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The Relationship of Auditory Discrimination and Reading Achievement at First and Fourth Grade Levels

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THE RELATIONSHIP OF AUDITORY DISCRIMINATION AND READING ACHIEVEMENT AT FIRST AND FOURTH GRADE LEVELS

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THE RELATIONSHIP OF AUDITORY DISCRIMINATION AND READING ACHIEVEMENT AT FIRST AND FOURTH GRADE LEVELS

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THESIS

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ABSTRACT OF THESIS

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ABSTRACT

The purpose of this study was to investigate the relationship between reading ability and the ability to discriminate verbal auditory stimuli among representative groups of first and fourth grade pupils. The sample was randomly selected from the first and fourth grade population of one Albuquerque, New Mexico elementary school located in a predominantly Caucasian low-middle to middle class neighborhood with some Mexican-American children.

Subjects were administered the Quiet and Noise subtests of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW), the Wepman Auditory Discrimination Test (Wepman), the Word Recognition subtest of the Wide Range Achievement Test (WRAT), and the Otis-Lennon Mental Ability Test (OLMAT).

Data were organized to test the relationship between the Quiet and Noise subtests of the GFW, the Wepman, the WRAT, and the OLMAT. In addition to correlational analysis between test measures, partial correlation coefficients were calculated to control for the effect of intelligence on the obtained relationships between the auditory discrimination measures and the reading measure.

The findings for the auditory discrimination measures and the reading measure partially supported the hypothesized relationship between the ability to discriminate verbal auditory stimuli and reading achievement. The Wepman was found to be significantly ($p < .05$) related to the WRAT at the first grade level but not at the fourth grade level. Neither subtest of the GFW was significantly related to the WRAT at either grade level. When intelligence was held constant, none

of the correlated measures reached significance for either grade level. No significant differences were found between either the first and fourth grade Pearson product-moment correlation coefficients or the first and fourth grade First-Order partial correlation coefficients.

In summary, the results of this study partially support the hypothesized relationship between auditory discrimination ability and reading achievement at the first grade level.

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CHAPTER I

INTRODUCTION AND REVIEW OF LITERATURE

The purpose of this study was to investigate the relationship between reading ability and the ability to discriminate verbal auditory stimuli. The investigation attempted to assess this relationship among representative groups of first and fourth grade pupils.

Evidence indicates that the aural factor makes an extremely significant contribution to early progress in word-attack and word-recognition skills. Wepman (1960), Durrell and Murphey (1953), and a review of the auding literature by Caffrey (1955) stress the role of auditory discrimination in learning to read. Other investigators (Wheeler and Wheeler, 1954; Templin, 1954; Reed, 1958; Reynolds, 1953), while finding relationships between auditory discrimination and reading, have suggested that the relationship is not stabile with increases in age and grade level, and Dykstra (1966), has pointed out that intelligence may play as crucial a role as does auditory discrimination in predicting reading success, especially in the first year of school. Hence, while some agreement is found in the literature in regard to the contributing role of auditory discrimination in reading success, a wide diversity is found in regard to the interpretation and implications of the role.

Auditory discrimination is defined in this paper as the capacity to distinguish between phonemes or individual sounds used in speech. When operating under normal conditions, this capacity applies even when the phonetic strucutres, especially the sound wave patterns, of the sounds to be discriminated are highly similar in nature (Wepman, 1960).

While all the premises upon which auditory discrimination theory are based have not been subjected to experimental research, Wepman (1960) advances the following notions documented through his research.

1. There is evidence that the more alike two phonemes are in phonetic structure, the more likely they are to be misinterpreted.
2. Individuals differ in their ability to discriminate among sounds.
3. The ability to discriminate frequently matures as late as the end of the child's eighth year.
4. There is a strong positive relation between slow development of auditory discrimination and inaccurate pronunciation.
5. There is a positive relation between poor auditory discrimination and poor reading.
6. While poor discrimination may be at the root of both speech and reading difficulties, it often affects only reading or spelling.
7. There is little, if any, relation between the development of auditory discrimination and intelligence as measured by most intelligence tests.

It is important for the reader to note that while all of the above premises do not apply specifically to the question at hand, several of the notions are of crucial importance to the hypothesis that auditory discrimination ability is significantly related to reading. First, if individuals differ in their ability to discriminate auditory stimuli, then it would be expected that those who are "good" discriminators would also be "good" readers. This point is substantiated by Wepman's notion

of a positive relation between poor auditory discrimination and poor reading. Secondly, the emphasis that is placed on the developmental nature of auditory discrimination would lead one to expect fewer children to have discriminatory problems at higher age levels. However, since the schools are besieged by a plethora of reading problems at all grade levels, the notion of developmental adequacy comes into question. Are the poor reading skills that are manifested by pupils in the higher grade levels due to inadequate discriminatory development; or if there has been adequate development, what other factors contribute to the reading problem? While heuristic purposes are served by questioning the internal specifics of the theory, the opinion of numerous investigators is that auditory discrimination ability determines the number of "good" and "poor" readers.

Dykstra (1966) has outlined three major categories under which investigators have attempted to determine the relationship of ability in auditory discrimination to success and achievement in reading. These may be described as follows: 1) Comparisons of "good" and "poor" readers with respect to the auditory capabilities of each; 2) Correlation studies which measure relationships between auditory discrimination and reading achievement when they are tested simultaneously, and; 3) Predictive studies which assess relationships between tests of auditory discrimination at the beginning of first grade and reading achievement at the end of first grade or in subsequent grades.

Comparitive studies are widely reported in the literature. Bond (1935), utilized a matched pair technique with 64 pairs of pupils from grades two and three. He found significant differences between "good" and "poor" readers on a test of auditory blending and auditory perception.

Significant differences were found between the groups in auditory discrimination. Bond also found that auditory abilities appeared to be more highly related to reading achievement when pupils were taught by means of an oral-phonetic approach.

Wolfe (1941) investigated differences between average and retarded readers in word-pair discrimination ability. He reported that the group of retarded readers was significantly poorer in the task than the average readers. Monroe (1932), used the same type of instrument and found a group of 32 first grade non-readers to be significantly lower than a group of unselected first grade children, despite the fact that the non-readers were older and had a higher mental age. Monroe concluded that the lack of precision in the discrimination of speech sounds may impede progress in reading.

Goetzinger, Dirks, and Baer (1960), equated 15 matched pair subjects in terms of sex, chronological age, intelligence, and visual acuity. The analysis of the comparisons between "good" and "poor" readers on a word-pairs discrimination test demonstrated highly reliable differences between the groups with the "good" readers scoring significantly higher. Supporting this relationship was a correlation coefficient of $\underline{r} = .56$ between reading achievement and the word-pairs. Similarly, Golden and Steiner (1969) investigated the relationship between specific auditory and visual functions and reading performance. They found that second graders matched on the basis of Mental Age (MA), Chronological Age (CA), and Intelligence Quotient (IQ), and classified as "good" and "poor" readers, obtained significant relationships between auditory discrimination abilities and reading. The "good" readers were significantly superior to the "poor" readers on three tests of auditory functions: sound blending, auditory sequential memory, and auditory closure.

Contrary to what was expected, the investigators found no significant differences between tests of visual functions for "good" and "poor" readers. These findings seem to suggest that "poor" readers were lacking primarily in auditory rather than visual functions.

Christine and Christine (1964) compared the performance of three groups of primary grade children on the Wepman Auditory Discrimination Test. Group one, the control group, consisted of children from grades one through three who were reading at grade level or above at the time of the study. Group two was composed of primary grade children who were reading below grade level, but who had normal speech capabilities, and Group three was composed of primary grade children who were attending special remedial classes for the correction of functional articulation disabilities. Comparisons between the three groups indicated significant differences in auditory discrimination ability between groups one and two and one and three, but not between groups two and three. These findings led Christine and Christine to conclude that poor auditory discrimination is a contributing factor to reading retardation and functional articulatory problems among primary grade children.

