PSYCHOLINGUISTIC ABILITIES AND ACADEMIC ACHIEVEMENT OF HARD OF HEARING STUDENTS

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A DISSERTATION PRESENTED TO THE GRADUATE COUNCIL
OF THE UNIVERSITY OF FLORIDA
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1974

DEDICATED TO THE MEMORY OF

ANN WILLIAMSON

ACKNOWLEDGEMENTS

The writer wishes to express appreciation to the Supervisory Committee members, Dr. E.C. Hutchinson, Dr. Norman Markel, Dr. R.J. Scholes, and Dr. Dan Sellers, and especially to the Chairman, Dr. Thomas B. Abbott, for support and guidance during the preparation of this dissertation.

Special thanks go to Mrs. Julia Wickersham, Director of Exceptional Child Education; Mrs. Eunice Carter, Coordinator, Language, Speech, and Hearing Services; and Mrs. Sandra Village, Audiologist, all of the Duval County Schools, Jacksonville, Florida, for their assistance and encouragement in this research. The writer is especially grateful to the hard of hearing students in Duval County, Florida, who cooperated willingly in this endeavor.

Mrs. Gene DeLoach, graduate student in Speech Pathology at the University of Florida, was of inestimable aid in helping to organize the study. Mrs. Elizabeth Etheridge gave able assistance in proofreading the manuscript.

Perhaps the most significant contributions toward the completion of this project were made by the family of the writer. Her children, Donny and Andrea, remained cheerful under sometimes trying circumstances, and her husband, Gary, understood and remained supportive.

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Graduate Council of the University of Florida in
Partial Fulfillment of the Requirements
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December, 1974

Chairman: T.B. Abbott
Major Department: Speech

The purposes of this study were: (1) to describe selected characteristics of a group of hard of hearing school-age subjects and (2) to determine possible relationships between their academic performance and the following variables: sex, socioeconomic status, characteristics of hearing aid use, special training, severity of the hearing loss, performance intelligence, language comprehension and expression, and speechreading skill.

The study involved 26 subjects with bilateral, sensorineural hearing impairments, greater than 30 dB Re: ANSI 1969, who attended regular school classes, grades 4 through 12, in Duval County, Florida, during the 1973-74 academic year. Only subjects with no discernible additional handicaps were included in the study.

Data were collected from questionnaires returned by parents of the subjects, from cumulative school records, from files maintained in the office of the school audiologist, and from tests administered by the investigator. The seven tests administered by the investigator were:

1. Performance sections of the Wechsler Intelligence Scale for Children and the Wechsler Adult Intelligence Scale

2. Peabody Picture Vocabulary Test

3. Test for Comprehension of Indirect/Direct Object Constituents

4. Test of Auditory Language

5. Screening Deep Test of Articulation

6. Picture Story Language Test

7. Utley Lipreading Test, Sentence Form

The mean age of subjects in the study was 14.5 years. Eighteen of the subjects consistently wore hearing aids. The mean hearing loss of the group of subjects was 61 dB with a range of losses from 30 dB to 88 dB. The mean performance IQ of the subjects was 100.3.

Academic performance of hard of hearing subjects was measured by the average of the national percentile scores for all subtests of the Stanford Achievement Test. The mean national percentile score for the hard of hearing subjects was 16.15.

The hard of hearing subjects performed at a level substantially below expectation for their age level on all language measures. The ability to write grammatically, measured by Syntax Quotient of the Picture Story Language Test, was the variable most highly correlated with grade point average of the subjects. No significant differences were demonstrated in the mean academic performance of subjects categorized as to sex, socioeconomic status, or characteristics of hearing aid use. The severity of the hearing loss was not significantly correlated with academic performance or with any of the language skills tested. Speechreading was not significantly correlated with academic performance.

Receptive vocabulary (Peabody Picture Vocabulary Test), Auditory Language (Test for Auditory Language), Written Language (Picture Story Language Test), and Syntactic Comprehension (Test for Comprehension of Indirect/Direct Object Constituents) were significantly correlated with academic performance.

A three-variable regression model was developed for prediction of the criterion variable, academic performance. This model, including receptive vocabulary, syntactic comprehension, and performance intelligence, could account for 52 percent of the variance of the criterion variable, academic performance. The regression equation was significant at the 0.001 level of confidence.

CHAPTER I
INTRODUCTION TO THE STUDY

Statement of the Problem

The acquisition of a native language is dependent upon linguistic experience, and this experience is initially acquired through audition (Hebb et al., 1973). The effect of profound, congenital auditory deprivation on language development is obvious to those who have been associated with deaf children. A number of studies are concerned with linguistic analysis of oral and written communication of the deaf and profoundly hard of hearing (Walter, 1955; Myklebust, 1964, 1965; Brannon and Murry, 1966; Power and Quigley, 1973; Pressnell, 1973).

The effect of a mild or a moderate congenital hearing impairment on the language behavior and academic performance of students is less well documented in published research. Moores (1972) noted that "research on this type child and his special problems is almost non-existent" (pp. 162,163). The Subcommittee on Human Communication and Its Disorders, National Advisory Neurological Diseases and Stroke Council (1969) stated that:

> In summary, we find ourselves in the situation of having some types of research knowledge on deaf children but of lacking not only other types of knowledge on the deaf, but also almost any research information on either hard of hearing children or acoustically impaired adults. (p. 67)

Purposes of the Study

This study investigated pertinent background information, audiologic data, language characteristics, intellectual ability, speechreading skill, and academic performance of hard of hearing students attending regular school classes.

Two specific purposes of the study were: (1) to describe selected characteristics of this group of hard of hearing school-age subjects and (2) to determine possible relationships between their academic performance and the following variables: sex, socioeconomic status, characterisitics of hearing aid use, special training, severity of the hearing loss, performance intelligence, language comprehension and expression,and speechreading skill.

Justification for the Study

The justification for this study was derived from the need to document more fully the nature of deficits that may be imposed by a significant, though not profound, sensorineural hearing impairment. Determination of the relative importance of potentially significant variables in predicting academic performance of these students should be useful in planning appropriate habilitative programs for hard of hearing students.

Although programs to assist hard of hearing school children have been in existence for many years, the Subcommittee on Human Communication and Its Disorders (1969) suggested that the educational management of these children has evolved primarily from tradition. This Subcommittee stated that:

> We are in a research desert the moment we leave the realm either of finding hard of hearing children or of quantifying their hearing deficits.
>
> Strong but conflicting traditions as to how to manage hard of hearing children educationally and socially have evolved 1) from "common sense," 2) from extrapolation of the experiences of hard of hearing adults and 3) from implications of research on psychological and linguistic performance of normal hearing children. . . . On the whole, these traditions lack either confirmation or refutation through research. (p. 72)

Scope and Limitations of the Study

This study was limited to those students enrolled in the schools of Duval County, Florida, during 1973-74 who: (1) had bilateral, sensorineural hearing impairments greater than 30 dB in the better ear in the speech frequencies 500 Hz to 2000 Hz; (2) were enrolled in the 4th through the 12th grades in school; (3) attended regular school classes; and (4) had no discernible additional handicap other than a loss of hearing.

Definition of Terms

Definitions of terms and variables used in the study are listed below.

Average Loss of Hearing

Unless otherwise specified, hearing levels quoted in this study represent the average pure-tone audiometric threshold levels for 500 Hz, 1000 Hz, and 2000 Hz for the better ear. Averages are given as decibel (dB) levels Re: American National Standard Specification for Audiometers (ANSI) 1969.

Normal Hearing

The zone of normal hearing is considered to extend from 0 to 25 dB, as Davis (1970) proposed.

Hard of Hearing

The handicap that is the result of auditory deprivation cannot be judged on the basis of audiometric tests alone (Johnson, 1973). However, it is necessary to specify as carefully as possible the severity of the hearing impairment of the subjects under study. According to Davis' (1970) classification, "the condition known as hard of hearing begins at 27 dB" (p. 85). Davis further defined a zone of "uncertainty" from 70 to 90 dB within which some people may function as socially deaf but most are merely very hard of hearing (p. 84).

