among older children and adults (McGeoch & Irion, 1952; Van Mondfrans & Travers, 1965). After a comprehensive survey of research on the visual and auditory presentation of verbal material, Day and Beach (1950) concluded that the visual modality became increasingly more efficient as the age, IQ, and reading level of the subjects increased.

The results of the verbal learning studies on sensory mode of presentation have limited implications for reading instruction. In most studies, the learning tasks have used printed words as visual stimuli, thereby confounding the stimulus material with the effects of reading ability. Among young children, audition is the primary sense modality for the acquisition of information. With older children and adults, vision or reading becomes the primary avenue for the acquisition of information. The age differences found in modality based learning may be explained by habitual patterns of usage, rather than by the intrinsic stimulus value of different modes of presentation. In the study by Hill and Hecker (1966), learning was equally efficient in both the auditory and visual modalities when the reading factor was controlled. Katz and Deutsch (1964), however, found a visual presentation more efficient for good and poor reading Negro children of low socioeconomic status. Perhaps the disparate results of these two studies suggest that mode of stimulus presentation of verbal material is important only for children from disadvantaged backgrounds. School related learning, however, depends upon the utilization of many modalities, making learning via one particular sense modality alone impractical and inefficient.

A few studies have examined the relationship of auditory and visual modality strengths to the development of reading skills. Bond (1935) and Fendrick (1935) studied the auditory and visual characteristics of the same samples of good and poor readers. The reading groups were sampled from the second and third grades of four schools, and matched on the factors of chronological age, IQ, school, sex, and amount of exposure to school. Three of the schools used a sight-word method to teach reading, while the reading approach in the fourth included an extensive phonics program. Bond (1935) found that the differences obtained between reading groups on auditory measures were greatest under an instructional program in which the children had been taught principally through a phonic, in contrast to a sight-word approach. In contrast, Fendrick (1935) found that the differences between good and poor readers on visual tests were most predominant under the "look-and-say" approach. Fendrick concluded that the "sensory differences were probably a function of the teaching method employed (p. 51)." However, the extent of reading disability among the poor reading group could have resulted from neglecting to match the methods of teaching to the auditory or visual perceptual proclivities of the pupils.

In a post hoc analysis, de Hirsch, Jansky, and Langford (1966) explored the relative strength of 53 subjects on pre-reading auditory and visual perception tests. Seven pupils with clear auditory strengths and three with visual strengths were identified. The three pupils superior on the visual tests were also good readers at the end of the second grade. Of the seven pupils who were identified with the auditory strengths, five were classified as good readers, while two failed an entire battery of reading tests. Further investigation of the auditory strength pupils revealed that the successful readers learned to read primarily under a phonic approach, while the two reading failures had been taught by a visual or sight-word approach. The results led the authors to conclude that "exploration of modality strength and weakness is of more than theoretical interest and should largely determine teaching methods (p. 82)."

Bateman (1967) tested the efficiency of auditory and visually oriented methods of teaching reading with first-grade children grouped by preferred learning modality (auditory or visual). Pupils were classified as auditory or visual subjects on the basis of their scores on the two automatic-sequential memory subtests from the Illinois Test of Psycholinguistic Abilities. Auditory subjects had auditory memory scores which exceeded their visual memory scores by more than nine months. Pupils were designated as visual if the discrepancy between the two memory test scores was less than nine months. A total of eight first grade classrooms participated in the study. In two classes, visual and auditory children were grouped homogeneously into separate classrooms, and taught to read using methods of instruction whose emphasis matched their perceptual strengths (i.e., visual subjects-visual method, etc.).

In two other classes, auditorily and visually dominant children were grouped homogeneously into separate classrooms, and the methods of reading instruction were used which matched their perceptual weaknesses (i.e., visual subjects-auditory method, etc.). In addition, four classes of unselected children participated in the study. Two of the classes received a visually oriented method, while the other two learned to read using a reading program with a heavier phonetic emphasis. The method used for the auditory approach was the Lippincott basal reading program; the visual method classes used the Scott, Foresman basal series. The results following the first grade found the auditory method pupils significantly superior, regardless of the preferred perceptual modality. Thus, the matching of teaching methods to perceptual strengths did not appear to enhance the development of reading achievement.

A number of methodological weaknesses are inherent in the above study. First, high ability pupils were used as subjects (mean IQ > 120). The impact of this factor upon the results can be clearly seen in the high level of reading achievement obtained by the eight participating classes. (The lowest achieving class obtained a mean reading grade equivalent of 2.98.) Since most children of high mental ability also possess superior auditory and visual memory, modality dominance would be expected to be less predictive of success in learning to read. Moreover, the choice of reading method is probably less important for children of high mental ability (Chall, 1967). The use of a high ability population probably precluded an adequate test of the efficacy of matching perceptual strengths to approaches to teaching reading.

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Second, the method used to classify pupils by preferred learning modality was inadequate. The use of more than two tests, measuring different facets of perception, is required in order to establish valid sense modality patterns of learning. Also, the selection criterion for the visual group was not as stringent as the one used to establish the auditory dominance group. Third, the influence of teacher effectiveness was uncontrolled. Recent evidence indicates that the teacher is more influencial than the teaching method in the development of reading skills (Bond & Dykstra, 1967; Dunn et al., in press). Finally, the two basal reading series used in the study do not differ enough in instructional emphasis to test adequately the relationship of matching teaching methods to the perceptual learning styles of children.

Robinson (1968) contrasted a basal reading program and the Hay-Wingo phonic approach for pupils with different auditory and visual aptitudes. The basal approach included 232 pupils, while 216 subjects participated in the Hay-Wingo program. A different school system was represented in each teaching approach. Upon entrance into the first grade, all pupils were administered three tests of visual discrimination that had been shown by Goins (1958) to be highly related to reading test performance. High and low visual perceivers were then administered the Wepman Auditory Discrimination Test. From the auditory and visual test scores, the following groups were constituted within each teaching method: 1) high visual-high auditory; 2) high visual-low auditory; 3) low visual-high auditory; and 4) low visual-low auditory. The four perceptual strength groups within each teaching method were contrasted on reading performance at the end of the third grade. Generally, the results failed to reveal any significant interaction between methods of teaching and perceptual abilities. However, the low visual-high auditory children made slightly greater progress under the phonic approach ($p = .10$) at the end of first grade.

Harris (1965) tested the effects of kinesthetic or phonic instruction upon the reading achievement of first grade children low in visual perception skills. Two visual perception tests and a test of rhyming from the Gates Reading Readiness Test, as well as the Bender Visual Motor Gestalt Test, were administered to a group of kindergarten subjects. On the basis of the pretest scores, four groups were established: 1) kinesthetic experimental (low visual perception, higher Bender), 2) kinesthetic control (low visual perception, low Bender), 3) phonic experimental (low visual perception, higher rhyming), and 4) phonic control (low visual perception, low rhyming). Each group contained between four and seven subjects (mean IQ = 113). The teaching methods were given by the teachers to each subject during periodic conferences. The results were analyzed by measuring the difference between predicted and obtained achievement on the basis of a regression equation between the visual perception and reading test scores. No evidence was obtained to indicate that subjects responded according to pretest aptitudes.

Some of the criticisms leveled against the Bateman (1967) study are equally applicable to the investigations of Robinson (1968) and Harris (1965). In both studies, the criteria used to classify subjects by modality dominance were not rigorous enough. A limited sampling of perceptual skills and the failure to maintain the same rigor in the selection criteria across the tests in different sense modalities probably served to minimize the differences between groups. Moreover, the methods of teaching were uncontrolled and did not appear to differ appreciably in content. Harris (1965) reported that observations revealed the presence of considerable variation between teachers in the teaching procedures used within each method. Failure to control these factors resulted in inadequate tests of the possible interaction between perceptual dominance and approaches to reaching beginning reading.

Cripe and Wilson (1966) studied the relationship of auditory and visual learning to perceptual dominance among 36 first grade subjects (IQs > 89). The subjects were divided into auditory or visual strength groups if the standard scores on one sensory channel exceeded that of the other channel by at least one standard deviation on either the decoding or association subtests of the Illinois Test of Psycholinguistic Abilities. Both sensory dominance groups were administered linguistic and nonlinguistic paired associates tasks under visual and auditory presentations. In the auditory presentation, the linguistic task consisted of vowel-consonant syllables, while the nonlinguistic task used noises. The visual linguistic and nonlinguistic presentations consisted of visual transformations of the auditory stimuli, produced by a sound spectograph. The results found that both sensory dominance groups learned the nonlinguistic material better under a visual presentation, while an auditory presentation resulted in more effective

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learning for the linguistic material. Again, the lack of stringency in the method used to classify subjects may have precluded an adequate test of the relationship of perceptual dominance to learning under varying modes of presentation.