Investigators who have used the task comparison paradigm have found evidence to support an auditory approach to learning. Budoff and Quinlon (1964), using 56 second graders divided into average and retarded readers, compared performance on learning a paired associates word task. Exercising stringent control of input, the investigators found the auditory modality to be significantly more effective for learning meaningful material than the visual modality. This result was especially true for the retarded readers.

In contrast to these findings are studies that have found the visual presentation to be more effective than the auditory presentation of tasks. Lockhart and Sidowski (1961) compared fourth and sixth graders on learning nonsense syllables and found superior performance through a visual presentation as opposed to an auditory input.

Walters and Kosowski (1936) in a uniquely designed experiment, used colored lights and nonverbal auditory tones to test fifth, sixth, and seventh grade retarded readers. Results indicated that the subjects responded more quickly to the visual stimulus. The researchers hypothesized that retarded readers may need an incentive in the learning situation, and unless highly motivated, appeared to be less attentive to stimuli. Katz and Deutsch (1963) tested first, third, and fifth grade black boys designated as "good" and "poor" readers on several measures of auditory discrimination. They observed that the "poor" readers had more difficulty with auditory presentations, whereas Many (1965) found sixth graders more adept at visual presentation of questions than the auditory presentation of questions.

The preceding review of literature indicates that when comparisons are made between matched groups of "good" and "poor" readers, skill in auditory discrimination appears to be significantly related to achievement in reading. Furthermore, while task comparison studies appear to stimulate diversified results, an important pattern of findings can be seen to emerge. Investigations using subjects from grades one through three generally indicate support for the value of auditory presentation of stimuli and auditory discrimination. Those studies that assess modality preference in older subjects, usually fourth grade and above, produce evidence that a visual presentation is more efficacious than an

auditory presentation.

Another technique for assessing the relationship of auditory discrimination and reading is that of measuring the two skills simultaneously and then determining the relationship which exists between them (Dykstra, 1966). Poling (1953) used a sample of reading disability cases from the University of Chicago Reading Clinic between 1944 and 1949. The sample included 58 boys and 20 girls, ranging between the ages of eight and thirteen with intelligence quotients ranging from 100 to 120. Poling discovered that the pupils with weak auditory discrimination were no more likely to make vowel, consonant, or reversal errors than those who were ranked high on auditory discrimination. Poling concluded that auditory discrimination is not a wide spread cause of inefficient word recognition.

Dykstra (1966) describes a research technique closely related to the study of clinical populations in which tests of reading ability and auditory discrimination are administered to a group of subjects with the purpose of establishing whether or not significant relationships exist between these two types of measures. This type of survey method differs from those investigations previously cited in that it does not attempt to discriminate among "good" and "poor" readers prior to the administration of the testing instruments.

Wheeler and Wheeler (1954), using 629 children in the fourth, fifth, and sixth grades, measured auditory discrimination in a number of ways. The various tests required each subject to 1) discriminate word pairs, 2) discriminate between paired sound elements and determine whether each pair was the same or different, 3) select the one word from four which did not rhyme, and 4) select from a list of three sounds, the one sound

which he had heard in a stimulus word previously pronounced by the examiner. Their results indicated that each of the measures of auditory discrimination were significantly related to reading achievement. However, the correlation coefficients obtained for the relationships ranged from $\underline{r}$ = .30 to $\underline{r}$ = .40. Considering the large size of the sample (N = 629), these correlation coefficients appear to be somewhat low. Wheeler and Wheeler (1954 p. 108) stated that "it cannot be concluded that at the intermediate grade level a substantial relationship exists between silent reading ability and the ability to discriminate sounds in a spoken language situation."

Reynolds (1953) looked at the relationship between auditory characteristics and specific silent reading abilities in a sample of 188 fourth grade children. He found that perceptual factors showed greater correlation with the criterion at younger ages and decreased substantially by the time the children reached the fourth and fifth grade. While discovering that auditory blending was unrelated to general reading ability, his results did indicate that auditory discrimination, which involved differentiating between word-pairs, demonstrated higher relationships with all aspects of reading achievement. Templin (1954), also using fourth grade pupils as the sample for his investigation, correlated several measures of auditory discrimination with the pupil's reading achievement. Correlation coefficients between reading ability and the various auditory discrimination tasks ranged from $\underline{r}$ = .22 to $\underline{r}$ = .47. Of all the auditory discrimination measures administered, only the ability to recognize a word containing a given sound ($\underline{r}$ = .47) significantly discriminated between a contrasted group of "good" and "poor" readers.

Durrell and Murphey (1953) investigated the relationship between

the ability to identify sounds in speech and reading in grades one through three. Correlation coefficients between the two variables ($r = .52$ to $r = .56$) led the authors to conclude that auditory skills were highly important in learning to read.

Employing the same instruments that Durrell and Murphey used, Harrington and Durrell (1955) found a similar relationship with 500 second grade pupils matched on MA, visual discrimination, and phonics ability, but differing on auditory discrimination. Their findings, similar to previously cited investigations using primary grade subjects, indicated that reading ability may be a function of auditory discrimination ability. Pupils with superior auditory discrimination were also superior in reading skills, while poorer performance on discrimination tasks compared significantly with lower reading achievement. An important corollary finding was that many children who were high in mental ability scored no higher than those of low mental ability in the background factors that made for success in reading. The authors concluded that MA had little influence on success in reading achievement.

Wepman (1960) measured the relationships between first and second grade pupil's auditory discrimination, articulation, intelligence, and reading achievement and found that children with poor auditory discrimination, whether or not they manifested speech difficulties, were more liekly to be poorer readers than the total group. A concomitant discovery, resulting from the comparison of the data for first and second graders, indicated a decreasing number of children with poor auditory discrimination; 27 percent in grade one decreasing to 19 percent in grade two. Wepman interprets these results in terms of the developmental nature of auditory discrimination abilities, and suggests that

special attention should be given to students eight years and older who manifest auditory discrimination deficits.

Deutsch (1964) incorporated both biological and social variables in her study of auditory discrimination abilities and reading. Sampling 180 first, third, and fifth grade white and black males from lower and middle socio-economic backgrounds, and comparing their performances on auditory, visual perception, intelligence, and attention measures, Deutsch supported her hypothesis that poor auditory discrimination is a major intervening variable between social conditions and reading retardation. She found this relationship to be stronger for blacks than for whites with decreases in the relationship with increases in age. She interpreted these data to mean that training should be oriented differently for various socio-economic groups. In explaining the decreasing differentiating ability of auditory tasks as children get older, Deutsch argues that a particular minimum level of auditory skill is necessary for the acquisition of reading and general verbal skills. Once this minimum level is reached, auditory discrimination is no longer significantly related to these skills. This hypothesis, while somewhat at variance with Wepman's developmental theory, accentuates her opinion that early training in auditory discrimination is imperative.

Studies that have approached the relationship between auditory discrimination and reading achievement by simultaneously measuring the two appear to stimulate dichotomous results. When the investigations utilize selected populations (disabled readers vs. able readers), correlational significance is generally reflected between auditory discrimination and reading. However, when the research paradign uses representative samples of elementary and secondary grade pupils, the

investigators report very different results, ranging from substantial correlational relationships to no relationship at all between the two variables.