The Subcommittee on Human Communication and Its Disorders (1969) described the hard of hearing child in this way:

> The hard of hearing child is the youngster who has sufficient hearing impairment to suffer educational and social handicap yet whose hearing is good enough so that it may be used as a major communication channel. Most such children have hearing losses that do not average more than about 65-70 dB when classified in terms of degree of threshold deficit. (p. 71)

Deaf

Davis (1970) defined deafness as beginning at 93 dB (p. 85). Berg and Fletcher (1970) described the deaf child in the following ways:

> The deaf child is a hearing impaired person who can identify through hearing at best only a few of the prosodic and phonetic features of speech and then

> not enough to permit auditory recognition of sound or word combinations. He relies mainly or entirely on speechreading or some other form of visual receptive communication for perception of the spoken or manual form of language. Provided the communicative context is within his linguistic code, he understands language in many instances. His linguistic code typically is less well developed than that of a hard of hearing child. (p.7)

Type of Hearing Loss: Conductive

A conductive hearing loss is an impairment of hearing due to damage or obstruction of the ear canal, drum membrane, or the ossicular chain in the middle ear. It involves a failure of air vibrations to be adequately conducted to the cochlea (Wood, 1971, p. 10).

Type of Hearing Loss: Sensorineural

A sensorineural hearing loss is a loss that is due to pathology in the inner ear, the VIIIth Cranial Nerve, or both (Wood, 1971, p.20).

Speech Reception Threshold

The Speech Reception Threshold (SRT) is measured in dB from the level at which the average normal ear's SRT has been established (Newby, 1964). It represents the level of amplification that will enable the subject to repeat correctly approximately half of the spondaic words that are presented to him (Wood, 1971).

Speech Discrimination

Speech discrimination tests attempt to determine the maximum percentage of words that are intelligible to the subject at the most favorable intensity (Davis, 1970, p. 211). In the present study speech discrimination refers to the percent of words correctly repeated from the C.I.D. Auditory Test W-22 Phonetically Balanced Word Lists (Newby, 1964, pp. 369-377).

Regular Classroom

An educational placement in the schools other than in a full-time special class for handicapped students is designated as a regular classroom in this study. Some students in the study received special assistance from resource teachers or clinicians, but the major part of each student's day was spent in a classroom with normal hearing children.

Socioeconomic Status

The four broad occupational groups utilized by the United States Bureau of the Census (1973) were used as the basis for determining the socioeconomic status of each subject. A description of these occupational groups may be found in Appendix A. The occupation of the parent whose employment represented the higher status was classified according to: (1) white collar worker, (2) blue collar worker, (3) farm worker, or (4) service worker.

Special Training

Special training refers to attendance in a preschool class for the hearing impaired; speech, hearing, and language therapy services; placement in a class for handicapped students; or special assistance by a resource teacher while attending regular school classes.

Performance Intelligence

Performance intelligence refers to the IQ score obtained by administration of the performance sections only of the Wechsler Intelligence Scale for Children (WISC) (Wechsler, 1949) or the Wechsler Adult Intelligence Scale (WAIS) (Wechsler, 1955).

Receptive Vocabulary

Receptive vocabulary refers to the standard score derived for each subject from the Peabody Picture Vocabulary Test (PPVT) Form B (Dunn, 1959).

Syntactic Comprehension

Syntactic comprehension refers to the raw score obtained on the Test for Comprehension of Indirect and Direct Objects (Scholes *et al.*, 1973).

Auditory Language

Auditory language refers to the subject's combined score on the Auditory Comprehension and Auditory to Visual Sections of the Test of Auditory Language (Myklebust, 1973, pp. 61,62).

Reading Ability

Reading ability refers to the reading subtest score, stated in national percentile score, on the Stanford Achievement Test.

Speech Articulation Proficiency

Speech articulation proficiency refers to the score, stated in number correct, on the Screening Deep Test of Articulation (McDonald, 1968).

Written Language

Written language refers to the subject's Syntax Quotient, stated in percentile form, on the Picture Story Language Test (Myklebust, 1965).

Speechreading Skill

Speechreading skill refers to the subject's score, stated in percent correct, on the Utley Lipreading Test, Sentence Form, Test Form A (Utley, 1947).

Academic Performance

In this study academic performance refers to the average of the national percentile scores on all subtests of the Stanford Achievement Test (SAT).

Grade Point Average

Grade point averages (GPA) were calculated for academic subjects in which the hard of hearing students were enrolled during the school year 1972-73. Grade points were assigned in the following manner: 4 points for each A, 3 points for each B, 2 points for each C, 1 point for each D, and zero points for each F.

Theoretical Development

Questions to be Examined

In order to describe the students in the study and the deficits that may have been imposed by their long-standing partial loss of hearing, the following questions were examined in this study: (1) What are the characteristics of hard of hearing subjects attending regular classes with regard to age, sex, socioeconomic status, etiology of the hearing impairments, use of amplification, special training, severity of their hearing loss, performance intelligence, and speechreading skill?

(2) What are the language characteristics of these hard of hearing children with regard to receptive vocabulary, syntactic comprehension, auditory language, reading ability, speech articulation proficiency, and written language? (3) How do the hard of hearing children in this study rank academically in comparison to national norms for students at their grade placement level? (4) What significant correlations exist between the following variables: average loss of hearing, SRT, speech discrimination score, receptive vocabulary, auditory language, syntactic comprehension, reading ability, speech articulation proficiency, written language, performance intelligence, age, speechreading skill, and grade point average?

Assumptions

For the purpose of this study it was assumed that:

1. A primary goal of education is that each child should perform academically at a level commensurate with his or her abilities.

2. Achievement test scores represent an index of the performance of hard of hearing students in relation to normal hearing students at the same grade levels.

3. The factors affecting the level of academic performance of students are complex and interrelated.

4. Some of the factors that are associated with academic performance of hard of hearing students can be identified and manipulated.

5. Ancillary services for hard of hearing children and youth attending regular school classes can be improved.

6. Improvements in ancillary services for hard of hearing students that may result in enhanced educational performance are desirable.

Hypotheses

On the basis of the preceding assumptions and the review of the related literature, eight hypotheses concerning the academic performance of hard of hearing subjects in the study were developed. These hypotheses, stated in the null form, are listed below.

Null hypothesis one

There is no significant correlation between the severity of the hearing impairment, stated as an average loss of hearing, and the academic performance of hard of hearing subjects.

Null hypothesis two

There is no significant correlation between the performance intelligence of hard of hearing subjects and their academic performance.

Null hypothesis three

There is no significant correlation between the receptive vocabulary of hard of hearing subjects and their academic performance.

Null hypothesis four

There is no significant correlation between the syntactic comprehension of hard of hearing subjects and their academic performance.

Null hypothesis five

There is no significant correlation between the auditory language of hard of hearing subjects and their academic performance.

Null hypothesis six

There is no significant correlation between the written language of hard of hearing subjects and their academic performance.

Null hypothesis seven

There is no significant correlation between the speechreading skill of hard of hearing subjects and their academic performance.

Null hypothesis eight

Regression of selected predictor variables on the criterion variable, academic performance, will result in no significant Beta coefficients.

Summary

The effect of a significant, though not profound, sensorineural hearing impairment on the language behavior and academic performance of school-age children has not been well documented in published research. The purposes of this study were: (1) to describe some of the pertinent characteristics of a group of hard of hearing school-age subjects and (2) to determine possible relationships between their academic performance and selected variables.

The present study was limited to hard of hearing students in the 4th through the 12th grades in Duval County, Florida, in 1973-74. Four questions related to the first purpose of the study were posed in this chapter, and eight null hypotheses related to the second purpose were stated.

CHAPTER II
REVIEW OF THE RELATED LITERATURE

Introduction

The literature and research studies that are relevant to this investigation are treated in four sections. The first section contains a review of studies concerning pertinent characteristics of hard of hearing school children. The second contains a review of studies relating to the verbal abilities of hard of hearing school children. The third section contains a review of studies concerning academic performance of hard of hearing school children. The fourth contains a review of studies regarding factors that may influence the academic performance of hard of hearing school children.