In summary, studies on verbal learning suggest that young children learn more efficiently if verbal material is presented auditorily, while older children and adults learn best under a visual presentation. However, the efficiency of learning verbal material via auditory and visual presentations appears to be influenced also by the factors of task complexity, intelligence, and socioeconomic status. When tasks which avoid the confounding of reading material are used, learning efficiency is not significantly affected by different modes of presentation among children of middle socioeconomic status (Hill & Hecker, 1966). For children of lower social status, learning performance appears to be superior under a visual or pictorial presentation of material (Katz & Deutsch, 1964). Due to a number of uncontrolled factors, the limited research relating methods of teaching to unique learning styles of children has yielded rather disappointing results. To date, little evidence exists to demonstrate the efficacy of matching teaching procedures in reading to the perceptual characteristics of children. In order to test for the presence of an interaction between perceptual characteristics and methods of teaching, improvements in the methodology of past studies, as well as the use of a subject population which demonstrates a high prevalence of perceptual and reading difficulties will be required.

Concluding Statement

Numerous studies have been conducted into the perceptual correlates of reading ability. The results of these efforts demonstrate that poor readers are inferior to good readers on auditory and visual perception, and perceptual integration. Moreover, auditory and visual perception skills appear to be especially important to the acquisition of reading skills. In the early primary grades, auditory and visual discrimination abilities frequently produce higher correlations with reading achievement than mental age (Bryan, 1964; Smith & Dechant, 1961).

The importance of perceptual abilities to the development of reading fundamentals appears to be an established fact. Yet, paradoxically, current instructional programs overlook the perceptual differences among children, while continuing to place an inordinate emphasis upon differences in verbal ability. From a consideration of research on perception and reading, it would seem to be efficacious to group children for instruction according to their perceptual strengths--i.e., according to the sensory input pathways through which they can learn most efficiently (Wepman, 1967). For example, if a student is deficient in visual perception and memory skills, the teacher might use either instructional techniques which stimulate this deficit, or ignore it by building upon auditory perceptual strengths.

An examination of research on perception and early reading performance suggests the feasibility of matching teaching procedures to the individual perceptual learning styles of children. Grouping children for instruction according to auditory and visual perceptual strengths might especially facilitate the development of reading skills among disadvantaged children--a group particularly predisposed toward the development of perceptual and reading deficiencies. Furthermore, if the efficacy of matching perceptual proclivities to teaching methods could be demonstrated among children who have nearly completed the developmental reading program, the results would provide a substantive foundation for the planning of remedial programs.

The relevance of auditory and visual modality strengths and/or weaknesses to the methods of teaching word recognition remains to be ascertained. An adequate assessment of the efficacy of matching auditory and visual methods of teaching reading to the perceptual strengths of children would require a number of improvements over past research methodology. First, the study should focus upon children who are known to have perceptual deficiencies and a high rate of reading failure. If the relationship between perception and reading is in fact a curvilinear one, it is unlikely that matching instructional procedures to perceptual strengths would facilitate the development of reading skills among children with average, or above average perceptual and/or intellectual ability. Second, in order to classify children validly on visual and auditory perceptual strengths, several different facets of perception must be assessed simultaneously. For reading, the significant aspects of perception might include the abilities of: (1) detecting minute differences between sounds and symbols (Smith & Dechant, 1961; Wepman, 1967), (2) accurately perceiving figures and sounds in the presence of distraction (Elkind et al., 1965; Stuart, 1967), (3) retaining auditory and visual perceptual impressions presented sequentially (Silver & Hagin, 1967), (4) synthesizing speech sounds and discerning perceptual "wholes" from incomplete figures (Goins, 1958; Kass, 1966; Monroe, 1933), (5) retaining perceptual entities presented as "wholes," or meaningful units (Vernon, 1957), and (6) integrating sensory stimuli within and across auditory and visual sense modalities (Birch & Belmont, 1964, 1965; Sterritt & Rudnick, 1966). Finally, an efficacy study involving different teaching approaches should endeavor to control systematically the influence of differential effectiveness among teachers. In a study involving several different intervention treatments Dunn et al. (in press) found the variability among classes within some treatments exceeded significantly the variability present among subjects within classes. One method of controlling the bias introduced by differences in teacher effectiveness would be to use each subject as his own control. Thus, auditory or visual strength subjects could be taught to recognize a different set of unknown words under both the auditory and visual approaches. Furthermore, differential teacher effectiveness could be controlled both through administering the learning criterion under controlled conditions, and by using the same teacher(s) equally in each treatment.

Another interesting consideration emerges from an examination of the research literature on perception and reading. The results obtained from using discrete groups of good and poor readers appear to differ from those obtained through correlational analyses with unselected school populations. Poor readers have been found repeatedly to be significantly inferior to good readers on tests of perception. However, the relationships between perception tests and reading among unselected groups are typically in the low to moderate range (with r's of .20 to .50). The data obtained under these different research paradigms may suggest the presence of a curvilinear relationship between auditory and visual perceptual skills and primary grade reading achievement. The existence of a curvilinear relationship between perception and reading would seem to indicate that some critical level of perceptual ability is a prerequisite to the normal development of reading skill. The nature of the relationship between perceptual skills and reading performance needs to be more precisely delineated.

APPENDIX B

INFORMATION ON AUDITORY AND VISUAL PERCEPTION TESTS

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Information on Auditory and Visual Perception Tests

Perceptual Speed

Perceptual Speed is one of five subtests from the Primary Mental Abilities Test, Grades 2-4 (Thurstone & Thurstone, 1963). It is a short, group administered test of 50 items which measures the rapid recognition of likenesses and differences between objects and symbols. The Primary Mental Abilities Test was standardized on a large sample of school children, stratified on the basis of regional location and school size (Science Research Associates, 1965). For grades two through four, a median test-retest reliability coefficient of .80 is reported for the Perceptual Speed Subtest over a one-month interval.

The authors consider the perceptual skill measured by Perceptual Speed to be particularly important to the acquisition of early reading skills (Thurstone & Thurstone, 1963). Goins (1958) found two tests highly similar to Perceptual Speed loaded on a visual perception factor which was designated as the ability to hold in mind a perceptual gestalt during rapid perception. The same two tests had the highest inter-correlations with total perception scores (included 12 other visual perception tests). Moreover, Kass (1966) found a poor reading group significantly inferior to the standardization sample on Perceptual Speed Subtest scores.

Auditory Attention Span for Related Syllables

Auditory Attention Span for Related Syllables is a subtest from the Detroit Tests of Learning Aptitude (Baker & Leland, 1967). It is a measure of short term memory for sentences. In the development of early

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reading skills, considerable stress is placed upon learning to recognize words from contextual clues. Thus, the ability to retain meaningful sentences appears to be an integral component of readiness for reading.

The scoring of the Test is based upon the number of errors made in recalling each sentence. A basal level is established when one sentence is correctly reproduced from memory. The test ceiling is reached when three or more errors (omissions, words added, substitutions) are committed within a single sentence. A correct reproduction of the sentence is given a score of three; one error is scored two points; two errors are given a score of one; and three or more errors are scored zero. The maximum attainable score is 129 points. Although no reliability data for the Subtest are reported in the manual, Sandstedt (1964) reported that children with reading disability performed poorly on the Auditory Attention Span for Related Syllables test.

Visual Automatic

The Visual Automatic test (Kass, 1962) is a measure of visual perceptual closure. The test consists of a series of 18 unfinished pictures of animals or common objects. The individual pictures are placed on a sequence of four cards, with each card displaying progressively more detail. The subject's score on each item is determined by how quickly he can give the correct response. A score of four is awarded to a correct response given on the first card. Scores of three, two, and one are given if the correct response is given to the second, third, and fourth cards, respectively. A score of zero is given for failure to give the correct response to the final card. The total score is arrived at by summing the

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scores awarded to each of the 18 test items. A maximum score of 72 points is possible. An internal consistency coefficient of .76 is reported on a sample of 91 children between the ages of seven and nine (Kass, 1962).

In a factor analytic study of 14 nonverbal visual perception tests, Goins (1958) found that a factor designated as "strength of closure" produced relatively high correlations with first grade reading performance. Goins (1958) concluded that reading achievement at the first grade level was dependent upon adequate facility in visual perceptual closure.

Memory-For-Designs

Memory-For-Designs (Graham & Kendall, 1960) is an individually administered measure of visual-motor memory. The test was developed primarily on groups of adults with various neurological and psychiatric symptomatology. The standardization also included a group of 194 children in grades one through nine. With children, correlations between the test scores and age, and intelligence, were low and negative (r's= -.34 and -.39, respectively). The immediate retest reliability was .81 (within 24 hours). In another study, Walters (1961) reported a test-retest reliability coefficient of .82 for a group of second grade children (interval within five days).

The Memory-For-Designs test consists of 15 simple geometric designs, printed on small cards in black ink. The scores for each design range from zero to three, depending upon the number of errors the subject commits. The subject's total score consists of the sum of scores obtained on each design. The skill required of this test is analogous to the processes involved in learning to recognize words as "whole" units. To successfully complete the task, the child must retain a visual image or perceptual

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gestalt (whole). Walters (1961) found that performance on the Memory-For-Designs test was associated significantly with reading achievement at the second grade level.