Among the literature devoted to the study of reading readiness are a number of investigations which report the predictive relationship of performance on specific tasks of auditory discrimination given during the pre-reading period and subsequent success in first grade reading. Gates, Bond, and Russell (1939) administered numerous tests of reading readiness including auditory discrimination tasks to four New York City public school first grades. Correlation coefficients between each of the auditory discrimination tests and each of the reading achievement measures were calculated midway through the first grade, at the end of the first grade, and midway through the second grade. Their results indicated a significant positive relationship only in the comparison between given words with the same or rhyming final sounds and reading achievement (r = .43). All other relationships between auditory discrimination measures and reading achievement were not significant.

Gates (1939) reported the results of a study which related readiness to reading achievement of pupils in classrooms in which reading instruction varied from giving very little emphasis to phonics to giving a great deal of emphasis to "sounding" techniques. Correlation coefficients between skill in rhyming and reading achievement ranged from r = .07 to r = .67 for the class studied, while similar correlation coefficients involving blending ability and reading ranged from r = .10 to r = .54. These results stimulated the conclusion that the highest correlation coefficients were yeilded by tests which measured abilities similar to those the children were going to be taught. Hence, tests

of auditory discrimination are more closely related to later reading success in classrooms in which the teacher utilized phonics as an aid to recognition of words.

Steinback (1940) used a sample of 300 entering first grade pupils. Each subject was administered a large number of readiness tests, including a word-pairs discrimination test. Results showed this test to rank second of all the readiness measures employed in terms of its relationship with reading achievement at the end of the school year (r = .51). Furthermore the word-pairs test ranked first with respect to its contribution to a multiple regression equation for the prediction of mid-year and end-of-year reading achievement. Dykstra (1966) administered selected measures of auditory discrimination to a sample of 632 first grade pupils and measured the same sample of pupils on reading achievement at the end of the year. A multiple regression analysis was employed to determine the extent and significance of the obtained relationships, as well as utilization of t tests to evaluate mean differences in performance between boys and girls on each of the measures. Dykstra's findings indicated that girls were significantly superior to boys in the auditory discrimination tasks measured, as well as being superior in reading achievement after a year of instruction. Boys apparently learned auditory discrimination skills less readily than girls and also took longer to master the reading process. Results of the correlational analysis and the multiple regression analysis indicated that the auditory discrimination tests ranked second to the intelligence test as far as its contribution to the prediction of reading achievement was concerned. This result led Dykstra to conclude that there is no justification for spending time testing auditory discrimination ability of first grade pupils if the

goal is to predict reading success; an intelligence test is sufficient.

Studies which have attempted to assess the relationship of auditory discrimination ability during the pre-reading period to future success in learning to read have generally reported small positive correlation coefficients ranging from approximately $\underline{r} = .20$ to $\underline{r} = .40$. Furthermore, intelligence has been reported to be a better predictor of reading success than is auditory discrimination ability for first grade subjects, and first grade girls were found to be superior to first grade boys in both auditory discrimination ability and reading achievement (Dykstra, 1966).

Despite the heterogeneity of results stimulated by the three different paradigms of research, several consistencies in the findings may be noted.

1. When comparisons are made between "good" and "poor" readers in terms of their auditory discrimination abilities, the relationship obtained between the two variables is stronger and reaches greater significance than when the two variables are compared within a representative sample of subjects (Dykstra, 1966).
2. Evidence indicates that the relationships obtained between auditory discrimination and reading for both selected and unselected samples reach a higher correlational value in the primary grades than in the secondary grades (Reynolds, 1953; Wheeler and Wheeler, 1954; Reed, 1958).
3. Inconclusive evidence exists regarding the role of intelligence as a contributory factor to the relation-

ship between auditory discrimination and reading achievement (Harrington and Durrell, 1955; Wepman, 1960; Dykstra, 1966).

The lack of consistency in the findings of studies that simultaneously measure the relationship between auditory discrimination and reading achievement in representative samples of subjects stimulates the need for further research. If the auditory discrimination factor is assumed to play a role in reading readiness and reading achievement with selected populations (disabled readers vs. able readers), then studies are needed that precisely define this role within representative groups of students in the regular classroom.

Problem

The purpose of this study was to investigate the relationship between reading ability and the ability to discriminate verbal auditory stimuli among two representative groups of first and fourth grade pupils. On the premise that auditory discrimination ability is a potent factor in the reading process, this study was designed to test the following hypotheses:

H_1: There is a significant positive relationship between the GFW Test of Auditory Discrimination (Quiet subtest) and the WRAT Word Recognition subtest for first and fourth grade samples.

H_2: There is a significant positive relationship between the GFW Test of Auditory Discrimination (Noise subtest) and the WRAT Word Recognition subtest for first and fourth grade samples.

H_3: There is a significant positive relationship between the Wepman Auditory Discrimination Test and the WRAT Word Recognition subtest for first and fourth grade samples.

H_4: With intelligence held constant, the relationship between the Quiet and Noise subtests of the GFW Test of Auditory Discrimination, the Wepman Auditory Discrimination Test, and the WRAT Word Recognition subtest for the first and fourth grade samples are positive and significant.

H_5: The Pearson product-moment and the First-Order partial correlation coefficients obtained between the auditory discrimination measures and the word recognition subtest for the fourth grade sample are significantly lower than the same correlation coefficients obtained for the first grade sample.

CHAPTER II

METHOD

Sample

Subjects for this study were selected from children enrolled in the two first grade classes and the two fourth grade classes of an elementary school in Albuquerque, New Mexico. Subjects were drawn from the first and fourth grade population who met the following criteria:

1. Visual acuity within the normal range, with or without glasses, as measured on the Snellen E chart.
2. Auditory acuity within the normal range as measured by the Mako Audiometric Sweep Test.
3. No manifestation of abnormal behaviors or character problems as judged by the subject's teacher.
4. No marked deficiencies in overall academic performance as judged by the subject's teacher.

An effort was made to select a sample of children from both grade levels who approximated the normal range of student performance within their respective classes. While pupils who were markedly deficient in their overall academic performance were excluded from the sample, teachers were asked to exercise flexibility in terms of their referral of children with reading problems for the investigation. The rationale underlying the sampling procedure was to eliminate the effect of extreme scores, but to include above average, average, and below

average readers within the sample.

Of the 50 children from the two fourth grade classes, and the 46 children from the two first grade classes who met the above criteria, 25 were randomly selected from each class level and assigned to their respective first and fourth grade groups.

Table 1 gives a description of the first and fourth grade groups by sex, age, cultural origin, and IQ score from the Otis-Lennon Mental Ability Test. The socio-economic level of their families was estimated to be low-middle to middle based on the type of housing in the school's attendance area.

Instrumentation

A battery of two tests of auditory discrimination, a test of word recognition, and a group IQ test were given each subject.

Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW). The GFW Test of Auditory Discrimination (Goldman, Fristoe, Woodcock, 1970) was designed to provide measures of speech sound discrimination ability, relatively unconfounded by other factors. It provides a measure of auditory discrimination under ideal listening conditions plus a comparative measure of auditory discrimination in the presence of controlled background noise. The test is comprised of three parts. The first is the Training procedure, which familiarizes the subject with the word-picture associations to be used during the two subtests and permits the examiner to establish the presence of these associations. The second part is the Quiet subtest, which provides a measure of auditory discrimination in the absence of background noise. Third is the

TABLE 1

DESCRIPTION OF THE FIRST AND FOURTH GRADE SAMPLES BY SEX, AGE, CULTURAL ORIGIN, AND D.I.Q. SCORE AS MEASURED BY THE OTIS-LENNON MENTAL ABILITY TEST

Descriptor	First grade	Fourth grade
Sex		
Males	11	12
Females	14	13
Age		
Mean	6 yrs. 6 mos.	9 yrs. 10 mos.
Standard Deviation	.42 mos.	.70 mos.
Cultural Origin		
Spanish Surname	9	8
Black	0	0
American Indian	0	0
Oriental	0	0
Other	16	17
Otis-Lennon D.I.Q. Score		
Total Sample		
Mean	107.8	104.4
Standard Deviation	9.6	12.3
Males		
Mean	109.9	108.1
Standard Deviation	8.5	14.6
Females		
Mean	106.1	104.2
Standard Deviation	10.4	11.5

Noise subtest, which provides a measure of auditory discrimination in the presence of background noise that is nine decibels less than the stimulus words. The nine decibel difference was chosen because most normal subjects showed a marked drop in discrimination performance at this level. At higher signal-to-noise ratios, normal subjects showed little decrement in performance when compared with their performance in quiet. A lower ratio resulted in extreme degradation in performance.