Characteristics of Hard of Hearing School Children

Prevalence

The present investigation concerned children with significant, though not profound, bilateral, sensorineural hearing impairments. The prevalence of this type of handicap in children attending regular school classes is difficult, if not impossible, to estimate from currently available information.

From figures obtained in a study conducted in the public schools of Pittsburgh, Pennsylvania, Eagles (1964) stated that "the percentage of children with any significant handicap . . . is 1.7 percent" (p. 14). Because of the design of the Pittsburgh study it is impossible to determine what portion of these hearing losses were sensorineural and what portion were conductive.

Johnson (1962) studied the problems of the partially hearing child in "ordinary" schools in England and suggested that there might be 2 per 1,000 school children, or 0.2 percent, with a marked bilateral sensorineural or mixed hearing impairment sufficiently severe to require some form of special help but not requiring special schooling (p. 22).

In reference to the prevalence of hearing handicaps among school-age children Silverman stated:

> Our best estimate supported by an extensive detailed study of Pittsburgh school children is that five percent of school-age children have hearing levels in one ear at least outside the range of normal and that from one to two of every 10 in this group require special education attention (Eagles et al., 1963). (These figures do not include children in special schools for the deaf.) (Silverman, 1971a, p. 403)

Northcott (1973) cited the Bureau of Education for the Handicapped, U.S.Office of Education as estimating a 0.5 percent incidence of children 5 to 19 years old who are hard of hearing. This prevalence figure also appeared in a 1963 Health, Education, and Welfare publication (Mackie et al., 1963). How the figure was derived and what types of hearing impairments were included were not specified.

In a personal communication, Dr. Raymond J. Trybus, Deputy Director of the Office of Demographic Studies, Gallaudet College stated that, "To the best of my knowledge no recent prevalence figures on hard of hearing students in public schools exists. The closest that is possible to come at present involves a procedure with a number of estimates and a good bit of guessing in between."

Etiology

The Annual Survey of Hearing Impaired Children and Youth, Office of Demographic Studies, Gallaudet College (1973a), collects information on the characteristics of hearing impaired students enrolled in special educational programs in the United States. The most recent data published were for the 1970-71 school year and concerned 41,000 hearing impaired students. In that year, information on the probable cause of hearing loss was reported by respondents for only about 75 percent of the students involved. Another 25 percent indicated that there was "no known cause" for the hearing loss (p. 10). The three probable causes that were listed most frequently for the group of students with hearing losses less than 85 dB (ISO) were: maternal rubella, prematurity, and hereditary causes (p. 20).

Johnson (1962) determined that familial deafness and meningitis accounted for more than one-third of the sensorineural hearing impairments of students attending ordinary schools in Cheshire, England. Forty-one percent of the total group had hearing losses of unknown etiology.

In Hine's (1970) study of hard of hearing children, also in England, 27 percent of the children had hearing losses of unknown cause. He described the etiology of the remaining as: 36 percent prenatal, 25 percent perinatal, and 12 percent postnatal. By a different classification, 25 percent had acquired some form of genetically determined hearing impairment, while as many as 37 percent were judged to have some form of brain damage leading to impaired hearing.

Severity of the Hearing Handicap

Complete data on the average hearing deficit of hard of hearing children attending regular schools are not available. Research studies concerning hard of hearing children attending regular classes have reported average hearing losses ranging from 14 dB to 78 dB (Quigley, 1968; Young and McConnell, 1957; Lewis, 1972).

In a detailed study of a group of students with sensorineural impairments, attending ordinary schools in Cheshire, England, Johnson (1962) found that the mean hearing loss for the middle range of frequencies was 54 dB.

Intelligence

The literature indicates agreement that mean intellectual levels of hard of hearing school children are within the average range when performance criteria, such as the performance sections of the Wechsler Intelligence Scales (Wechsler, 1949, 1955), the Nebraska Test of Learning Aptitude (Hiskey, 1955), or the Leiter International Scale (Leiter, 1940), are used as measures (Reynolds, 1955; Young and McConnell, 1957; Hardy et al., 1958; Kodman, 1963; Hine, 1970; Lewis, 1972).

When verbal measures are used to assess abilities of hard of hearing children, most published research indicates that these children perform substantially below the average for their age level (Madden, 1931; Young and McConnell, 1957; Hine, 1970; Lewis, 1972). In a study conducted at Johns Hopkins University, however, Hardy et al. (1958) reported that hard of hearing subjects obtained a mean IQ of 101.25 on the Stanford Binet Scale, which is considered to be heavily weighted in the verbal areas (Vernon and Brown, 1964).

Steer et al. (1961), in a study conducted at Purdue University, chose a vocabulary test as an instrument upon which to base estimates of the intelligence of hard of hearing public school subjects and controls. These authors stated that:

> The Ammons Full Range Picture Vocabulary Test is individually administered and designed to provide an estimate of mental ability. Since this is a performance-type test, it was felt that the use of this instrument would minimize the language handicap possibly resulting from a hearing impairment and would thus provide more valid comparisons between experimental and control subjects. (pp. 48,49)

There may be disagreement with the premise that a vocabulary test would minimize the language handicap of hard of hearing children in any way. In view of other research (Young and McConnell, 1957; Lewis, 1972) it is not surprising that on this verbal test Steer found that "the control subjects consistently exhibited higher mean intelligence scores than the experimental subjects" (p. 85). It is surprising, however, that the scores reported for the experimental subjects were within the range of average (97.93) for 15 students with binaural hearing losses of 60 to 74 dB and only slightly below the average range (91.56) for the nine students with binaural hearing losses of 75 to 100 dB (p. 163).

Socioeconomic Background

Socioeconomic status of hard of hearing subjects is seldom discussed in published research studies. Hine (1970) noted that the class distribution of hard of hearing subjects in his study was "not significantly different from that of the area from which the children came" (p. 173).

Steer (1961) analyzed parents' occupations and showed insignificant differences between hard of hearing subjects and controls. Although Hardy (1958) reported no detailed information on socioeconomic status, he stated that the experimental and control subjects were matched according to socioeconomic status and that controls were drawn from children of the medical faculty and residency staff of Johns Hopkins University. Experimental subjects were drawn from the patient load in the Hearing and Speech Center of Johns Hopkins Hospital.

Verbal Ability of Hard of Hearing School Children

Verbal ability is recognized as a highly reliable predictor of academic achievement in normal hearing children (Stroud, 1957). Each of the studies reviewed in this section concerns the assessment of verbal abilities of hard of hearing children.

With regard to hard of hearing children, O'Neill commented that:

> Language has been unduly neglected by researchers. Some clinicians feel that hard of hearing children show some retardation in language usage and comprehension. Here again, we may have only a generalization from random experience. (1964, p. 109)

Receptive Vocabulary

There is general agreement in the research literature that hard of hearing children demonstrate a vocabulary deficit when compared to normal hearing students. Young and McConnell (1957) administered the Ammons and Ammons Full Range Vocabulary Test to a group of 20 hard of hearing children with a mean hearing loss of 51 dB and to a matched control group of normal hearing children. Mean age of both groups was 11 years. The authors found a highly significant difference in the vocabulary level favoring the control group as indicated by a *t* score of 6.72, which well exceeded that required for the 0.01 level of confidence.

Hardy's (1958) subjects, although within the range of normal on the vocabulary section of the Metropolitan Series of Achievement Tests, differed significantly from controls, who performed well above average.

Lewis (1972) reported that students at the New York League for the Hard of Hearing achieved a mean difference of 23.8 months between vocabulary age and chronological age on the Peabody Picture Vocabulary Test. Similar results were reported by Jones and Byers (1971).

Auditory Comprehension

No studies directly related to auditory comprehension of language were found in the published research on hard of hearing children. Since it appears that many hard of hearing children have difficulty with single word, receptive vocabulary, it may follow that their understanding of syntactic clues in the language might also lag behind that of the normal hearing child.

Wilcox and Tobin (1974) employed a repetition task to investigate syntactic patterns of 10 hard of hearing children. They determined that the hard of hearing group achieved significantly lower means in each grammatical form than the normal hearing controls. The hard of hearing children showed a much wider range of performance than did the normal hearing children and apparently found some constructions relatively easy and others extremely difficult. The normal hearing children had little difficulty with any of the constructions.