Children's Embedded Figures Test

The Children's Embedded Figures Test (Karp & Kornstadt, 1963) measures the ability involved in perceiving a simple geometric figure embedded in a complex one. The test was standardized on a total of 160 children between the ages of five and twelve. The internal consistency reliability coefficient for the nine and ten year old children was .88.

In reading, perception of words and letters occurs in the presence of complex and competing stimuli. Unless a child can successfully perceive words in the presence of distracting visual stimuli (words, pictures, etc.), the attainment of proficiency in reading is doubtful. In one study of junior high school pupils, good readers were found to be significantly superior to poor readers on an embedded figures test (Stuart, 1967). Elkind, Larson, and VanDoornick (1965) found poor readers (CA 9 to 12) slower than good readers, matched on CA and IQ, in learning to extract hidden figures from more complex ones. Thus, adequate facility in this perceptual skill appears to be an important component to the development of reading skills.

Digit Span

Digit Span is a subtest of the Wechsler Intelligence Scale for Children (Wechsler, 1949). It is an auditory measure of short-term memory for digits which are presented sequentially. The Wechsler

Intelligence Scale for Children was standardized on 2200 children (CA 5 through 15), representative on the variables of geographic region, urban-rural residence, age, and parental occuption. The alternate form reliability reported for Digits Forward and Digits Backward is .59 for children with chronological ages of ten years, six months.

Silver and Hagin (1967) have found poor readers consistently inferior in sequential memory. Moreover, a number of studies have found poor readers to demonstrate inferior performance on the Digit Span Subtest (Graham, 1952; Hirst, 1960; McDonald, 1964; Neville, 1961; Robeck, 1964). In summary, the results of a number of studies indicate poor readers possess deficiencies on tests of auditory memory (Neville & Bruininks, in press).

Wepman Auditory Discrimination Test

The Wepman Auditory Discrimination Test is designed to measure the ability to distinguish between the fine differences that exist among the phonemes used in English speech (Wepman, 1958). The test includes two alternate forms, each containing 40 word-pairs (e.g., tub-tug, etc.). In constructing each form, familiarity was controlled by selecting words arranged as closely as possible on the Thorndike and Lorge Teacher's Word Book of 30,000 Words (Thorndike & Lorge, 1944). Furthermore, each word pair was equated for length and matched strictly within recognized phonetic categories (i.e., no cross phonetic category matching was done). The test was standardized on 533 unselected children in grades one through three. The reported test-retest reliability coefficient (interval not cited) for the test is .91. A low positive correlation with intelligence (r= .32) is also reported (Wepman, 1958).

Roswell-Chall Auditory Blending Test

The Roswell-Chall Auditory Blending Test (Roswell & Chall, 1963) measures the ability to synthesize individual and separate speech sounds into a whole word. The test was standardized on 62 children, followed from grades one through four. The odd-even reliability coefficients at the end of each grade ranged between .86 and .93. The test score comprises the number of words blended correctly out of a total of 30 words.

Adequate skill in auditory blending is considered essential to the development of phonic ability and independence in word recognition (Chall et al., 1963; Monroe, 1933). A number of studies have found that poor readers perform poorly on tests of sound blending (Chall et al., 1963; Kass, 1966; Monroe, 1933). Furthermore, the Roswell-Chall Auditory Blending test has been found to produce significant correlations with reading achievement (Chall et al., 1963).

Perceptual Integration Tests

The process of learning to read requires the integration of auditory and visual temporal stimuli within and across sense modalities (Birch & Belmont, 1964; Monroe, 1933; Sterritt & Rudnick, 1966). The Perceptual Integration Tests are designed to measure the ability to match accurately a temporal code received via the sense modalities of audition or vision with a visual-spatial dot pattern. The stimulus and response patterns appear in Appendix D. Although no published reliability data are available on the Auditory and Visual Integration Tests, they have been found to correlate significantly with a measure of reading achievement (Sterritt & Rudnick, 1966; Rudnick et al., 1967).

Visual-Motor Sequencing

Visual-Motor Sequencing is one of nine subtests from the Illinois Test of Psycholinguistic Abilities (McCarthy & Kirk, 1961). The Visual-Motor Sequencing Subtest is an individually administered test which assesses the ability to reproduce a sequence of visual stimuli from memory. The test items consist of different pictures or form chips arranged on a tray in a given sequence. Following a five second observation, the subject is given two opportunities to reproduce the correct sequence. To establish a basal level, three consecutive items must be passed on the first trial. The test is terminated after three consecutive items have been failed on both trials. The Illinois Test of Psycholinguistic Abilities was standardized on 700 children between the ages of two and nine. The overall internal consistency reliability coefficient for the Visual-Motor Sequencing Subtest was .91.

Since words are arranged in an invariable left-to-right order, adequate memory for visual sequences is essential to the development of word recognition. Kass (1966) found poor readers performed poorly on the Visual-Motor Sequencing Subtest.

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APPENDIX C

INSTRUCTIONS FOR THE PERCEPTUAL INTEGRATION TESTS

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INSTRUCTIONS FOR THE PERCEPTUAL INTEGRATION TESTS[1]

Auditory Integration Test

The subject and examiner were seated at opposite sides of the examining table, facing each other. The examiner said to the subject: "I am going to tap some sound patterns for you. Listen very carefully because I want you to remember them." The examiner tapped the three visual dot patterns of Example 1 on the edge of the table behind a cardboard screen, pausing three to five seconds between each example.

The subject was then shown the response sheets containing the visual dot patterns. Using Example 1, the subject was told: "Look at this first row of dot patterns. I am going to tap one of these patterns. The pattern that you will hear is going to sound like one of the three dot patterns you see." (The examiner pointed to the first row of dot patterns.) "Let me show you; listen very carefully; I want you to remember it." (The examiner again tapped the pattern on the edge of the table behind the cardboard screen.) After completing the pattern, the examiner said: "Which one of these dot patterns did you hear?" The subject was asked to point to the correct response. If the response was correct, the examiner said: "That's right." If the response was incorrect, the examiner said: "No, listen again," and then repeated the pattern. If the subject again missed the correct response, the examiner pointed to the correct pattern and said: "No, this is the pattern that you heard. Look at it very carefully as I tap it again." The examiner tapped the stimulus pattern again. If the subject still

[1]These instructions have been adapted from those used in studies conducted by Birch and Belmont (1964, 1965).

was encountering trouble, the examiner pointed to one of the other distractor patterns and said: "Look at this pattern. It sounds like this." The examiner tapped the pattern, along with the remaining distractor pattern, explaining to the subject that each one looked exactly like the sounds he was hearing.

The stimulus pattern for Example 2 was tapped for the subject, following the above procedures. After the first two examples were tapped with a pencil, the examiner said:

> Instead of tapping on the table, we are going to use the earphones to hear the sound patterns. These sounds will be like the ones that I just tapped for you on the table. Please listen to these sound patterns very carefully so you can remember them. Remember, each pattern that you hear is going to sound like one of the dot patterns that you see. I want you to choose the dot pattern that looks like the one you hear.

Examples one through four were then administered to the subject via earphones. Following the examples, the examiner again stated: "Listen carefully, remember the sounds, and then choose the dot pattern that looks like the one you hear." The 20 test patterns were then administered. The subject was instructed to select the correct dot pattern from two other distractors. Only the first choices were accepted, and no changes in response were recorded.

Visual Integration Test

Following the Auditory Integration Test, the subject was instructed to remove the earphones. The examiner said:

> I am going to show you some light patterns. (The examiner used a flashlight to illustrate these patterns.) Look at this first row of dot patterns. I am going to flash a light pattern. The light pattern that you will see is going to look like one of the

> dot patterns (examiner pointed to the row of visual dot patterns). Watch carefully; I want you to remember it.

The first two examples were illustrated with a flashlight, following the same procedures as those outlined for the Auditory Integration Test. If the subject made an incorrect response, the examiner pointed to the correct response, and then flashed it for him. Again, if the subject encountered any difficulty, the examiner illustrated the distractor patterns with a flashlight. Following the first two examples, the examiner said:

> You are going to see the light patterns in the window of this metal box. The light patterns will be like the ones that I have flashed for you with the flashlight. Please look carefully at these light patterns. Remember them, and then choose the dots that look like the light pattern you see.

The subject was instructed to put on his earphones prior to the administration of the examples. The four examples were then administered to the subject via the window of the metal box. Following the examples the examiner repeated:

> You are going to see a light pattern in the window of this metal box. The light pattern will look like the ones that I just flashed for you. Please look carefully at these light patterns. Remember them, and then choose the dots that look like the light pattern you see.

The 20 test patterns were then administered to the subject. The subject was instructed to make the correct choice from two other distractors. Only the first choices were accepted, and no changes in response were recorded.