The effects of extraneous factors on the auditory scores of the GFW have been minimized in the following ways: First, the GFW adds a new dimension to the testing of discrimination ability by using a different aspect of memory and avoiding the artifical type of auditory memory task found in many tests. Second, the adequacy of the stimulus materials in terms of meaningfulness and familiarity for the subject is evaluated through the use of training plates. Third, the administration of the two subtests is controlled through the use of a pre-recorded tape and the use of earphones (Goldman, et al., 1970, p. 7-8).

The GFW Test of Auditory Discrimination was standardized on a sample of 745 subjects ranging in age from 3 to 84. Test-retest reliability yielded a correlation coefficient of $r = .87$ on the Quiet subtest and $r = .81$ on the Noise subtest. Concurrent validity was determined by comparing the two subtests scores with the judgements of expert clinicians. Correlation coefficients for the Quiet and Noise subtests were $r = .68$ and $r = .72$ respectively.

Wepman Auditory Discrimination Test (Wepman). The Wepman Auditory Discrimination Test (Wepman, 1958) was designed to measure the ability to distinguish between fine differences that exist among the phonemes used in English speech. Forty pairs of words are included on each test

form, and the subject must decide whether the words said by the examiner are the same or different. Wepman states that the test has been found useful in selecting children, especially those in the early elementary school years, who are slower than their peers in developing auditory discrimination.

The test-retest administrations produced a reliability coefficient of $r = .91$ ($N = 109$), while comparison of the difficulty of each phoneme on the two test forms (A and B) shows a Spearman Rank Order correlation coefficient of rho = .67 ($N = 214$).

Wide Range Achievement Test (WRAT). The WRAT (Jastak and Jastak, 1965) was designed as an adjunct to tests of intelligence and behavior adjustment. While the test consists of a Reading subtest, a Spelling subtest, and an Arithmetic subtest, only the Reading subtest was employed in this study. The WRAT Reading subtest, which consists of recognizing and naming letters and pronouncing words, was chosen for use in this investigation because of ease in administration and adequate reliability and validity. Split-half reliability coefficients for the WRAT Reading subtest range from $r = .98$ to $r = .99$ for level I (ages 5-10 to 11-11), and $r = .983$ to $r = .988$ for level II (ages 12-0 to adulthood). Concurrent validity coefficients between the WRAT Reading subtest and external criteria range from $r = .81$ to $r = .84$.

Otis-Lennon Mental Ability Test (OLMAT), Otis and Lennon (1967). The various levels comprising the OLMAT series were designed to provide comprehensive, carefully articulated assessment of general mental ability, or scholastic aptitude, of pupils in American schools. Emphasis is placed upon measuring the pupil's facility in reasoning and dealing abstractly with verbal, symbolic, and figural test content.

The OLMAT was standardized on a sample of approximately 200,000 pupils in 117 school systems drawn from all 50 states. Approximately 12,000 pupils per grade level were tested in grades 1 through 12 during October-November, 1966. The Split-half reliability measures obtained for the Primary II level and the Elementary II level yielded correlation coefficients of $\underline{r}$ = .90 and $\underline{r}$ = .94 respectively. The OLMAT is designed for use with classroom groups and may easily be administered by the classroom teacher. It was primarily for this reason that this indicator of mental ability was chosen.

The Primary II level of the OLMAT was used with the first grade sample. Total time required for administration is approximately 30 to 35 minutes. No reading is required by the child.

The Elementary II level of the OLMAT was used with the fourth grade sample. The test at this level is comprised of 80 items. Time required for administration is a single period consisting of 40 minutes.

Procedure

The GFW, the Wepman, and the WRAT were administered individually to each subject during a 45 minute test session. The test session was conducted in a small room, separate from other classrooms, and there were no visual distractions other than the equipment necessary for the administration of the GFW Test of Auditory Discrimination.

A Wollensack Model 6020 tape recorder, a Newcomb 9 jack adapter, and two sets of Jax # 305 8 ohm Dynamic Stereo Headphones were used in the administration of the GFW. One set of headphones was used by the subject, while the other set was used by the examiner. The tape recorder was calibrated between 60 and 70 decibels as recommended in the manual.

The complete training procedure was given to each child. Specific instructions were: "You are going to see some pictures here (examiner points to picture Easel-kit). I will say a word. Then I want you to put your finger on the picture of the word I have said." This was followed by the instructions for the Quiet subtest which were: "Now I am going to show you some more pictures. But this time you will hear what to do through these earphones. Later in the test you will hear a lot of noise and the words will be harder to understand. Listen carefully and be sure to look at all four picture each time." Further instructions are given to the child on the tape.

The Wepman requires that verbal instructions be given to the subject prior to the actual administration of the test. During the instructional period the examiner and the subject are facing each other, and the examiner reads the following directions: "I am going to read some words to you - two at a time. I want you to tell me or let me know in some way whether I read the same word twice or two different words. Remember, if the two words are exactly the same, you say yes or same; if they are not exactly the same, you say no or different." The subject is then asked if he understands. This is followed by a practice period in which the examiner states: "Let's try a few pairs for practice. Man (pause) Man...Did I say the same word twice or two different ones?" If the subject gives a correct response, another practice pair is given. If a correct response is elicited on the second trial, the subject is turned around with his back toward the examiner and the administration of the test begins. The word-pair test items are read slowly and clearly with a one-second pause between words until all 40 pairs have been completed.

The administration of the WRAT is a simple procedure in which the subject is shown a list of words that occur with increasing difficulty and given the following directions. The examiner points to the first word and says: "Look at each word carefully and say it aloud. Begin here (examiner points), and read the words across the page so I can hear you. When you finish the first line, go on to the next line and then the next." If the subject hesitates or says "I don't know that," the examiner encourages the subject to "Try the word anyway or take a guess at it." If failures occur in the first line of the reading subtest, the three pre-reading parts of the subtest are administered. These involve the naming of 13 letters, recognizing 10 letters, and eliciting the name of 2 letters in the subject's name.

The OLMAT was administered to both first and fourth grade pupils in a group testing session. The first grade subjects were tested at the beginning of the year by their classroom teacher, while the fourth grade subjects were tested at the end of the year by the investigator. Time factors did not allow for a second testing of first grade subjects at the end of the school year, hence the appropriate use of their beginning year IQ scores in this investigation may be questioned. However, since the OLMAT test level that would have been used for the last half of grade one also required no reading, the beginning year scores may be used with some degree of confidence.

Data Collection

Both raw scores and standard score data were collected from the GFW and the WRAT. A raw score, utilizing number correct, was obtained from the Wepman, and a Deviation IQ, which is a standard score, was obtained from the OLMAT. Deviation IQ's obtained from the OLMAT

have a mean of 100 and a standard deviation of 16 points. Standard scores obtained from the GFW and the WRAT have means of 50 and 100, and standard deviations of 10 and 15, respectively.