Power and Quigley (1973) studied deaf children's comprehension of the passive voice by requiring them to move toys to demonstrate the action of a sentence or to select a picture showing the action of the sentence such as: "the car was pushed by the tractor" (p. 6). They stated that virtually all hearing children have mastered both comprehension and production of the passive voice by the age of eight years; however, many deaf children had not achieved this mastery by age 17 or 18 years.

Scholes (1973) investigated the ability of normal hearing children to utilize syntactic clues in order to comprehend sentences. His study involved the comprehension of indirect and direct object constructions by children ages 5 through 13 years. The results of this study indicated that the accuracy of response to disambiguating clues of article placement and disjuncture increased gradually over the age groups. Five-year-olds responded at a level of 61 percent accuracy, 7-year-olds at 71 percent accuracy, 11-year-olds at 85 percent accuracy, and 13-year-olds at 91 percent accuracy. The acquisition of complex syntactic structures develops slowly in normal children. It is possible that such subtle linguistic clues may be difficult for congenitally hard of hearing children to assimilate.

Spoken Language

Calvert et al. (1968) studied the expressive language of a group of partially hearing students in France. They concluded that the children exhibited a deficit in expressing notions of relationship, analogy, or opposition and that there was a syntactical "awkwardness and a poorness in narrative" in their speech (p. 203).

Hardy et al. (1958) performed a type-token analysis of words in a spoken language sample elicited from 20 hard of hearing children and 20 normal hearing controls. The control group was not significantly superior to the experimental group in number of different words employed or in total number of words employed. In addition, the authors compared the groups on the ratios of four major syntactical categories (actor, action, connective, modifiers) to the total number of different words. They found no basic differences in the means or standard deviations between the groups. These findings led Hardy to the conclusion that the hard of hearing children in that study:

> . . . are by and large functioning well within normal limits, as demonstrated by the controls in terms of grasp of range and extent of their native language and of their capacity to employ the language within the scope of the experimental communicative situation. (p. 11)

In commenting on the techniques used by Hardy (1958) and by Brannon and Murry (1966), Wilcox and Tobin (1974) asserted that the measures such as type-token ratios and mean length of response are inadequate for an understanding and assessment of language ability because they are limited to an observation of surface performance (p. 286).

It is widely recognized that speech articulation problems often exist in the presence of congenital, sensorineural hearing impairments (Van Riper, 1963; Silverman, 1971b). Goetzinger et al. (1964) administered the Templin-Darley Sentence Test of Articulation to a group of children with mild sensorineural hearing losses and to matched controls. Chronological age range for both the experimental and control groups was 9 to 16 years. No child in the control group made articulatory errors, while a total of 28 errors were made by the experimental group.

Nielson (1967) found that 40 percent of his subjects with high frequency sensorineural hearing losses exhibited "mild to moderate" articulation disorders. Most commonly misarticulated phonemes were: [s], [z], [sh], and [ch].

Written Language

A review of the published research literature failed to reveal studies of the written language of hard of hearing children. Watson (1967) observed that:

> The written work of children with partial hearing loss of long standing has often been observed to be exceptionally poor in comparison with their spoken language. This is understandable in view of the very incomplete patterns which they receive, but it also seems to indicate that not enough stress has been laid upon the development of reading skills. (p. 184)

Myklebust (1964, 1965, 1973) has extensively studied the written language of deaf and hearing children. He developed the Picture Story Language Test (Myklebust, 1965) and established developmental norms for normal hearing children as well as for the deaf. Using this instrument he was able to establish that hearing children wrote longer stories than did deaf children at every age level except at 7 years. Sentences written by deaf children were short and simple when compared to those written by normal children. Syntactic ability was measured by patterns of formation and structure of sentences. Deaf children were found to be inferior to hearing children in syntactic ability at age 7 years and remained "substantially so at each of the age levels studied" (Myklebust, 1964, p. 292).

With regard to the graphic medium as a method of teaching language to the deaf, Lenneberg (1968) contended that:

> Congenital deafness has a devastating effect on the vocal facilitation for speech, yet presentation of written material enables the child to acquire language through a graphic medium without undue difficulty. (p. 33)

Academic Performance of Hard of Hearing Children

In some respects the research concerning the academic performance of hard of hearing children seems equivocal. Results of some studies indicate that hard of hearing children perform academically within normal range (Madden, 1931; Sprunt and Finger, 1949; Reynolds, 1955; Hardy, 1958). Other studies suggest that, as a group, hard of hearing children perform below expectation academically (Steer *et al.*, 1961; Kodman, 1963; Nielson, 1968; Quigley, 1968; Hine, 1970). O'Neill cautiously stated that:

> There are some indications that the child with a hearing loss may experience some retardation in academic progress. There may be a slight retardation in language learning but this retardation does not appear severe enough to incapacitate the individual. (p. 114)

Interpretation of the research literature on the academic performance of hard of hearing children is facilitated by the realization that children designated as "hard of hearing" are not a homogeneous group. In order to interpret the results of research concerning hard of hearing children or to make generalizations from research results to any population of hard of hearing children, it is necessary to be cognizant of the handicap with which the particular study deals. At the outset it is important to ascertain: the mean hearing level of the hard of hearing children in the study; whether the experimental group included children whose hearing losses were conductive, sensorineural, or both; unilateral, bilateral, or both; acquired, congenital, or both; and whether children with multiple handicapping conditions were included in the study. Research studies on the academic performance of hard of hearing students are examined below in the light of these factors.

Madden (1931) studied the school performance of a group of hard of hearing students in two schools in New York City. In 1931, pure tone audiometric testing was relatively new, wearable hearing aids were cumbersome, and antibiotic drugs were not in wide use. Madden did not indicate whether his experimental group had been differentiated as to type of their hearing losses. It would be interesting to know what percentage of the group had conductive impairments as opposed to sensorineural impairments. The criterion set for impaired hearing was "15 Sensation Units for a 2-A Audiometer" (p. 23). The hard of hearing subjects represented the 5 percent of the schools' population with the "poorest hearing." Madden found no demonstrable differences between the school achievement of the experimental group and that of the controls.

For reasons previously cited, it may be inappropriate to make generalizations about the academic performance of hard of hearing children from Madden's study except as the results may apply to the 5 percent of students in the school population with the poorest hearing.

Sprunt and Finger (1949) compared the Stanford Achievement Test performance of 28 hard of hearing subjects in the 4th through the 7th grades with a matched number of hearing students of equivalent nonverbal IQ. Defective hearing was defined as an average loss in the better ear of 10 dB or greater. Statistically significant differences in subtest scores could not be demonstrated.

Reynolds (1955) compared the educational achievement, as measured by the California Achievement Tests, of 36 children with "minimal" hearing loss (mean hearing loss in the better ear of 21.26 dB) to matched normal hearing controls. Assuming that this hearing level reflects 1951 American Standards Association (ASA) audiometric standards, this level may be translated to approximately 11.26 dB Re:ISO 1964 or ANSI 1969 for purposes of comparison to more recent studies (Newby, 1971, p. 355). Reynolds found no statistically significant differences between scores made by the two groups on the California Achievement Test.

Both the Reynolds (1955) and the Sprunt and Finger (1949) studies concerned children whose hearing levels were within the range of normal (Davis, 1970).

Hardy (1958) compared a group of 20 hard of hearing children ranging in age from 6 to 15 years with a matched group of normal hearing children. All experimental subjects in the study had sensorineural impairments involving only the peripheral auditory mechanism. This group of hard of hearing children had not undergone extensive adjunctive training, had a "fair start in language development," and attended regular school classes (p. 5). It was reported that 18 of the 20 were regular hearing aid wearers. The mean average loss of hearing in the better ear was 41 dB (approximately 31 dB Re: ANSI 1969).

Each child in the Hardy study was given a vocabulary subtest and a reading subtest from the Metropolitan Series appropriate for his age and grade level in school. There were no significant differences between the reading quotients of the two groups, but they were significantly different groups in terms of vocabulary quotient. However, the vocabulary scores of the hard of hearing subjects were within normal range.