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APPENDIX D

STIMULUS AND SPATIAL DOT PATTERN LISTS FOR PERCEPTUAL INTEGRATION TESTS

ERIC

AUDITORY INTEGRATION TEST

Stimulus Patterns

EXAMPLES:

1) ● ●

2) ●   ●   ●

3) ● ●   ●

4) ●   ● ●

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AUDITORY INTEGRATION TEST

Stimulus Patterns

TEST ITEMS:

1) ● ●   ● ●

2) ●   ● ● ●

3) ●   ● ●   ●

4) ● ●   ●   ● ●

5) ●   ●   ● ● ●

6) ●   ●   ●   ● ●

7) ● ●   ●   ●   ●

8) ●   ● ● ● ● ●

9) ● ●   ●   ● ● ●

10) ● ●   ●   ●   ●   ●

AUDITORY INTEGRATION TEST – continued

Stimulus Patterns

TEST ITEMS:

11) ● ●   ●   ● ●   ●

12) ●   ●   ● ●   ● ●   ●

13) ● ●   ● ● ● ●   ●

14) ● ● ● ● ●   ●   ●

15) ●   ● ●   ● ●   ●   ●   ●

16) ● ● ● ●   ● ● ●   ●

17) ● ● ●   ●   ●   ●   ● ●   ●

18) ● ● ● ●   ● ● ●   ● ●

19) ● ● ● ●   ●   ● ● ●   ● ●

20) ● ●   ● ● ●   ● ● ●   ● ●

ERIC

AUDITORY INTEGRATION TEST

EXAMPLES:

1) ● ● ● ● ● ● ●

2) ● ● ● ● ● ● ● ● ●

3) ● ● ● ● ● ● ● ● ● ●

4) ● ● ● ● ● ● ● ● ●

ERIC

AUDITORY INTEGRATION TEST

TEST ITEMS:

1) ●● ● ●   ●●● ● ●   ●● ●●

2) ● ● ● ●   ● ●●●   ●●● ●

3) ●● ●● ●   ●●● ●   ● ●● ●

4) ●● ●●●   ●●● ● ●   ●● ● ●●

5) ● ● ●●●   ●●●● ●   ● ● ●● ●

6) ● ●● ● ●● ●   ● ● ● ●●   ● ●● ● ●

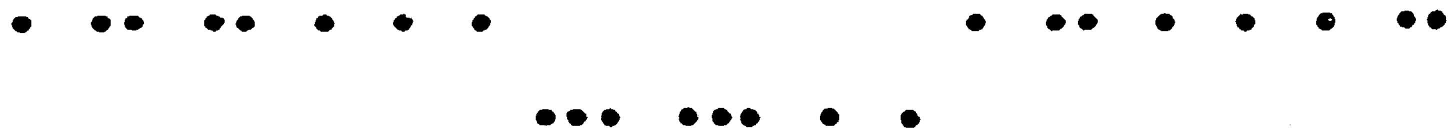
7) ● ● ● ●●   ●● ● ● ●   ●● ● ●●

TEST ITEMS:

8)	●●● ● ● ●	● ●● ● ●●	● ●●●●●
9)	● ●●● ●●●	●● ● ●●●	●● ● ● ● ●●
10)	● ●● ●●●	●● ● ● ● ●	●● ●● ● ●
11)	●● ● ●● ●	● ● ●●●● ●	● ● ●●● ●
12)	● ● ●● ● ●●	●●●● ● ● ●	● ● ●● ●● ●
13)	● ● ●●● ● ●	●● ●●●● ●	● ●● ● ● ●●
14)	●●●●● ● ●	● ● ● ●● ● ●	●● ●●●● ●

AUDITORY INTEGRATION TEST - continued

TEST ITEMS:

15) 

16) 

17) 

18) 

AUDITORY INTEGRATION TEST - continued

<u>TEST ITEMS</u>:

19) ●●●● ● ●●● ●● ●●●●●● ●● ● ●

●● ● ●● ● ●● ● ●

20) ● ●● ● ●●● ● ●● ●●●● ● ●● ● ●●

●● ●●● ●●● ●●

VISUAL INTEGRATION TEST

Stimulus Patterns

EXAMPLES:

1) ●   ●

2) ●   ● ●

3) ● ●   ●

4) ● ● ●

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VISUAL INTEGRATION TEST

Stimulus Patterns

TEST ITEMS:

1) ● ● ●   ●

2) ● ●   ● ●

3) ●   ●   ● ●

4) ● ●   ● ● ●

5) ● ● ●   ●   ●

6) ●   ● ● ●   ●

7) ●   ●   ● ●   ●

8) ●   ● ● ●   ● ●

9) ● ● ●   ●   ● ●

10) ● ●   ● ● ●   ●

VISUAL INTEGRATION TEST - continued

Stimulus Patterns

TEST ITEMS:

11) ●●●● ● ●

12) ● ●● ●● ● ●

13) ●●● ● ● ●●

14) ● ● ●●●●●

15) ● ● ●●● ● ● ●

16) ● ●● ● ●● ● ●

17) ● ● ●●●● ● ● ●

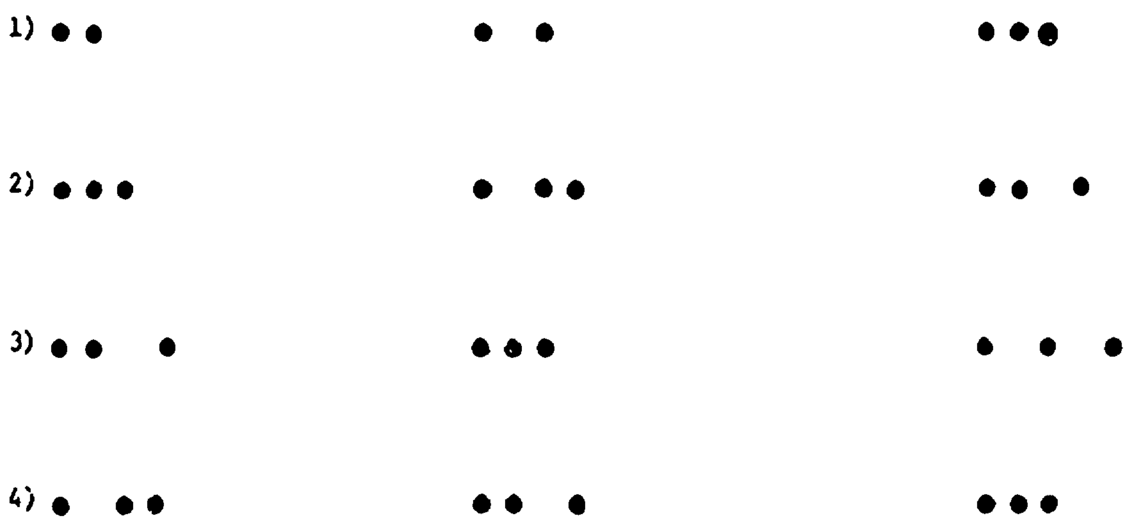
18) ●● ●● ●●●●●

19) ● ●●●● ● ● ●● ●

20) ● ●● ● ●● ●● ●●

VISUAL INTEGRATION TEST

EXAMPLES:



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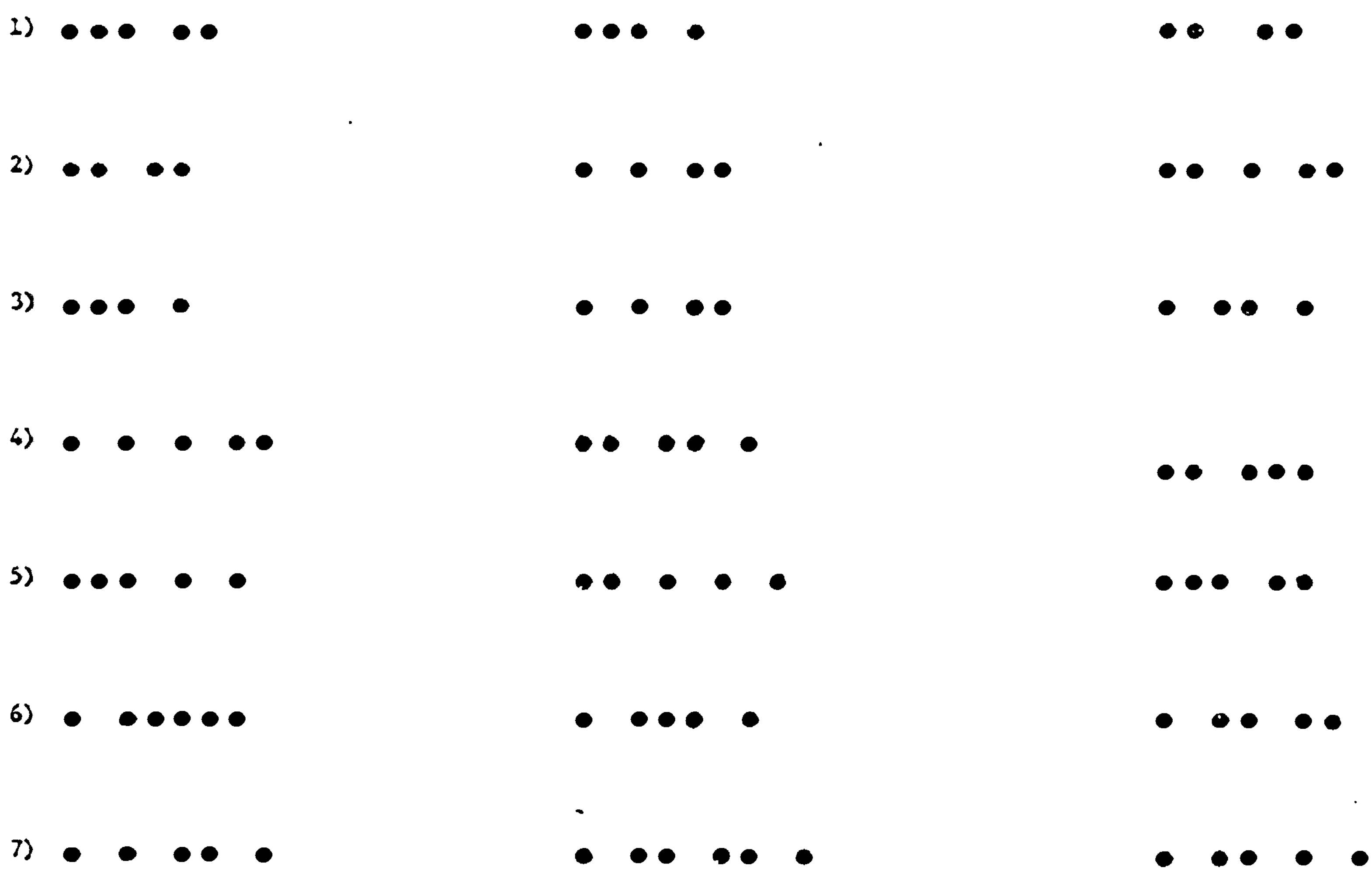
VISUAL INTEGRATION TEST