Data Analysis

The degree of relationship between each of the auditory discrimination tests, the reading test, and the IQ test were determined by Pearson product-moment correlations. First-Order partial correlations were used to control for the effect of intelligence on the obtained relationships between auditory discrimination and reading. All correlation coefficients were tested for statistical significance through the use of a *t* test, and differences between the correlation coefficients were tested via the Test of Difference Between Two Correlation Coefficients (McCall, 1970). A *t* test for the Difference Between Means was used to compare mean scores between grade level and sex for all test measures. An alpha of .05 was chosen as the level of significance.

CHAPTER III

RESULTS

The purpose of this study was to investigate the relationship between reading ability and the ability to discriminate verbal auditory stimuli among representative groups of first and fourth grade pupils. Each subject in both the first and fourth grade groups was administered two tests of auditory discrimination, a test of reading ability, and a group I.Q. test.

The specific hypotheses are as follows:

H_1: There is a significant positive relationship between the GFW Test of Auditory Discrimination (Quiet subtest) and the WRAT Word Recognition subtest for first and fourth grade samples.

H_2: There is a significant positive relationship between the GFW Test of Auditory Discrimination (Noise subtest) and the WRAT Word recognition subtest for first and fourth grade samples.

H_3: There is a significant positive relationship between the Wepman Auditory Discrimination Test and the WRAT Word Recognition subtest for first and fourth grade samples.

H_4: With intelligence held constant, the relationships between the Quiet and Noise subtests of the GFW Test of Auditory Discrimination, the Wepman Auditory Discrimination Test, and the WRAT Word Recognition subtest for the first and fourth grade samples are positive and significant.

H_5: The Pearson product-moment and the First-Order partial correlation coefficients obtained between the auditory discrimination measures and the Word Recognition subtest for the fourth grade sample are significantly lower than the same correlation coefficients obtained for the first grade sample.

Means, standard deviations, and *t* test values for the difference between means for grade levels and sex for all tests appear in Table 2. See Appendix A and B for Raw Data. Table 2 shows that the first and fourth grade samples were not significantly different in regard to the total sample mean scores for the tests administered with the exception of the GFW Noise subtest. Comparison between the first and fourth grade sample means on this measure resulted in a *t* of 2.9 ($p < .01$), indicating that the first grade sample scored significantly higher than the fourth grade sample on the auditory discrimination test when extraneous noise was introduced.

Differences between means were also calculated in comparing male and female mean scores for all tests administered within each grade level (Table 2). Significant differences were found for only one test, the GFW Quiet subtest. Comparison between the fourth grade male and female mean scores on this measure resulted in a *t* of 3.3 ($p < .01$), which indicated that the fourth grade females scored significantly higher than the fourth grade males on the auditory discrimination test when the noise factor was controlled.

Correlation coefficients for the Quiet subtest of the GFW and the WRAT for first and fourth grade samples were $r = .16$ (Table 3) and $r = .21$ (Table 4), respectively. This indicated no significant relationship between the measures. Therefore, H_1 is rejected.

Correlation coefficients for the Noise subtest of the GFW and the WRAT for the first and fourth grade samples were $r = .28$ (Table 3) and $r = .18$ (Table 4), respectively. No significant relationship between the measures is indicated. Therefore, H_2 is rejected.

TABLE 2

FIRST AND FOURTH GRADE MEANS AND STANDARD DEVIATIONS FOR TOTAL SAMPLE AND SEX FOR ALL TEST MEASURES ADMINISTERED, AND t TEST VALUES FOR THE DIFFERENCE BETWEEN GRADE LEVEL AND BETWEEN SEX WITHIN GRADE LEVEL

Measures	Grade	Total Sample Mean	Total Sample S D	Males Mean	Males S D	Females Mean	Females S D	t Btwn Grade Level	t Btwn Sex Within Grade Level
WRAT[a]	First	107.2	14.4	113.3	15.9	104.1	12.8	.022	1.6
	Fourth	108.3	20.5	112.3	23.0	104.6	17.9		.93
GFW Quiet[b]	First	51.0	7.8	50.8	6.6	56.9	8.9	1.8	1.9
	Fourth	47.2	6.8	43.2	5.9	50.8	5.6		3.3*
GFW Noise[b]	First	57.8	8.5	59.1	8.3	56.9	8.9	2.9*	.63
	Fourth	51.3	7.2	52.6	8.5	50.1	5.7		.86
Wepman[c]	First	35.2	2.9	35.4	2.4	35.0	3.3	1.7	.33
	Fourth	36.5	2.6	36.8	3.3	36.2	1.6		.57
OLMAT[d]	First	107.8	9.6	109.9	8.5	106.1	10.4	1.11	.98
	Fourth	104.4	12.3	108.1	14.6	104.2	11.5		.74

[a] Standard scores with a mean of 100 and standard deviation of 15.

[b] Standard scores with a mean of 50 and standard deviation of 10.

[c] Scores are computed as the number correct out of 40.

[d] Standard scores with a mean of 100 and a standard deviation of 16.

* $p < .01$.

Correlation coefficients for the Wepman and the WRAT for the first and fourth grade samples were r = .40 (Table 3) and r = .23 (Table 4), respectively. This indicated a significant positive relationship between the measures for the first grade sample, but an insignificant relationship between the measures for the fourth grade sample. Therefore, H_3 is partially accepted.

TABLE 3

PEARSON PRODUCT-MOMENT CORRELATION MATRIX
FOR SELECTED MEASURES
FOR THE FIRST GRADE SAMPLE

	Measures	Measures 1	2	3	4	5
1.	WRAT Word Recognition	-	.16	.28	.40*	.63**
2.	GFW Quiet subtest		-	.47*	.03	.32
3.	GFW Noise subtest			-	.50*	.39
4.	Wepman Test				-	.58**
5.	OLMAT					-

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

TABLE 4

PEARSON PRODUCT-MOMENT CORRELATION MATRIX
FOR SELECTED MEASURES
FOR THE FOURTH GRADE SAMPLE

	Measures	Measures 1	2	3	4	5
1.	WRAT Word Recognition	-	.21	.18	.23	.82**
2.	GFW Quiet subtest		-	-.10	.25	.30
3.	GFW Noise subtest			-	.41*	.05
4.	Wepman Test				-	.08
5.	OLMAT					

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

Correlation coefficients for the auditory discrimination measures and the word recognition test when intelligence was held constant yielded the following results. For the first grade sample, First-Order partial correlation coefficients between the measures ranged from $\underline{r}$ = -.05 to .06 (Table 5). For the fourth grade sample, First-Order partial correlation coefficients ranged from $\underline{r}$ = -.07 to .29 (Table 5). This indicated no significant relationships between the measures. Therefore, H_4 is rejected.

TABLE 5

FIRST-ORDER PARTIAL CORRELATION COEFFICIENTS
FOR SELECTED MEASURES FOR FIRST AND FOURTH GRADE SAMPLES
WITH INTELLIGENCE CONTROLLED

Correlated Measures	First grade Partial r	Fourth grade Partial r
WRAT Reading X GFW Quiet	-.05	-.07
WRAT Reading X GFW Noise	.04	.25
WRAT Reading X Wepman Test	.06	.29

Calculations to determine whether significantly lower correlation coefficients existed between the auditory discrimination measures and the reading measure for the fourth grade sample as compared to those obtained between the same measures for the first grade sample yielded insignificant results (Table 6). The correlation coefficients obtained between the Quiet subtest of the GFW and the WRAT increased in value from $\underline{r}$ = .16 for the first grade sample, to $\underline{r}$ = .21 for the fourth grade sample. A Test of the Difference Between Two Correlation Coefficients (McCall, 1970) was computed which resulted in an insignificant Z_{obs} of .17.