In order to interpret studies of the academic performance of hard of hearing children it is necessary to consider factors unrelated to the actual hearing deficit of the subjects. It has been demonstrated, for example, that academic performance of normal hearing students is directly related to socioeconomic status (Lavin, 1965). The higher one's social status, the higher one's academic performance is likely to be. It is possible that both the control and experimental subjects in the Hardy study represented a rather select socioeconomic group. As stated previously, the experimental subjects were drawn from the patient load in the Hearing and Speech Center of Johns Hopkins Hospital and the matched control subjects were drawn from children of the medical faculty and residency staff of Johns Hopkins University and from friends and classmates of the children in the experimental group (Hardy, 1958). If this premise is correct, it may be that the results of the Hardy study should be generalized only to those children with rather high socioeconomic status who have mild sensorineural hearing impairments and who are consistent hearing aid users.

Kodman (1963) studied 100 Kentucky school children with SRT scores ranging from 20 to 65 dB, with a mean SRT of 40 dB (30 dB Re: ANSI 1969). Mean achievement test results indicated that these children were achieving at a level one year below their expected grade level according to chronological age. Kodman noted that "based on the degree of organic hearing loss (30 dB or greater in the better ear), 65 percent of the children were possible candidates for a hearing aid . . . however, only 35 percent of the pupils were fitted with aids" (p. 298).

In a study at Purdue University, Steer et al. (1961) compared hard of hearing subjects enrolled in regular classes to control subjects on three subtests of the Stanford and Metropolitan Achievement Tests and demonstrated a significant deficit in the reading subtest scores for the experimental group but no significant differences in spelling or in arithmetic. The total hard of hearing group included students with monaural, binaural, conductive, and sensorineural hearing losses from marginal to profound severity.

The Purdue study also included a group of hearing impaired students attending special classes. Results of achievement testing with these students led to the puzzling conclusion that academic retardation was inversely related to degree of hearing loss. The worse the hearing, the better the academic achievement (p. 76). As a possible explanation, the authors offer the fact that a greater number of mentally retarded subjects were within the mild and moderate hearing loss classification. Why the Purdue research design included a group of subjects whose major handicap was mental retardation is not clear.

O'Neill (1964) apparently misread these data and erroneously cited the Steer (1961) study to indicate that:

> The hard of hearing children in special classes showed academic achievement directly related to the degree of hearing ability. The better the hearing, the better the academic achievement. (p. 111)

Nielson (1968) studied the effects of high frequency hearing impairments on academic performance of school-age children. He compared the total achievement efficiency scores of students with bilateral, high frequency sensorineural hearing losses at 2000 Hz and above to national norms of the Metropolitan Achievement Test. Seventy-seven 3rd through 8th grade students in the Salt Lake City schools with hearing losses ranging from 40.5 dB to 60.5 dB were subjects in this study. A significant difference in achievement efficiency scores for the hearing impaired children and the national norms was demonstrated, suggesting that there may be educational retardation associated with high frequency, sensorineural hearing loss in the population investigated.

Hine (1970) measured the intelligence, academic attainments, and social adjustments of 100 children, aged 8 to 15 years, at a school for the partially hearing in England. The mean hearing loss of the children was 66.1 dB. Hine administered the Schonell Silent Reading Tests A and B and Essential Mechanical and Problem Arithmetic Tests. The research results were interpreted to indicate that on reading and arithmetic the children were retarded relative to normal children and that they fall proportionately further behind as they grow older.

Quigley (1968) administered the Word Meaning, Paragraph Meaning, and Language subtests of the Stanford Achievement Test, Form W, to a group of 116 students in the public schools of Elgin, Illinois, who had been identified as having a hearing impairment but for whom no special educational provisions had been made. The mean hearing threshold level in the better ear for the group was 16.84 dB, while the mean hearing threshold for the worse ear was 37.75 dB. The study included students with conductive as well as sensorineural impairments and unilateral as well as bilateral impairments.

Although no statistical procedures were utilized in the Quigley study, the author reported the differences between expected performance and actual performance of the subjects on the subtests of the Stanford Achievement Test. For each subtest in every hearing level category, actual performance was lower than expected performance. A steady progression was noted in retardation on each subtest through the various hearing threshold categories with the exception of the last category, where only the Language subtest maintained the progression. The expected grade placement of the subjects (based on individual birth-date) was 6.90, and the actual grade placement was 5.78.

As noted previously, the mean hearing loss of the children in the Quigley (1968) study was less than the level currently considered to be handicapping (Davis, 1970).

Factors That May Influence the Academic Performance of Hard of Hearing Children

Most research studies concerning the academic performance of hard of hearing children suggest that, as a group, children with significant, though not profound, sensorineural hearing impairments show academic retardation of varying degrees (Kodman, 1963; Nielson, 1968; Quigley, 1968; Hine, 1970). At least one study, Hardy et al. (1958), seemed to indicate that hard of hearing children are not significantly retarded in academic or verbal achievement.

It is reasonable to expect that as wide a range of motivation and learning aptitudes exists among hard of hearing children as among normal children. However, it is desirable to understand the factors that may contribute to the academic performance of hard of hearing children so that more effective measures may be taken to promote a higher level of academic performance in this group of students.

Severity of the Hearing Impairment

Many authorities stress that the use a child makes of his residual hearing is more important than the amount of his residual hearing (O'Neill, 1964; Silverman, 1971b; Johnson, 1973). However, it has been shown that hard of hearing children demonstrate a higher level of language performance than the deaf (Brannon and Murry, 1966) and that their speechreading skills may be more advanced than that of the deaf (Costello, 1957). Because of these differences, which have been documented, it seems reasonable to expect that the degree of hearing deficit suffered by a child will affect his performance in the school situation. In this regard, however, Northcott (1972) stated that:

> The prognosis for success in an integrated classroom setting is dependent not upon the degree of hearing loss but on the "listening age" which dates from the day a hearing aid is prescribed and worn and auditory training is begun. (p. 8)

Silverman (1971b) has suggested that the use children are able to make of their residual hearing:

> . . . is not simply a matter of hearing level for speech but also such different factors as age of onset, of the severity and exact type of hearing loss, the intelligence

> of the child, the amount of training that the child has had, the age at which the training was begun, and particularly the auditory and language environment of the child. (p. 431)

Speechreading Skill

Frick (1973) noted that the ability to read lips is more essential to the hard of hearing child in the public school than it is in the school for the deaf. Costello (1957) was able to demonstrate that reading showed a significant relationship with speechreading in a group of deaf and hard of hearing children. However, other researchers have been unable to achieve correlations high enough to permit prediction between speechreading and school achievement (Jeffers and Barley, 1971, p. 115).

Socioeconomic Status

Lavin (1965) reviewed 13 studies, which reported that socioeconomic status is directly related to academic performance in normal hearing students. The higher one's social status, the higher one's academic performance is likely to be. The relationship has been variously attributed to motivational level, the "achievement syndrome," and a variety of cultural values (p. 124). If socioeconomic status is correlated with academic performance in the general population, it should also be correlated in the hard of hearing population.

Intelligence

The relationship between ability and academic performance is well documented (Lavin, 1965). Travers (1949) found that correlation between intelligence and grades ran between 0.50 and 0.75 on the 8th to 10th grade level.

Vernon and Brown (1964) cautioned that "to be valid as a measure of the intelligence of a deaf youngster, an IQ test must be a nonverbal performance-type instrument" (p. 415). Stroud (1957) found that nonverbal tests predicted academic achievement as well as the verbal tests in normal children.

Verbal Ability

Verbal ability is recognized as a highly reliable predictor of academic performance in normal children (Stroud, 1957). Verbal skills present some of the most significant difficulties for hearing handicapped children (Young and McConnell, 1957; Myklebust, 1953, 1964, 1973; Goetzinger *et al*., 1964; Brannon and Murry, 1966; Calvert *et al*.,1968; Lewis, 1972; Power and Quigley, 1973; Wilcox and Tobin, 1974). It may follow that a hard of hearing child's academic performance is bound rather directly to his verbal skill.