TEST ITEMS:



VISUAL INTEGRATION TEST - continued

TEST ITEMS:

8)

9)

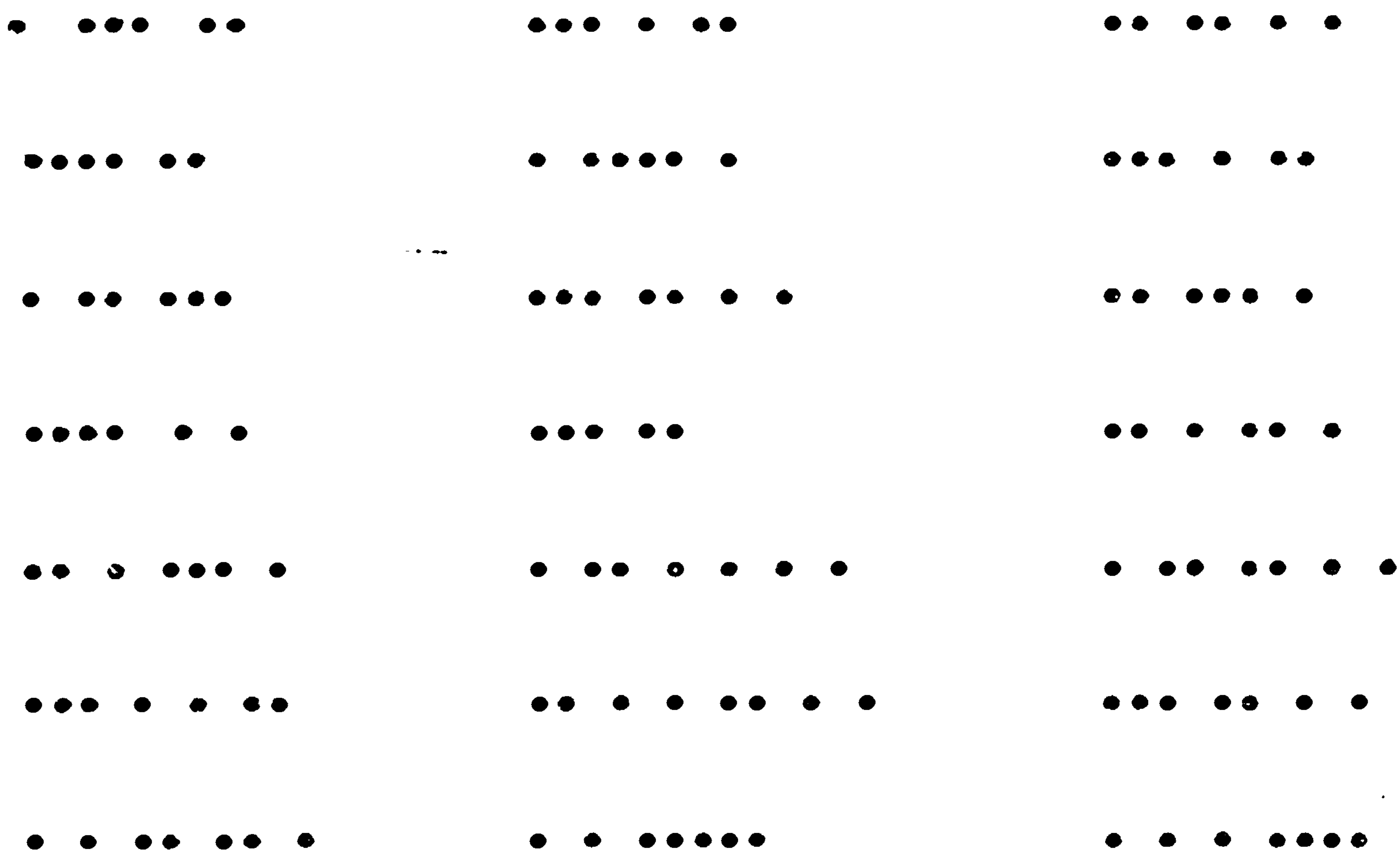
10)

11)

12)

13)

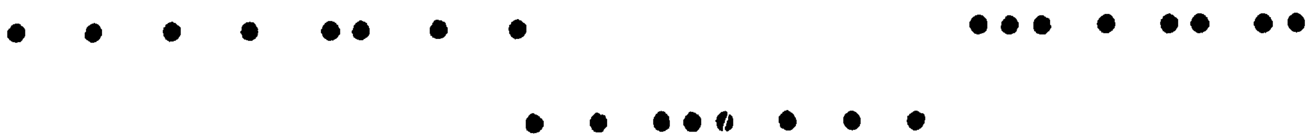
14)



VISUAL INTEGRATION TEST - continued

TEST ITEMS:

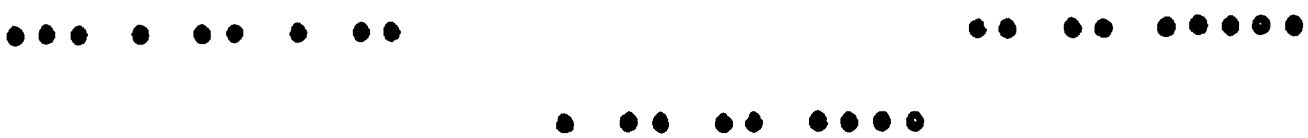
15)



16)

17)

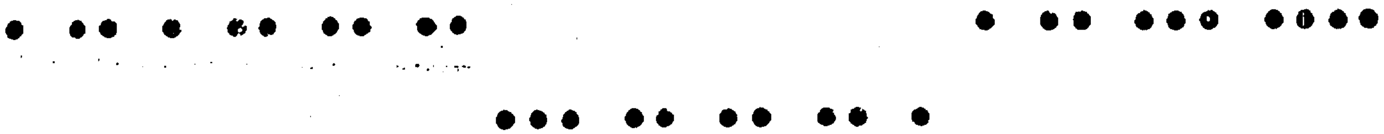
18)



VISUAL INTEGRATION TEST - continued

<u>TEST ITEMS</u>:

19) 

20) 

APPENDIX E

PILOT STUDY ON THE MILLS LEARNING METHODS TEST

PILOT STUDY ON THE MILLS LEARNING METHODS TEST

The purpose of this study was to determine the difficulty level of the Mills Learning Methods Test for third grade disadvantaged Negro boys. Thirty Negro boys were selected from two third grade classes in a control school of the Cooperative Reading Project (Dunn et al., in press). Many of the children in this school are probably slightly higher than the sample subjects on indices of socioeconomic status (housing, parent's education, etc.). Moreover, the pilot study school is the only school in the Cooperative Reading Project which has been accredited by the Southern Association of Colleges and Schools.

The subjects were administered the 130 third grade words from the Mills Learning Methods Test. The number of unknown words and incorrect responses were recorded for each subject. After it was discovered that four children failed to miss the minimum criterion of 30 words, a list of additional words was constructed from the Thorndike and Lorge word list (Thorndike & Lorge, 1944). These words were designated Alternate Deck One. The words of Alternate Deck One were administered to the subjects who had missed less than 60 words on the Mills Test.