The correlation coefficients obtained between the Noise subtest of the GFW and the WRAT decreased in value from $\underline{r}$ = .28 for the first grade sample, to $\underline{r}$ = .18 for the fourth grade sample, but the difference was not significant (Z_{obs} = .35). The correlation coefficients obtained between the Wepman and the WRAT decreased from a significant $\underline{r}$ = .40 found with the first grade sample, to an insignificant $\underline{r}$ = .23 obtained with the fourth grade sample. Again, an insignificant difference between the two correlation coefficients was demonstrated via the Test of Difference Between Two Correlation Coefficients (Z_{obs} = .63).

TABLE 6

PEARSON PRODUCT-MOMENT AND FIRST-ORDER PARTIAL CORRELATION COEFFICIENTS FOR EACH CORRELATED MEASURE BY GRADE LEVEL AND Z VALUE FOR THE TEST OF DIFFERENCE BETWEEN TWO CORRELATION COEFFICIENTS

Correlated measure	First grade $\underline{r}$	Fourth grade $\underline{r}$	Z value	First grade partial $\underline{r}$	Fourth grade partial $\underline{r}$	Z value
WRAT X GFW Quiet	.16	.21	.17	-.05	-.07	-.07
WRAT X GFW Noise	.28	.18	.35	.04	.25	.72
WRAT X Wepman	.40*	.23	.63	.06	.29	.79

* $\underline{p} < .05$

When the Test of Difference Between Two Correlation Coefficients was applied to the First-Order partial correlation coefficients, insignificant Z_{obs} values were obtained for all correlated measures (Table 6). The direction of the correlation coefficients obtained between the auditory discrimination measures and the reading measure when intelligence

was controlled for differed from the direction of the Pearson product-moment correlation coefficients, in that all correlations increased in value as a function of grade level. The differences in value, as stated previously, were not significant. Therefore, H_5 is rejected.

Additional findings resulting from the statistical analysis between the test measures that were administered to the first and fourth grade samples are presented in Tables 3 and 4. Correlational analysis between the WRAT and the OLMAT resulted in a significant $r = .63$ ($p < .01$) for the first grade (Table 3), and a significant $r = .82$ ($p < .01$) for the fourth grade (Table 4). The GFW Quiet subtest was found to correlate significantly ($r = .47$, $p < .05$) with the GFW Noise subtest for the first grade sample, but the relationship between the two measures decreased to an insignificant and negative value ($r = -.10$) for the fourth grade sample. Conversely, the relationship obtained between the GFW Quiet subtest and the Wepman increased as a function of grade level, with $r = .03$ in the first sample (Table 3), and $r = .25$ in the fourth grade sample (Table 4). Neither value, however, reached significance. The GFW Noise subtest was significantly related ($p < .05$) to the Wepman for both grade levels. A higher correlation coefficient was found with the first grade sample ($r = .50$) than for the fourth grade sample ($r = .41$). Table 3 also shows that while the Wepman was significantly related ($p < .01$) to the OLMAT in grade one, a significant relationship did not exist between the OLMAT and either subtest of the GFW. At fourth grade (Table 4), no significant relationships were found between the OLMAT and any of the measures of auditory discrimination.

Correlational analysis designed to test hypotheses 1, 2, and 3 resulted in rejection of hypotheses 1 and 2 and partial acceptance of hypothesis 3. When intelligence was held constant, none of the correlated measures reached significance for either grade level. Consequently, hypothesis 4 was rejected. No differences were found between either the first and fourth grade Pearson product-moment correlation coefficients or the first and fourth grade First-Order partial correlation coefficients when compared by the Test of Difference Between Two Correlation Coefficients. Hence, hypothesis 5 was also rejected.

CHAPTER IV

DISCUSSION

The purpose of this study was to investigate the relationship between reading ability and the ability to discriminate verbal auditory stimuli among representative groups of first and fourth grade pupils. Subjects were administered the reading subtest of the Wide Range Achievement Test (WRAT), the Quiet and Noise subtests of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW), the Wepman Auditory Discrimination Test (Wepman), and the Otis-Lennon Mental Ability Test (OLMAT). Pearson product-moment correlation coefficients were calculated between each of the auditory discrimination measures and the reading measure to test the hypothesized relationships. First-Order partial correlation coefficients were calculated to control for the effect of intelligence on the relationships obtained between auditory discrimination and reading. All correlation coefficients were tested for significance through the use of a *t* test, and differences between the correlation coefficients were tested via the Test of Difference Between Two Correlation Coefficients (McCall, 1970).

Hypotheses

The results of this study do not support the hypotheses that there is a significant positive relationship between the Quiet and Noise subtests of the GFW and the WRAT for first and fourth grade subjects (H_1 and H_2). These findings are not in agreement with those of Durrell and Murphey (1953), and Harrington and Durrell (1955) cited earlier, in which they found significant positive relationships

between measures of auditory discrimination and reading ability with representative samples of primary grade subjects. However, the insignificant findings resulting from the testing of the first two hypotheses are consistent with the results obtained by investigators who have examined the relationships between auditory discrimination and reading with representative samples of upper elementary grade subjects. Wheeler and Wheeler (1954) found insignificant relationships between the two measures when using a representative sample of 629 fourth, fifth, and sixth grade children, and Reynolds (1953) found the correlation between auditory discrimination and reading to decrease substantially by the time children reached the fourth and fifth grade.

The findings of the present study partially support the prediction of hypothesis three, in that a significant positive relationship was obtained between the Wepman and the WRAT for the first grade sample. This finding supports the Durrell and Murphey (1953) conclusion that auditory skills were highly important in learning to read for primary grade children, and also support Harrington and Durrell's (1955) results, which indicated that primary grade reading ability may be a function of auditory discrimination ability. The significant positive relationship obtained between the Wepman and the WRAT for the first grade sample is also consistent with the results obtained by Wepman (1960), and Christine and Christine (1964). Both of these investigations used the Wepman as the measure of auditory discrimination ability in comparisons with primary grade reading ability, and found significant positive relationships between the two measures. The insignificant relationships obtained between the Wepman and the WRAT

for the fourth grade sample is again consistent with the results of investigators that have compared auditory discrimination ability and reading ability in representative groups of fourth grade subjects (Wheeler and Wheeler, 1954; Reynolds, 1953; Templin, 1954). Investigators using task comparison paradigms have found evidence to support an auditory approach to learning in the primary grades (Budoff and Quinlon, 1964), and a visual approach to learning in grades four and above (Lockhart and Sidowski, 1961; Walters and Kosowski, 1963). Consequently, the significant relationship obtained between auditory discrimination and reading for the first grade sample, as compared to the insignificant relationship obtained between the two measures for the fourth grade sample, suggest that the importance of auditory discrimination in terms of its relation to reading, decreased as a function of age.

The insignificant relationships obtained between the auditory discrimination measures and the reading measure for the first and fourth grade samples when intelligence was held constant reject the prediction of hypothesis four. This result lends support to Dykstra's (1966) conclusion that an intelligence test is a better predictor of reading success for first grade pupils than is an auditory discrimination test. However, the insignificant findings in regard to hypothesis four do not corroborate Harrington and Durrell's (1955) notion that mental age has little influence on success in reading achievement.