Summary

The literature and research studies reviewed in this chapter were treated in four sections. The first contained a review of studies pertaining to such characteristics as prevalence, etiology and severity of the hearing handicap, intelligence, and socioeconomic background of hard of hearing school children. The second concerned a review of studies relating to the verbal abilities of hard of hearing school children. The third section contained a review of studies concerning academic performance of hard of hearing school children. The fourth contained a review of studies regarding factors that may influence the academic performance of hard of hearing school children.

CHAPTER III
THE METHOD AND DESIGN OF THE STUDY

Introduction

The purposes of this study were: (1) to describe selected characteristics of a group of hard of hearing school-age subjects and (2) to determine possible relationships between their academic performance and the following variables: sex, socioeconomic status, characterisitcs of hearing aid use, special training, severity of the hearing loss, performance intelligence, language comprehension and expression, and speechreading skill.

This chapter describes the procedures used in data collection, the experimental design of the research, and the instruments used in data collection.

Procedures Used in Data Collection

Setting of the Investigation

This research was conducted in the Duval County School District, which encompasses the city of Jacksonville, Florida. The general population of Jacksonville is 560,000, and the total school population of the school district is 110,000. The present study concerns students in grades 4 through 12. The total school population in those grades is 78,559.

Duval County has well-established programs in hearing conservation; speech, hearing, and language therapy; education of the deaf;

and education of the hard of hearing. A full-time certified audiologist administers pure tone threshold tests to all students who fail hearing screening tests in the county schools. Records are maintained for those children for whom medical or other referrals are made or whose audiograms indicate the presence of a loss of hearing. Those county school students with known hearing handicaps are retested at least once each school year.

Preschool training is provided for hearing handicapped students beginning at age 3 years. Self-contained classes for the deaf and for the hard of hearing are provided for those students who require full-time special educational placement. Resource teachers for the hearing handicapped are provided for students in grades 7 through 12 who attend regular classes but require special academic assistance.

Selection of Subjects

An attempt was made to locate each child in the Duval County Schools during the academic year 1973-74 who had a bilateral sensorineural hearing impairment of 30 dB or greater, who attended regular school classes in grades 4 through 12, and who had no discernible handicap other than the loss of hearing. The Coordinator of Speech, Hearing, and Language Services supplied the original list of 37 students who apparently met these criteria. In an attempt to locate more students, the audiograms of all students for whom records had been kept within the last 10 years were examined, and those suggesting the presence of a sensorineural hearing loss greater than 30 dB in the better ear were selected as possible subjects. This procedure yielded seven students who apparently met the criteria and were not on the original list, bringing to 44 the total number of potential subjects.

Individualized form letters explaining the research project were mailed to parents of these 44 students. Each mailing contained the letter, a questionnaire, a statement for the parent's signature granting permission for the student to take part in the project, and a stamped, addressed return envelope. The letter, permission slip, and questionnaire may be found in Appendix B.

Questionnaires and signed permission slips were returned for 34 students. This represented 77 percent of the letters mailed. Of the 34 subjects whose parents gave permission for their participation in the study, eight were not included in the study for the following reasons: three had multiple handicaps, four had hearing losses less severe than that specified in the criteria for the study, and one subject who met the criteria left the school district before the testing was completed.

Assuming that the 10 students whose parents did not return questionnaires met the criteria for this study, a total of 37 students with bilateral sensorineural hearing losses greater than 30 dB were known to be attending regular school classes in Duval County in 1973-74. This number represented 0.047 percent of the enrollment for grades 4 through 12.

Testing Procedures

Each subject who had not had an audiological evaluation within the previous calendar year was requested to make an appointment for such an evaluation. All testing procedures were individualized and took approximately 3 hours for each subject. Frequent rest periods were allowed. In order to negate any effect that fatigue might play in test performance, the order of test administration was systematically varied from subject to subject.

Achievement test data were taken from each child's permanent record folder or from information provided by the Director of Testing Services for the Duval County Schools. Students in the present study took achievement tests along with their hearing classmates in the school they attended. Apparently no special arrangements or procedures were utilized because of their handicap.

Experimental Design of the Research

The first purpose of the study was to describe selected characteristics of the hard of hearing subjects including deficits that may have been imposed by their long-standing, partial loss of hearing. In Chapter I the following questions concerning the characteristics of hard of hearing subjects were posed:

1. What are the characteristics of hard of hearing subjects attending regular classes with regard to age, sex, socioeconomic status, etiology of the hearing loss, use of amplification, extent of special training, severity of the hearing impairments, performance intelligence, and speechreading skill?

2. What are the language characteristics of these hard of hearing children with regard to receptive vocabulary, syntactic comprehension, auditory language, reading ability, speech articulation proficiency, and written language?

3. How do the hard of hearing children in this study rank academically in comparison to national norms for students at their grade placement level?

4. What significant correlations exist between the following variables: average loss of hearing, SRT, speech discrimination, receptive vocabulary, auditory language, syntactic comprehension, reading ability, speech articulation proficiency, written language, performance intelligence, age, speechreading skill, and grade point average?

In order to examine these questions, 22 variables were selected for use in describing the subjects in this study. The nature of the variables selected required their separation into two types: classification variables and numeric variables. The classification variables are categorical in nature (their variability is limited to discrete categories). The numeric variables are more nearly continuous and numeric values can be assigned to their variates.

The eight classification variables in this study were:

1. Sex of the subject
   - (a) Female
   - (b) Male
2. Socioeconomic status of the subject's family
   - (a) Parent is employed as a white collar worker
   - (b) Parent is employed as a blue collar worker
   - (c) Parent is a farm worker
   - (d) Parent is a service worker or is unemployed
3. Age at which the subject first wore a hearing aid
   - (a) Before the age of 2 years
   - (b) Between the ages of 2 and 4 years
   - (c) Between the ages of 4 and 6 years
   - (d) Between the ages of 6 and 10 years
   - (e) Between the ages of 10 and 15 years
   - (f) The subject has never worn a hearing aid
4. The consistency of the subject's present hearing aid use
   - (a) Never wears a hearing aid
   - (b) Wears a hearing aid less than 3 times a week
   - (c) Wears a hearing aid from 3 to 6 hours every day
   - (d) Wears a hearing aid from 6 to 12 hours every day
   - (e) Wears a hearing aid for over 12 hours every day
5. Special training: preschool for the hearing impaired
   - (a) Attended a preschool class for the hearing impaired
   - (b) Did not attend a preschool class for the hearing impaired

6. Special training: speech, hearing, or language therapy

   (a) Has been enrolled in a speech, hearing, or language therapy program
   (b) Has never been enrolled in a speech, hearing, or language therapy program

7. Special training: full-time class for the school-aged hearing impaired

   (a) Has been enrolled in a full-time class for school-age hearing impaired students
   (b) Has never been enrolled in a full-time class for school-age hearing impaired students

8. Special training: academic assistance from a resource teacher while the subject was enrolled in regular school classes

   (a) Has had assistance by a resource teacher
   (b) Has never had assistance by a resource teacher

The following statistical treatments were used with the classification variables. The means and standard deviations of selected variables in the classification categories were reported. The means of selected numeric variables in certain classification categories were compared statistically by use of a one-way analysis of variance technique (Ferguson, 1966, p. 281). A chi square test (Ferguson, 1966, p. 191) was performed to determine the significance of any difference between the proportions of the subjects' parents who were employed in each of four broad occupational categories and the proportions of the population in the United States who were employed in each of the same occupational categories.

The 14 numeric variables in the study were:

1. Age
2. Average loss of hearing
3. Speech reception threshold (SRT)
4. Speech discrimination score
5. Performance intelligence
6. Receptive vocabulary
7. Syntactic comprehension

8. Auditory language
9. Reading ability
10. Speech articulation proficiency
11. Written language
12. Speechreading skill
13. Academic performance
14. Grade point average (GPA)

In order to further describe the subjects the means, standard deviations, and intercorrelations with other variables are reported for the numeric variables in the study.

The second purpose of this study was to determine possible relationships between the academic performance of the subjects and the following variables: sex, socioeconomic status, characteristics of hearing aid use, special training, severity of the hearing loss, performance intelligence, language comprehension and expression, and speechreading skill. The relationships between the classification variables listed and the dependent variable, academic performance, were studied by comparing the mean academic performance of subjects in the various classification categories by means of the one-way analysis of variance technique.