The number of words missed by subject for both the 130 words of the third grade list from the Mills Test and Alternate Deck One are listed in Table 9. Examination of Table 9 reveals that, with the addition of Alternate Deck One, only two subjects failed to miss the required number of words (N = 30). Therefore, in order to increase the difficulty level of the pretest, another list of words was prepared from the Thorndike and Lorge list (see Appendix F). The third word list, designated Alternate Deck Two, was not included in the pilot study.

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Table 9

Number of Words Missed on the Mills Test

and on Alternate Deck One

Subject	Mills Test Words	Alternate Deck One
1	57	31
2	76	
3	63	31
4	36	18
5	117	
6	25	10
7	82	
8	127	
9	130	
10	117	
11	128	
12	127	
13	71	
14	19	14
15	98	
16	33	19
17	128	
18	128	
19	129	
20	111	

Table 9 - continued

Number of Words Missed on the Mills Test

and on Alternate Deck One

Subject	Mills Test Words	Alternate Deck One
21	118	
22	83	
23	26	14
24	113	
25	108	
26	122	
27	115	
28	130	
29	6	10
30	9	4

APPENDIX F

WORDS USED IN THE MODIFIED MILLS LEARNING METHODS TEST

WORDS USED IN THE MODIFIED MILLS LEARNING METHODS TEST

The test words for the modified Mills Learning Methods Test were divided into four groups: 1) the Main Deck of third grade words from the Mills Test, 2) Alternate Deck One, 3) Alternate Deck Two, and 4) the Distractor Deck. The words used in the Main Deck were taken from the third-grade word list of the Mills Learning Methods Test (Mills, 1964). Words for Alternate Decks One and Two were selected from the Thorndike and Lorge 30,000 word list (Thorndike & Lorge, 1944). In constructing the Alternate Decks, words were selected if they were: 1) nouns, 2) primarily phonetic, and 3) capable of being pictorially illustrated. The numbers listed beside the words represent their frequency of occurrence per million words of print. The Thorndike and Lorge list uses the following system to code word frequencies:

a) 1 = at least one occurrence per million words, but not so many as two per million;

b) 2 = at least two per million, but not so many as three per million, and similarly up to 49;

c) A = at least 50 per million, but not so many as 100 per million;

d) AA = 100 or over per million; and

e) number/18,000,000 = number of words occurring per 18,000,000 words.

Mills Test Words (Main Deck)

1. apron
2. artist
3. attic
4. axe
5. bamboo
6. banana
7. barrel
8. beach
9. beast
10. beaver
11. beetle
12. belt
13. bench
14. blossom
15. boat
16. brick
17. buffalo
18. cabin
19. camel
20. camera
21. canal
22. castle
23. caterpillar
24. cattle
25. chain
26. chest
27. chief
28. circle
29. clover
30. comb
31. cord
32. cottage
33. cradle
34. crown
35. curtain
36. diamond
37. dollar
38. donkey
39. drum
40. eagle
41. elevator
42. eleven
43. envelope
44. fiddle
45. forty
46. fountain
47. giant
48. grain

49. grocery
50. hawk
51. highway
52. hotel
53. insect
54. island
55. jacket
56. key
57. knee
58. lantern
59. library
60. lily
61. lip
62. loaf
63. motor
64. napkin
65. needle
66. newspaper
67. nurse
68. onion
69. package
70. peach
71. pencil
72. piano
73. pillow
74. pitcher
75. plow
76. plum
77. railroad
78. rainbow
79. reindeer
80. sack
81. sailor
82. sandwich
83. seal
84. shelf
85. snail
86. snake
87. soap
88. soldier
89. sweater
90. sword
91. thread
92. toad
93. tongue
94. towel
95. trousers
96. tub
97. tulip
98. whale
99. wigwam
100. witch

Alternate Word Deck One

	Words	Frequency Count		Words	Frequency Count
1.	ankle	21	22.	farmer	AA
2.	aspirin	11/18,000,000	23.	firecracker	14/18,000,000
3.	back	AA	24.	fisherman	26
4.	bandage	14	25.	hamburger	16/18,000,000
5.	barber	16	26.	hammock	6
6.	block	A	27.	ladder	19
7.	bottle	A	28.	lamp	A
8.	bridge	AA	29.	lamp-post	11/18,000,000
9.	bubble	28	30.	mailman	8/18,000,000
10.	butterfly	22	31.	monkey	23
11.	button	39	32.	mushroom	10
12.	cabbage	16	33.	peanut	7
13.	candle	43	34.	picnic	16
14.	centipede	16/18,000,000	35.	puppet	6
15.	checkerboard	10/18,000,000	36.	ribbon	36
16.	chimney	30	37.	rollerskate	7/18,000,000
17.	circus	16	38.	starfish	3
18.	clarinet	13/18,000,000	39.	stove	40
19.	coconut	8	40.	tractor	12
20.	cork	11	41.	turtle	13
21.	drumstick	12/18,000,000	42.	umbrella	13
			43.	yardstick	8/18,000,000

Alternate Word Deck Two

	Words	Frequency Count
1.	alligator	6
2.	alphabet	7
3.	ambulance	8
4.	ammunition	9
5.	amphibian	1
6.	aquarium	2
7.	arrowhead	1
8.	asparagus	6
9.	baggage	11
10.	bandanna	1
11.	barometer	2
12.	bayonet	9
13.	beverage	8
14.	binoculars	1
15.	birthday	37
16.	biscuit	14
17.	blanket	30
18.	calendar	10
19.	candlestick	4
20.	chicken	A
21.	crawfish	1
22.	crocodile	5
23.	cucumber	6
24.	currency	14
25.	cylinder	16
26.	dandelion	6
27.	dessert	12
28.	dominoes	1
29.	dragonfly	2
30.	elephant	35
31.	feather	44
32.	handkerchief	35
33.	haystack	1
34.	hexagon	1
35.	hippopotamus	1
36.	lemonade	7
37.	lettuce	12
38.	lumber	34
39.	minnow	3
40.	moccasin	4
41.	nutcracker	6/18,000,000
42.	octagon	14/18,000,000
43.	opossum	1
44.	partridge	12
45.	pendulum	5
46.	perpendicular	8
47.	porcupine	7
48.	rattlesnake	3

49. rectangle 5
50. rooster 6
51. saxophone 1
52. speedometer 1
53. squirrel 24
54. steamshovel 10/18,000,000
55. submarine 12
56. tablespoon 24
57. thermometer 12
58. tomahawk 3
59. toothbrush 3
60. triangle 8
61. vegetable A
62. watermelon 1

Distractor Word Deck

1. ant
2. bicycle
3. broom
4. cheese
5. cherry
6. church
7. cowboy
8. desk
9. fifty
10. fork
11. gift
12. gun
13. hammer
14. kite
15. map
16. mitten
17. pin
18. queen
19. rat
20. sixteen

APPENDIX G

INSTRUCTIONS FOR THE MODIFIED MILLS LEARNING METHODS TEST

ERIC

INSTRUCTIONS FOR THE MODIFIED MILLS LEARNING METHODS TEST

General Instructions

1. In administering the pretest, present the words in random order (word-side up). If the child fails to respond to a word, or makes an incorrect response, place the word in a pile to one side. Do not tell the child what the word is. If he asks, explain that he will learn it later.

2. If a child fails to miss at least 40 words, administer the words in Alternate Deck One. If still an insufficient number of words is missed after Alternate Deck One, administer Alternate Deck Two. The child must miss at least 30 words to complete the test.

3. Randomly assign 20 words to each teaching method (phonic-visual) --i.e., shuffle the unknown words and count out 20 words for each approach. Record the card number in parentheses beside the word. Teach the first 15 words of each list. Use any of the five additional words if the child spontaneously names the word before you begin the teaching exercises.

4. Administer the immediate and delayed recall tests in random order (shuffle cards) among the 20 words from the Distractor Deck. Place the missed words to one side and record the errors after completing the test.

5. Administer the teaching methods to each child according to the order prescribed on the subject roster.

6. The two teaching methods must be separated by at least a

one-week interval. The delayed recall tests must be given exactly one week following each lesson.

Visual Method

For each of the 15 "unknown" words from the controlled list, teach the child recognition of these words stressing exclusively their visual appearance, along with other visual clues. The steps outlined below must be followed, in order, in teaching each word. Spend approximately one-and-a-half minutes on each word.

1. Present the picture-word card to the child with the picture-side up. Ask him to look at the picture, at the word, and then to say what it is. After the child supplies the word, say: "Yes, this is the word ______. This is a picture of a ______."

2. Using the word, make a sentence for the child to communicate its meaning.

3. Ask the pupil to repeat the name of the word and to observe it carefully (emphasize looking at the whole word), using the word-side of the card. (The child may need help in pronouncing the word.) Then ask the pupil: "Look at the whole word. (Examiner points.) Try to get a picture of how the word looks. (Child's name), try to see a picture of the word with your eyes closed. What is the word?"