Evidence presented previously indicated that the relationships obtained between auditory discrimination and reading ability for both selected and unselected samples reach a higher correlational value

in the primary grades than in grades four and above. For example, Reed (1958), concluded that primary grade reading ability is dependent on procedural skills - learning to move one's eyes from left to right, distinguishing among similar objects, and detecting slight differences in sounds. In contrast, Reed stated that reading ability in the fourth grade and above is a function of verbal meaning and verbal reasoning skills. He found that in the first grade, perception and space tests had the highest correlations with reading, while a verbal meaning test had no correlation with reading scores at all. At grade four, however, the verbal meaning and reasoning measures were the best predictors of reading, with the tests of perception and space having substantially lower correlations with reading. Similarly, other investigators (Reynolds, 1953; Wheeler and Wheeler, 1954), have reported a decrease in the magnitude of the correlation coefficients between auditory discrimination and reading as age increases. However, findings of the present study do not support the prediction of hypothesis five, that the correlation coefficients obtained between the auditory discrimination measures and the reading measure for the fourth grade sample are significantly lower than the same correlation coefficients obtained for the first grade sample. While the results did not indicate significantly different correlation coefficients between the two grade levels, the results did show lower Pearson product-moment correlation coefficients between two measures of auditory discrimination and the reading measure for the fourth grade sample (Table 6). Although these findings are consistent with those investigations cited earlier (Reed, 1958; Reynolds, 1953; Wheeler and Wheeler, 1954), which reported decreasing correlation coefficients as a function of increasing

grade level, the comparison between the first and fourth grade partial correlation coefficients yeilds results which contradicts their notion. When intelligence was controlled, the relationships between the GFW Noise subtest and the WRAT, and between the Wepman and the WRAT, were higher for the fourth grade sample than for the first grade sample. Again, while the differences between the partial correlation coefficients were not significant, the higher correlation coefficients obtained for the fourth grade sample support Wepman's (1960) notion that auditory discrimination ability may not fully develop until the child's eighth year.

Effects of Sample Characteristics

Evidence presented previously indicated that the magnitude of the correlation coefficients obtained between auditory discrimination ability and reading ability varies with the type of sample used. When comparisons are made between "good" and "poor" readers in terms of their auditory discrimination abilities, the correlation coefficients between the two variables are stronger and reach greater significance than when the two variables are compared within a representative sample of subjects (Dykstra, 1966; Wheeler and Wheeler, 1954; Reynolds, 1953). The rejection of hypotheses 1, 2, 4, and 5, and only partial acceptance of hypothesis 3 lends support to this conclusion. An analysis of individual reading scores for the first grade sample shows that 24 of the 25 subjects were within the average to superior range of reading ability as placed by the WRAT classification system. Only one first grade subject's reading score fell in the below average range. Similarly, 21 of the 25 fourth grade subjects were within the average to superior

range in reading ability, with four subjects scoring in the inferior to low average range. The distribution of reading standard scores for both the first and fourth grade samples appears to be skewed toward the higher ranges of reading ability, and hence the sampling design does not resemble those studies that compare auditory discrimination abilities among samples of "good" and "poor" readers.

The effects of the sample characteristics are also reflected in the auditory discrimination scores obtained by both grade samples. The raw scores obtained for the first grade sample on the GFW Quiet subtest range from 23 to 30. One subject obtained a raw score of 23, with all other raw scores falling between 27 and 30. The absence of variability between scores is also indicated by the raw scores obtained for the first grade sample on the GFW Noise subtest, with one subject obtaining a raw score of 15, and all other subjects scoring between 19 and 26, and by the raw scores obtained on the Wepman which ranged from 29 to 40.

A similar homogeneity of auditory discrimination scores can be observed with the fourth grade sample. Raw scores obtained for the GFW Quiet subtest ranged from 26 to 30, while the GFW Noise subtest scores and Wepman scores ranged from 18 to 25 and from 28 to 40, respectively.

The lack of variability within the auditory discrimination raw scores for both grade samples demonstrates that the children selected for participation in this study are either very similar to each other in auditory discrimination ability, or the tests that were used to measure auditory discrimination ability are not sensitive enough to distinguish fine differences in this ability among "normal" subjects.

This absence of individual differences among subjects serves to reduce the variability of the trait measured. When the trait is then compared with a criterion to assess the existing relationship between the two, the absence of variability between scores would tend to reduce the correlation coefficient (McCall, 1970).

An additional sample characteristic that would tend to reduce the size of the correlation coefficient is that of sample size. Those investigations cited previously that have obtained significant positive relationships between auditory discrimination ability and reading ability with representative samples of subjects have used large samples of subjects. For example, Durrell and Murphey (1953) obtained correlation coefficients ranging from $\underline{r}$ = .52 to $\underline{r}$ = .56 when they compared auditory discrimination ability and reading ability within a sample drawn from three grade levels, and Harrington and Durrell (1955) found similar relationships with a sample of 500 second grade pupils. In accordance with statistical theory, the larger the sample size, the greater the variability among subjects. As explained previously, as the variability between scores increases, the size of the correlation coefficient increases (McCall, 1970). Hence, the size of the samples used in this study (N = 25), and the homogenous nature of the test scores obtained by the subjects within the two samples, would necessarily decrease the variation among scores and reduce the size of the correlation coefficient obtained between the test measures.

A concomitant explanation for the insignificant relationships obtained in the present study is provided by Deutsch (1964). She argues that a particular minimum of auditory skill is necessary for the acquisition of reading and general verbal skills. However, once

this minimum level is reached, auditory discrimination is no longer significantly related to these skills. Hence, it could be assumed for the sample of subjects used in this study, that the contribution that auditory discrimination is hypothesized to make to the reading process, was diminished to a point below statistical significance.

Relationships Between the Measures of Auditory Discrimination

An effort was made in this investigation to use more than one measure of auditory discrimination to test the hypothesis of an existing relationship between auditory discrimination and reading. The Wepman and the GFW were chosen for use in this study because they are among the most widely used tests of auditory discrimination, and hence the findings of this study might prove helpful to those who administer them. The Wepman has been reported in the literature to correlate significantly with tests of reading ability (Wepman, 1960; Christine and Christine, 1964), while reports of relationships between the GFW and reading ability were not available in published form.

In agreement with the previous research findings (Wepman, 1960; Christine and Christine, 1964), the results of this study show the Wepman to correlate significantly ($p < .05$) with the WRAT for the first grade sample. However, an insignificant relationship was obtained between the Wepman and the WRAT for the fourth grade sample. Neither subtest of the GFW was significantly related to the WRAT at either the first or fourth grade level.

A major finding resulting from comparisons between the two measures of auditory discrimination was that while the Wepman was significantly related to the Noise subtest of the GFW at both grade levels, it was not

significantly related to the Quiet subtest of the GFW at either grade level. These results may be attributed to the nature of stimulus presentation of the words to be discriminated. While the Quiet subtest of the GFW controls and screens any extraneous noise except the stimulus word, both the Noise subtest of the GFW and the Wepman are administered in the presence of background noise. The Noise subtest of the GFW artificially produces a random noise level nine decibels less than the stimulus word, and all subjects who were administered the Wepman in this study, took the test with hallway noise and ringing office phones in the background. It could perhaps be hypothesized that the nature of stimulus presentation may determine in some way what the degree of relationship of that auditory discrimination task is to reading ability. Since neither the ability to distinguish individual sounds used in speech, nor reading ability is developed within a sound proof vacuum, the use of the Quiet subtest of the GFW may preclude practically any significant relationships with other tests of auditory discrimination or tests of reading ability.