In Chapter I, eight null hypotheses concerning the relationship between academic performance of the subjects and selected numeric variables were stated.

Null hypothesis one. There is no significant correlation between the severity of the hearing impairment, stated as an average loss of hearing, and the academic performance of hard of hearing subjects.

Null hypothesis two. There is no significant correlation between the performance intelligence of hard of hearing subjects and their academic performance.

Null hypothesis three. There is no significant correlation between the receptive vocabulary of hard of hearing subjects and their academic performance.

Null hypothesis four. There is no significant correlation between the syntactic comprehension of hard of hearing subjects and their academic performance.

Null hypothesis five. There is no significant correlation between the auditory language of hard of hearing subjects and their academic performance.

Null hypothesis six. There is no significant correlation between the written language of hard of hearing subjects and their academic performance.

Null hypothesis seven. There is no significant correlation between the performance intelligence of hard of hearing subjects and their academic performance.

Null hypothesis eight. Regression of selected predictor variables on the criterion variable, academic performance, will result in no significant Beta coefficients.

Two methods of data analysis were utilized to investigate these relationships: (1) the coefficients of correlation between the academic performance of the subjects and the numeric variables included in the null hypotheses were calculated and (2) a regression model was developed to predict the criterion variable, academic performance. Only numeric variables were utilized as potential predictor variables in developing this model.

The IBM 370-165 Computer at the Northeast Regional Data Center of the State University System of Florida was used to obtain means, standard deviations, intercorrelations, multiple correlations, Beta coefficients, $\underline{t}$ statistics, $\underline{F}$ ratios, and probability levels of the results. The Statistical Analysis System (SAS) Forward Selection STEPWISE Procedure (Service, 1972) was used to develop a regression model designed to predict the criterion variable, academic performance. The Forward Selection Procedure was programmed to include those predictor variables which were significant at the 0.50 level.

The SAS printed the probability of each correlation coefficient or regression coefficient indicated. Null hypotheses one through seven were rejected when it was found that the correlation between the given variables had reached the 0.05 level of significance. Rejection of null hypothesis eight was indicated when it was found that the *t* value for the Beta coefficient of a predictor variable was significant at the 0.05 level of confidence. The 0.05 level was also accepted as the significance level for *F* ratios in the analysis of variance procedure.

Data Collection Instruments

The data collected in this study that related to age, socio-economic status, probable cause of the hearing loss, hearing aid use, and special training were obtained from questionnaires returned by parents of the subjects. The data related to academic performance, reading ability, academic grades, and audiologic testing were taken from existing school records. The data related to performance intelligence, speechreading skill, receptive vocabulary, auditory language, syntactic comprehension, articulation proficiency, and written language were obtained through tests administered by the investigator. The various instruments used in data collection are described in the paragraphs below.

Parent Questionnaire

A questionnaire was developed by the investigator and consisted of spaces for identifying information and six questions related to the child's hearing handicap. It was designed to assist in the description of the subjects and for gathering pertinent background information. A copy of the Parent Questionnaire may be found in Appendix B.

Audiometric Tests (Variable: Severity of the Hearing Loss)

Information concerning average loss of hearing, speech reception threshold (SRT), and speech discrimination score for each of the hard of hearing students in the study was taken from records in the Audiology Section of the Exceptional Child Program in the Duval County Schools. The audiometer used was a Maico-24 calibrated to ANSI Re: 1969 standards. The subjects were tested in an IAC chamber. All testing was done by the Duval County School District audiologist, who held the American Speech and Hearing Association Certificate of Clinical Competence in Audiology.

Wechsler Intelligence Scale for Children (Variable: Performance Intelligence)

The Wechsler Intelligence Scale for Children (WISC) is composed of 12 subtests, which are divided into two subgroups identified as Verbal and Performance. The Performance Section of the WISC was administered to subjects in this study who were 16 years old or younger.

The subtests in the Performance Section of the WISC include: Picture Arrangement, Picture Completion, Block Design, Object Assembly, and Coding or Mazes. The Coding subtest rather than the Mazes was administered to each subject.

Vernon and Brown (1964) cautioned that to be a valid measure of the intelligence of a hearing impaired child, a test must be of the performance type as opposed to a verbal scale. These authors further stated that "The Wechsler Performance Scale is at present the best test for deaf children ages 9-16" (p. 416).

Wechsler Adult Intelligence Scale (Variable: Performance Intelligence)

The Wechsler Adult Intelligence Scale (WAIS) consists of 11 subtests. Six of these are grouped in the Verbal Scale; the remaining five compose the Performance Scale. The WAIS Performance Scale was administered to subjects 17 years old and older. Vernon and Brown (1964) also suggested that the WAIS Performance Scale was the best test presently available for deaf individuals over 16 years old.

The performance subtests of the WAIS include: Digit Symbol, Picture Completion, Block Design, Picture Arrangement, and Object Assembly. On both the WISC and the WAIS,

> . . . the method used in the computation of the deviation IQ was to set the average sum of scaled scores on the Verbal, Performance, or Full Scale equal to an IQ of 100 for each age group. The standard deviations of the distributions of sums of scaled scores were set at 15 IQ points for each age group. Thus, for any age group, the distribution of IQ's has a mean of 100 and a standard deviation of 15. The middle 50 percent of each group will have IQ's between 90 and 110. (Wechsler, 1955, p. 3)

Peabody Picture Vocabulary Test (Variable: Receptive Vocabulary)

Receptive vocabulary was determined by administration of the Peabody Picture Vocabulary Test (PPVT). The PPVT is an untimed, individual intelligence test consisting of a booklet with 3 practice and 150 test plates, each with 4 numbered pictures. The examiner reads the stimulus word and the subject responds by pointing to or giving the number of the picture best illustrating the word.

For purposes of the present research, the test procedures were modified to include graphic presentation of the stimulus word as it was spoken by the examiner. For this purpose, each stimulus word was typewritten on a 3"x5" white card. Although this modification was contrary to the instructions presented in the PPVT manual (Dunn, 1959) it was considered necessary to insure that the hearing handicapped subjects correctly perceived the stimulus word.

In the present study, standard scores were reported for each subject. Dunn (1959) described the PPVT standard score equivalents in the following manner:

> The standard score norms were derived by preparing separate raw score distributions for each age level in the standardization sample. The mean and standard deviation of raw scores were then found for each distribution . . . an IQ of 100 was arbitrarily assigned to the mean raw score for each age level and the standard deviation set at 15 IQ points. (pp. 28-29)

Test for Comprehension of Indirect and Direct Object Constituents (Variable: Syntactic Comprehension)

Syntactic comprehension was assessed by administration of the Test for Comprehension of Indirect and Direct Object Constituents (Scholes *et al.*, 1973). The purpose of this test is to determine the ability of an individual to utilize syntactic clues to comprehend sentences. Use of two types of clues are evaluated: placement of the definite article to distinguish between such sentences as:

he showed her the baby pictures

and

he showed her baby the pictures

and auditory clues of disjuncture to distinguish between such sentences as:

he showed her - baby pictures

and

he showed her baby - pictures.

Twenty-five different sentences are used in the test. Twenty of the sentences are unambiguous and are presented once each. Five of the sentences are ambiguous in meaning and these are presented twice each. A total of 30 tape-recorded stimuli thus are used.

The types of sentences used are illustrated in the example set below:

Clue	
article placement	he showed her bird the seed
	he showed her the bird seed
disjuncture	he showed her - the bird seed
	he showed her bird - the seed
ambiguous	he showed her bird seed

Five such sets were constructed. Scholes explained the sentence construction in the following way:

> For each set one sentence is ambiguous as to which words of the predicate comprise the indirect object and which words comprise the direct object. In recording these sentences, the ambiguity was preserved.
>
> Of the four unambiguous sentences in each set, two are made clear as to the indirect/direct object constituents by means of a definite article preceding the direct object, and, in the other two sentences, this constituency is made clear by disjuncture (a complexity of pause, intonation, and stress cues) preceding the direct object (denoted by "-" in the examples above). Within these pairs of sentences disambiguated by article or disjuncture clues, one member has only the last noun as the direct object and the other member has the last two nouns as the direct object. (p. 6)

The stimuli for the test consisted of tape-recorded sentences and line-drawing pictures. For the purposes of the present research, test procedures were modified to allow for the presentation of each stimulus sentence in graphic as well as auditory form. Each stimulus sentence was typewritten, without punctuation, on a 3"x5" white card and was presented to the subject simultaneously with the tape-recorded presentation.