4. Place the study word before the child (word-side up), along with two words from the Extra Deck.[2] Discuss the relative length of the three

---

[2]The Extra Words comprised the following: cart, club, fan, fifteen, fireman, furniture, kettle, owl, pen, and stocking. All of the Extra Words were selected from the third grade list of the Mills Learning Methods Test.

words. Ask the child to do the following: "Point to the longest word. Point to the shortest. Point to our word." If an incorrect choice is made, the Examiner points out, and states, the correct word.

5. Draw configurational diagrams of the word and the two Extra Words on a sheet of 4 X 5 1/2 inch paper. Say: "Point to the outline that looks like our word. (Examiner points to the test word.) Now, place the word below the right outline." If the child's response is incorrect, explain the reason(s) for his error, and ask him to look again for the form which matches the word. Complete this step by asking the child to say the word.

The rest of the words from the controlled list are presented to the subject according to the above procedures. At the end of 23 minutes, administer the immediate recall test. Begin by shuffling the Test Words into the Distractor Words. Administer the recall tests (immediate and delayed) by exposing the word-side of the card. If the child responds correctly to the word within five seconds, place a + by that word in the "Immediate" column on the test record form.

Auditory Method

Using 15 "unknown" words from the other controlled list, teach the child recognition of these words, stressing exclusively their sound qualities through the use of the following teaching procedures (use only the word-side of the card). The steps outlined below must be followed, in order, in teaching each word. Spend approximately one-and-a-half minutes on each word.

1. Print the words on the 4 X 5 1/2 inch test papers, saying the

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word slowly; then have the child repeat the word after you.

2. Using the word, make a sentence for the child to communicate its meaning.

3. Point to (and underline) the opening letter of the first word. Say: "This is the letter ___. It makes the sound ___. The next letter is ___. It makes the sound ___." Follow these steps for each letter, underlining the separate sound components of each word as you teach it. Have the child repeat the separate sounds after you as you say them for each word. (In teaching the sounds, emphasize the separate sounds of each word. For example, if the word consists of two letters which form a blend, break them, if possible, into separate sounds. Then, teach the letters as a single sound unit--e.g., s-t-e-p to st-e-p). Complete this step by asking the child to say the word.

4. Say: "Listen. I'm going to give you the sounds of the letters." Repeat the word for the child with exaggerated sound stresses, placing short pauses between the sound elements. Ask the child to listen closely to the sounds as you point to the particular part of the word being sounded. Then, ask the child to say the word.

5. Say: "Now I want you to give me the sounds." Ask the child to pronounce (Examiner points to the letters) each of the sounds. Help the child with those sounds in which he still lacks sight-sound recognition. Urge him to blend the sounds into a whole word. Finish by asking the child to repeat the word.

At the end of 23 minutes, administer the immediate recall test according to the procedures prescribed above for the visual method.

APPENDIX H

RAW DATA

ERIC Full Text Provided by ERIC

VARIABLE IDENTIFICATION FOR RAW DATA

ON THE ENTIRE SAMPLE

Variable Order

1. Subject Number
2. Chronological Age
3. Stanford Binet IQ
4. Wepman Auditory Discrimination Test
5. Wepman Auditory Discrimination Test (with noise)
6. Digit Span
7. Roswell-Chall Auditory Blending Test
8. Auditory Attention Span for Related Syllables
9. Auditory Integration Test
10. Sum of Standard Scores for Auditory Tests
11. Perceptual Speed
12. Children's Embedded Figures Test
13. Visual Motor Sequencing
14. Visual Automatic
15. Memory-For-Designs
16. Visual Integration Test
17. Sum of Standard Scores for Visual Tests
18. Metropolitan Achievement Test Reading Sum (sum of the Word Knowledge, Word Discrimination, and Reading subtests)

Table 10

Raw Data on the Entire Sample

1	2	3	4	5	6	7	8	9	10
1	116	94	33	27	8	21	42	6	301
2	103	79	30	25	9	2	55	8	289
3	101	93	34	27	7	21	60	8	323
4	99	98	35	32	8	23	36	10	334
5	106	109	33	26	8	24	74	9	350
6	97	86	30	28	7	20	40	7	289
7	103	96	34	19	9	25	58	9	325
8	104	81	37	33	7	21	65	5	338
9	118	90	33	28	7	17	45	8	302
10	118	81	34	27	8	10	49	10	313
11	99	83	32	24	7	5	40	3	246
12	102	80	37	25	6	6	35	6	266
13	98	80	30	25	5	23	37	7	270
14	100	90	36	31	8	22	47	5	321
15	98	108	35	25	8	21	68	7	330
16	100	75	30	26	4	0	36	9	239
17	108	91	34	27	6	19	41	8	295
18	104	77	27	23	3	8	29	6	209
19	100	92	30	31	7	22	34	2	273
20	118	87	36	26	7	18	58	9	323
21	100	95	36	30	8	21	39	10	331

Table 10 - continued

Raw Data on the Entire Sample

i	11	12	13	14	15	16	17	18
1	42	16	8	32	6	6	330	7.6
2	9	14	9	29	15	4	231	6.0
3	23	13	15	32	1	7	322	8.2
4	[illegible]	13	13	27	1	7	303	7.6
5	[illegible]	13	16	43	4	10	338	15.4
6	15	14	15	28	14	8	290	9.6
7	23	10	13	21	2	12	313	7.6
8	19	9	15	15	24	9	266	3.5
9	21	8	16	39	4	7	311	7.9
10	14	8	[illegible]	32	4	4	264	6.6
11	20	8	18	30	10	10	307	9.0
12	15	6	14	23	22	7	242	8.0
13	18	12	18	32	0	6	318	7.3
14	23	13	13	41	10	8	317	10.1
15	21	10	16	28	2	6	302	13.8
16	11	9	11	36	12	8	269	5.3
17	19	11	16	30	5	8	309	9.2
18	20	10	17	31	13	8	299	3.7
19	15	9	11	29	10	10	278	7.9
20	19	5	18	29	18	9	279	5.7
21	21	10	13	30	3	8	303	8.9

Table 10 - continued

Raw Data on the Entire Sample

1	2	3	4	5	6	7	8	9	10
22	108	105	34	28	8	15	53	13	338
23	112	86	35	26	7	19	41	12	318
24	97	87	26	21	6	04	32	6	220
25	101	86	37	32	9	23	42	8	343
26	105	95	32	25	8	20	46	8	304
27	112	77	31	25	6	20	38	11	293
28	97	106	34	19	10	18	76	8	335
29	108	87	34	27	8	27	50	6	320
30	101	87	25	19	7	0	40	5	216
31	101	83	33	30	8	16	41	5	296
32	103	81	37	31	8	15	39	9	323
33	101	98	32	24	7	19	44	4	275
34	99	99	29	24	7	28	62	9	318
35	101	101	36	26	8	8	36	8	292
36	99	82	34	28	9	18	62	6	328
37	97	108	34	31	7	23	53	10	338
38	103	84	35	24	8	20	45	5	296
39	107	71	26	31	5	3	12	9	229
40	102	92	32	19	9	6	40	11	284
41	106	91	34	24	7	16	41	12	308
42	107	110	33	31	7	19	35	4	287

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Table 10 - continued

Raw Data on the Entire Sample

1	11	12	13	14	15	16	17	18
22	18	15	20	36	11	12	346	9.2
23	17	15	15	28	3	2	288	6.5
24	15	16	14	28	3	9	314	5.7
25	22	10	16	21	2	6	295	9.8
26	22	11	17	14	5	7	293	8.5
27	11	8	12	24	10	6	249	6.5
28	23	10	14	23	7	12	312	8.6
29	24	11	16	37	2	15	358	10.5
30	15	12	13	29	7	8	291	6.1
31	21	12	12	30	11	4	276	6.7
32	18	11	15	32	2	7	306	8.4
33	23	10	18	32	8	7	312	12.2
34	20	11	12	23	5	6	280	7.5
35	20	13	14	45	4	9	332	9.0
36	13	12	16	26	8	5	279	8.5
37	19	7	14	28	1	11	306	12.5
38	13	4	17	22	21	7	241	7.8
39	7	16	15	32	25	7	265	5.8
40	24	9	19	39	16	5	303	8.7
41	23	14	23	22	10	11	340	5.2
42	20	15	19	24	13	8	311	7.0

Table 10 - continued

Raw Data on the Entire Sample

1	2	3	4	5	6	7	8	9	10
43	104	99	35	24	9	16	66	6	322
44	102	104	35	24	8	13	40	6	286
45	102	98	33	25	9	21	52	10	330
46	107	89	28	26	9	12	44	9	293
47	103	103	33	20	10	18	67	9	330
48	106	76	28	19	5	11	44	8	242
49	104	103	35	22	6	21	51	12	315
50	103	80	36	30	8	16	40	9	320
51	108	94	23	13	10	8	57	8	258
52	103	82	34	27	7	20	39	8	301
53	102	92	33	26	8	14	49	9	308
54	99	101	34	25	7	5	40	7	272
55	99	81	33	31	8	17	51	10	332
56	104	92	38	31	9	23	70	9	374
57	103	74	36	25	8	25	42	5	306
58	102	103	36	26	9	23	45	6	319
59	110	83	31	22	6	20	40	6	266
60	103	91	33	23	7	19	42	9	294
61	106	78	33	30	9	10	67	4	314
62	103	79	27	21	4	3	33	10	225
63	107	92	35	27	7	18	55	7	312