The difference in construction of the two auditory discrimination tests may account for the higher relationships found with the Wepman and the WRAT, than with the GFW and the WRAT. Investigators that have found significant relationships between auditory discrimination and reading with representative groups of subjects have used several discrimination tasks. These include recognizing a word containing a given sound (Templin, 1954; Durrell and Murphey, 1953; Harrington and Durrell, 1955), the discrimination of word-pairs (Steinback, 1940; Wheeler and Wheeler, 1954; Wepman, 1960), and rhyming techniques (Wheeler and Wheeler, 1954). While the Wepman uses a word-pair discrimi-

nation format, the GFW uses both an auditory and a visual presentation. The subject hears the stimulus word through earphones, and then chooses the picture of that word from a field of four pictures. The provision of both the auditory and the visual cue for a discrimination perhaps reduces the item difficulty for normal subjects, especially on the Quiet subtest. This reduction in item difficulty is evidenced by both the homogeneity of scores obtained by both grade samples on the Quiet subtest, and the normative data supplied in the GFW instruction manual. For example, the table of percentiles corresponding to raw scores in the GFW manual indicates that one error on the Quiet subtest decreases the percentile score 23 percentile points for age groups 6-0 to 6-5.

The Role of Intelligence

Evidence cited earlier indicated a difference in results regarding the role of intelligence as a contributory factor to the relationship between auditory discrimination and reading achievement. Harrington and Durrell (1955) concluded that mental age had little influence on success in reading achievement, whereas Dykstra (1966) concluded that for first graders, an intelligence test was a better predictor of reading success than was an auditory discrimination test. The findings of the present study lend support to Dykstra's conclusion, in that the highest correlation coefficients obtained for either grade level were between the OLMAT and the WRAT. Furthermore, when intelligence was partialed from the relationships obtained between the auditory discrimination measures and the reading measure for the first grade sample, all relationships decreased in magnitude (Table 5).

An interesting finding occurred when intelligence was partialed

from the obtained relationships between the auditory discrimination measures and the reading measure for the fourth grade sample. Similar to the first grade results, when intelligence was partialed from the relationship between the Quiet subtest of the GFW and the WRAT (r = .21), the value of the correlation coefficient decreased to r = -.07 (Table 5). However, when intelligence was partialed from the relationships between the Noise subtest of the GFW and the WRAT, and the Wepman and the WRAT, the correlation coefficients increased from r = .18 to r = .25, and from r = .23 to r = .29, respectively (Table 5). One possible explanation is Wepman's notion that the ability to discriminate auditory stimuli matures as late as the end of the child's eighth year. Accordingly, when the effect of intelligence was controlled in the relationships between the auditory discrimination measures and the reading measure for the fourth grade sample, the importance of auditory discrimination appears to increase as opposed to the decrease found with the first grade sample. Consequently, these findings, while not significant, suggest that intelligence holds a greater value in the reading process for first graders than for fourth graders.

An alternative explanation is provided through inspection of the data in Tables 3 and 4. The Pearson product-moment correlation coefficients obtained from the comparison of the auditory discrimination measures and the OLMAT for grade one, are of greater magnitude than the same relationships obtained for grade four, with the exception of the relationship between the Quiet subtest of the GFW and the OLMAT. Since the correlation coefficients between the auditory discrimination measures and the OLMAT are used in the First-Order partial correlation formula, the lower correlation coefficients obtained between the auditory

discrimination measures and the OLMAT for the fourth grade sample, would tend to increase the fourth grade partial correlation coefficients. Hence, the increase of the partial correlation coefficients between the reading subtest and the auditory discrimination measures in the fourth grade sample is a statistical function of the decreasing relationship between the OLMAT and the Noise subtest of the GFW, and the OLMAT and the Wepman (Table 4). Low correlation coefficients would be expected between the measures of auditory discrimination and the intelligence test since Wepman (1960) reported little, if any, relationship between the development of auditory discrimination and intelligence. Ironically, the findings of this study support his conclusion, with the exception of a significant positive relationship between his own test and the OLMAT for the first grade sample (Table 3).

In summary, the results of this study indicate a significant positive relationship between one measure of auditory discrimination (Wepman) and reading ability for one grade level (first). No significant relationships were found between the auditory discrimination measures and the reading measure for the fourth grade sample. When intelligence was held constant, none of the correlated measures reached significance for either grade level. No significant differences were found between either the first and fourth grade Pearson product-moment correlations coefficients or the first and fourth grade First-Order partial correlation coefficients. The above average test score characteristics of the two samples used in this study indicate a limitation in the "representatives" of the samples.

APPENDIX A

Individual Raw Scores and Standard Scores for First Grade Subjects on the WRAT Word Recognition Subtest, the GFW Test of Auditory Discrimination (Quiet and Noise Subtests), the Wepman Auditory Discrimination Test, and the Otis-Lennon Mental Ability Test.

INDIVIDUAL RAW SCORES AND STANDARD SCORES
FOR FIRST GRADE SUBJECTS ON ALL TEST MEASURES.

Subject	WRAT WORD RECOGNITION Raw Score	S.S.	GFW QUIET SUBTEST Raw Score	S.S.	GFW NOISE SUBTEST Raw Score	S.S.	WEPMAN TEST Raw Score	OLMAT DIQ Score
1	51	112	29	51	26	71	36	113
2	31	97	29	53	21	55	33	100
3	33	91	28	46	20	48	33	96
4	33	99	29	53	22	58	39	104
5	44	103	29	51	22	55	34	115
6	39	108	29	53	23	62	38	104
7	34	112	28	47	19	50	31	100
8	25	85	28	46	22	55	34	92
9	42	112	30	62	25	69	40	128
10	47	106	30	60	23	59	38	111
11	36	117	29	54	25	71	39	115
12	56	140	28	46	22	58	36	125
13	41	100	29	51	23	59	34	111
14	37	117	30	63	22	60	29	99
15	28	96	28	46	20	51	32	97
16	35	114	27	44	25	71	35	105
17	31	90	29	51	22	55	34	113
18	36	105	30	62	22	58	34	106
19	36	105	29	53	25	69	36	98
20	31	97	28	46	15	37	31	101
21	50	139	27	44	21	56	40	120
22	29	96	23	29	18	44	35	96
23	55	136	30	62	21	55	35	119
24	39	108	27	43	21	55	37	113
25	36	96	30	60	25	66	36	113

APPENDIX B

Individual Raw Scores and Standard Scores for Fourth Grade Subjects on the WRAT Word Recognition Subtest, the GFW Test of Auditory Discrimination (Quiet and Noise Subtests), the Wepman Auditory Discrimination Test, and the Otis-Lennon Mental Ability Test.

INDIVIDUAL RAW SCORES AND STANDARD SCORES
FOR FOURTH GRADE SUBJECTS ON ALL TEST MEASURES.

Subject	WRAT WORD RECOGNITION Raw Score	WRAT WORD RECOGNITION S.S.	GFW QUIET SUBTEST Raw Score	GFW QUIET SUBTEST S.S.	GFW NOISE SUBTEST Raw Score	GFW NOISE SUBTEST S.S.	WEPMAN TEST Raw Score	OLMAT DIQ Score
1	86	160	29	48	25	61	39	133
2	58	95	30	58	20	45	35	106
3	71	114	30	58	21	48	38	122
4	61	99	26	34	25	61	36	97
5	63	101	28	43	24	58	37	95
6	74	115	28	41	25	61	39	102
7	81	131	29	47	21	45	37	112
8	56	98	28	43	24	58	39	94
9	64	100	29	47	24	57	36	100
10	60	88	29	46	24	56	38	95
11	48	75	29	46	24	56	40	95
12	65	104	29	48	22	51	33	97
13	62	100	27	38	20	45	34	96
14	62	98	30	57	23	52	36	97
15	82	133	30	57	24	57	38	103
16	67	104	30	57	24	57	36	103
17	68	106	29	47	19	40	40	98
18	56	84	29	47	23	52	35	94
19	62	100	27	38	20	45	28	111
20	57	93	29	48	18	41	36	95
21	77	134	28	43	23	55	40	109
22	76	122	29	48	20	45	36	107
23	80	133	28	43	23	55	37	128
24	58	82	28	40	19	37	34	90
25	84	139	30	57	21	45	36	131

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