Table 10 - continued

Raw Data on the Entire Sample

1	11	12	13	14	15	16	17	18
43	22	13	24	41	5	10	366	10.5
44	21	16	20	37	6	13	366	8.9
45	15	12	12	38	6	8	299	11.0
46	15	4	14	28	15	8	257	6.5
47	29	15	20	43	0	9	378	6.5
48	14	8	16	8	18	7	239	4.3
49	17	8	11	33	18	7	259	11.2
50	22	12	15	44	2	7	331	7.3
51	18	10	13	20	26	9	254	10.7
52	27	11	15	31	16	2	279	7.1
53	21	9	12	37	2	11	317	8.1
54	8	7	14	26	4	8	267	6.0
55	16	14	14	32	5	10	315	7.7
56	29	10	14	16	8	11	306	10.1
57	17	11	13	33	13	9	291	8.1
58	9	9	13	27	16	7	251	8.3
59	14	14	14	33	4	8	306	7.4
60	15	12	17	42	0	6	322	8.0
61	19	13	18	25	5	7	309	3.8
62	12	14	14	19	13	9	276	5.3
63	17	16	13	44	1	8	333	10.4

Table 10 - continued

Raw Data on the Entire Sample

1	2	3	4	5	6	7	8	9	10
64	108	93	37	21	9	23	45	8	319
65	96	71	20	19	4	1	27	8	184
66	105	92	36	23	8	22	60	9	330
67	109	109	35	31	7	28	50	9	340
68	105	71	23	25	4	3	35	6	208
69	107	95	35	29	8	20	38	11	327
70	99	86	34	27	8	21	57	11	340
71	108	83	33	29	8	22	44	9	322
72	97	74	38	25	7	18	32	6	289
73	109	75	36	25	8	16	41	5	292
74	106	90	34	25	9	6	44	8	396
75	105	92	34	30	8	21	40	5	305
76	105	104	37	33	9	24	53	9	361
77	107	91	34	27	7	14	42	9	300
78	97	102	37	27	10	16	39	8	325
79	100	98	36	25	6	4	43	7	272
80	97	92	33	15	8	17	57	6	279
81	98	100	35	23	8	25	35	7	301
82	105	70	34	28	6	14	43	9	296
83	100	84	30	22	6	5	43	5	241
84	99	84	36	27	9	20	43	8	324

Table 10 - continued

Raw Data on the Entire Sample

1	11	12	13	14	15	16	17	18
64	13	14	20	39	21	8	305	7.5
65	10	5	13	9	11	9	235	3.2
66	19	16	13	40	8	8	321	8.4
67	29	15	21	45	1	10	385	10.6
68	11	3	12	14	8	7	229	4.0
69	26	15	12	31	11	7	307	11.4
70	21	10	17	41	20	7	298	10.4
71	17	13	17	36	8	8	315	7.6
72	14	6	14	33	12	6	263	8.5
73	16	14	14	31	12	9	299	9.6
74	22	20	17	41	2	6	352	9.8
75	23	14	19	38	25	8	312	8.4
76	22	20	12	34	0	15	369	16.0
77	25	17	19	30	8	9	345	10.1
78	18	8	17	28	10	5	278	7.8
79	25	13	29	23	4	7	353	10.0
80	12	12	16	27	8	7	286	9.9
81	10	8	15	14	18	10	249	7.4
82	29	13	14	17	10	6	293	6.9
83	14	3	14	17	20	8	231	5.0
84	14	10	11	29	22	6	245	5.9

Table 10 - continued

Raw Data on the Entire Sample

1	2	3	4	5	6	7	8	9	10
85	98	96	33	21	6	21	53	6	283
86	99	107	36	27	7	21	49	12	335
87	98	75	35	24	7	7	37	7	273
88	99	106	37	28	8	14	51	12	339
89	117	81	32	29	8	23	43	10	325
90	106	97	33	30	8	18	67	11	349
91	108	85	36	31	8	12	51	11	337
92	104	94	36	27	9	21	56	7	334
93	101	106	37	29	9	16	52	4	318
94	97	79	25	18	6	5	42	10	238
95	108	84	36	29	9	25	50	11	357
96	106	99	37	27	7	20	53	8	322
97	99	103	30	29	7	6	38	10	284
98	101	85	27	23	7	15	28	13	277
99	106	89	35	29	7	20	42	11	324
100	98	74	35	21	10	8	43	6	288
101	98	73	26	21	5	4	31	4	203
102	102	96	35	27	7	16	50	9	313
103	108	92	23	17	9	22	49	8	273
104	98	86	36	33	8	17	46	10	340
105	102	89	31	25	7	22	45	8	297

Table 10 - continued

Raw Data on the Entire Sample

1	11	12	13	14	15	16	17	18
85	23	15	15	24	4	8	317	8.9
86	15	14	16	35	7	11	325	11.5
87	10	12	16	35	8	5	285	5.8
88	19	11	18	28	9	11	318	9.1
89	27	16	15	27	16	13	334	9.2
90	20	17	15	25	5	8	317	13.4
91	29	12	17	33	3	12	355	8.2
92	29	16	16	35	6	4	327	12.3
93	22	14	13	22	7	4	283	14.1
94	13	11	13	24	7	7	274	8.2
95	21	14	16	33	6	7	317	7.7
96	15	13	17	25	6	11	313	8.1
97	22	8	11	17	10	10	273	3.2
98	18	12	16	32	4	13	334	5.1
99	13	12	19	31	4	8	313	7.9
100	19	10	14	39	8	7	302	4.5
101	7	6	12	20	13	6	226	6.5
102	24	8	21	29	2	6	318	7.4
103	24	12	16	24	4	7	309	8.2
104	16	10	15	25	18	9	274	7.5
105	19	13	19	41	3	6	332	10.0

VARIABLE IDENTIFICATION FOR RAW DATA ON AUDITORY AND VISUAL PERCEPTUAL DOMINANCE GROUPS

<u>Variable Order</u>

1. Auditory Test Sum (transformed standard scores)
2. Visual Test Sum (transformed standard scores)
3. Visual Method--Immediate Recall
4. Visual Method--Delayed Recall
5. Auditory Method--Immediate Recall
6. Auditory Method--Delayed Recall
7. Reading Average
8. Stanford-Binet IQ
9. Order: 1 = Visual:Auditory; 2 = Auditory:Visual

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Table 11

Raw Data on Auditory and Visual Perceptual Dominance Groups

	1	2	3	4	5	6	7	8	9
Auditory Dominance									
2	289	231	3	0	3	1	6.0	79	2
4	334	303	9	10	8	10	7.6	98	2
8	338	266	1	1	1	1	3.5	81	1
10	313	264	0	0	1	1	6.6	81	2
20	323	279	5	8	7	4	5.7	87	1
21	331	303	11	9	13	13	8.9	95	1
23	318	288	6	5	9	8	6.5	86	2
25	343	295	15	12	11	8	9.8	86	2
27	293	249	4	1	3	2	6.5	77	1
34	318	280	12	11	11	10	7.5	99	2
36	328	279	14	15	14	12	8.5	82	2
38	296	241	13	10	14	10	7.8	84	2
45	330	299	13	14	12	12	11.0	98	1
46	293	257	6	5	7	7	6.5	89	1
56	374	306	12	11	7	8	10.1	92	1
58	319	251	14	14	12	13	8.3	103	2
81	301	249	11	8	7	7	7.4	100	1
84	324	245	10	7	10	4	5.9	84	2
95	357	317	13	11	13	13	7.7	84	1
104	340	274	8	7	3	1	7.5	86	1

Raw Data on Auditory and Visual Perceptual Dominance Groups

	1	2	3	4	5	6	7	8	9
Visual Dominance									
11	246	307	13	15	10	10	9.0	83	1
13	270	318	9	11	12	13	7.3	80	1
16	239	269	1	1	0	0	5.3	75	1
18	209	299	1	0	1	1	3.7	77	2
24	220	314	6	2	1	0	5.7	87	2
30	216	291	1	0	1	0	6.1	87	1
39	229	265	1	0	0	0	5.8	71	1
41	308	340	7	1	10	4	5.2	91	1
43	322	366	13	11	13	12	10.5	99	2
44	286	366	13	11	12	10	8.9	104	1
47	330	378	14	7	11	8	6.5	103	1
59	266	306	7	5	6	4	7.4	83	2
62	225	276	1	0	0	0	5.3	79	1
65	184	235	0	0	0	0	3.2	71	2
74	296	352	11	10	11	9	9.8	90	2
79	272	353	14	14	11	10	10.0	98	2
85	283	317	11	12	11	8	3.9	96	1
94	238	274	5	0	8	5	8.2	79	2
98	277	334	3	2	2	3	5.1	85	2
103	273	309	11	11	13	13	8.2	92	2

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