Accompanying each sentence presented to the subject was an 8½"x11" paper containing four line drawings. One of the drawings corresponded to the sentence presented, one of the drawings corresponded to the alternate reading of the sentence, and two of the pictures corresponded to the readings of a different set of sentences. Thirty different sheets of four drawings each were used. Pictures were arranged randomly on each page.

The subject heard a tape-recorded sentence at an individually selected listening level and was simultaneously shown the same sentence in written form. The subject selected from among the four pictures presented the one that corresponded to the stimulus sentence.

The raw score obtained represented the number of correct choices involving the 20 unambiguous test sentences. The responses to the 10 ambiguous test sentences were used to determine whether a possible bias existed for one interpretation or the other.

As reported in Chapter II, Scholes (1973) used this instrument to study the developmental comprehension of English syntax in normal hearing children from age 5 to 13 years. His findings indicated that the ability to use the syntactic clues of article placement and disjuncture increased gradually over the age groups. Five-year-olds were able to select the appropriate interpretation with 61 percent accuracy, seven-year-olds with 71 percent accuracy, eleven-year-olds with 85 percent accuracy, and thirteen-year-olds with 91 percent accuracy. In a pilot study utilizing similar materials, college students maintained a 95 percent accuracy rate (Scholes, 1973).

Other findings were that ambiguous sentences such as:

He showed her baby pictures

were most often interpreted by normal hearing children to mean:

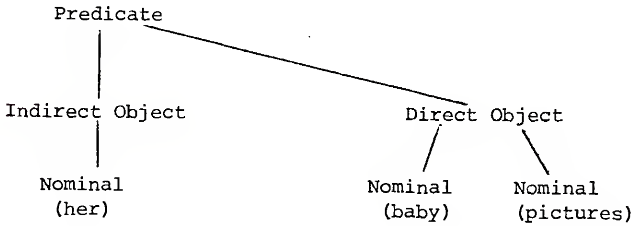
He showed her the baby pictures

rather than:

He showed her baby the pictures.

College-age students in a pilot study selected each of the two interpretations with almost equal frequency. Scholes referred to the first interpretation as the "B" interpretation and stated that:

> Since such an interpretation cannot be accounted for by syntactic, semantic, or phonologic information contained in the sentence, the procedures employed by subjects to make this interpretation is termed a <u>strategy</u>. This particular strategy says that a predicate sequence of nominal + nominal + nominal is to be interpreted as:



(Scholes, 1973, p. 8)

Auditory Language Test (Variable: Auditory Language)

The Test of Auditory Language (Myklebust, 1973, pp. 61-62) was chosen as an instrument with which to assess the subjects' ability to follow oral directions. Although the instrument was not designed for hearing impaired children, it was chosen because it simulated in many ways the types of instructions that students are required to follow in the classroom.

Test One: Auditory Comprehension is composed of a group of 10 instructions of increasing difficulty. The subject was given a form to use for his or her responses. Sentences were spoken slowly and distinctly but the direction was given only once. An example of one of the directions is: "Write the day it was yesterday."

Test Two: Auditory to Visual was administered in the same manner. The subject's response form contained five rows of letters, and the directions involved instructions such as: "Draw a cross on the a's and circle the t's."

Because the test author did not provide complete directions for scoring the tests, the results obtained in this study were not compared to the normative data provided by Myklebust (1973). The scores reported in the present study represented the combined total correct score on Test One: Auditory Comprehension and Test Two: Auditory to Visual. An error was recorded in each instance that the direction given was not explicitly followed.

Screening Deep Test of Articulation (Variable: Speech Articulation Proficiency)

Speech Articulation Proficiency was quantified in this study as the number correct on a modified version of the Screening Deep Test of Articulation (McDonald, 1968). The Screening Deep Test elicits 10 productions each of the following consonants: [s], [l], [r], [ch], [th], [sh], [k], [f], and [t].

This instrument was chosen for use in this study because it permitted the evaluation of commonly misarticulated consonants in a variety of phonetic contexts. The test utilizes pairs of pictures to elicit the subject's production of bisyllables. Because all the subjects in the present study were readers, it seemed desirable to use a sentence test in order to simulate more nearly the conditions of connected speech. Therefore, for each pair of stimulus pictures on the Screening Deep Test, a sentence was constructed containing the same words in the same relationship as they appeared on the test. The stimulus sentences that were used may be found in Appendix C.

McDonald (1968) cautioned against counting all of a child's correct productions and expressing these as a total articulation score. He emphasized that a total score would not reveal the pattern of a child's articulatory development. It was with some reservation, therefore, that this method was used to express the articulation proficiency of the subjects in this study. It is clear that this method of quantifying articulatory proficiency leaves much to be desired. However, since all subjects in the study were past the age at which considerable spontaneous gains in articulation skill are expected (Powers, 1971) and because the primary purpose for assessing articulation in this study was to describe the general articulatory behavior of this group, it was determined that this method of expressing the score was defensible.

Picture Story Language Test (Variable: Written Language)

Written language of the hard of hearing children in the present study was surveyed by use of the Picture Story Language Test (Myklebust, 1965). The purpose of this test is to "serve as an instrument for the study of language developmentally and diagnostically" (Myklebust, 1965, p. 70).

Administration of the test involves a stimulus picture which the subject is able to view throughout the examination period. The subject is provided with a pencil and paper and asked to write a story about the picture. There is no time limit. The written story is scored according to directions provided by the test author.

The score reported as "Written Language" in the present study was actually the percentile equivalent (based on age) of the Syntax Quotient. Myklebust (1965) described the Syntax Scale in the following way:

> In summary, the Syntax Scale incorporates a measure of syntax, certain morphological aspects, correctness of word choice, and punctuation. Therefore, it cannot be compared with measures using only sentence structure, complexity or parts of speech. Our objective was to devise a scale which comprised all aspects pertinent to the accuracy with which the written word is used. Though referred to as the Syntax Scale because of the lack of a more appropriate term, not only syntax was included. We justified this approach theoretically in that our interest was in studying the growth of language usage in general, not a single component or facet such as syntax, punctuation, or morphology. For this reason we developed a generalized scale of correctness. (pp. 110-111)

Utley Lipreading Test (Variable: Speechreading Skill)

A live presentation of Part I, the Sentence Test, Form A, of the Utley Lipreading Test was used to assess the subjects' speechreading ability. Utley (1947) designed what is ". . . probably the best known and most widely used test of speechreading ability" (Jeffers and Barley, 1971, p. 336). This filmed version includes three parts. Part I is a Sentence Test and consists of two forms, A and B; Part II is a Word Test; and Part III is a Story Test.

Jeffers and Barley (1971) demonstrated that college students and hard of hearing adults scored substantially higher when the Sentence Test was presented live rather than in the original filmed version. The presentation method described by Jeffers and Barley (p. 339) was utilized in the present study. Each sentence was presented only once. The subject wrote down what he perceived. Five practice sentences were given before the test. No voice was used. The examiner used a fairly slow, though normal, rate of speech and ample, but not exaggerated, lip and jaw movement. Facial expression appropriate to the content was employed.

The scoring method used in the present study was developed by the Audiology Clinic at Northwestern University (Jeffers and Barley, 1971). In this method, a sentence is scored correct if the content is perceived with reasonable accuracy. There are 31 sentences in Test Form A, and the score was reported as the percent of correct sentences.

Stanford Achievement Tests (Variables: Academic Performance and Reading)

The Stanford Achievement Tests are comprehensive achievement tests designed to measure student progress in subject areas, skills, and understandings generally accepted as desirable outcomes of elementary and secondary education (Buros, 1972).

There are six test battery levels in the Stanford Series: Primary I and II, Intermediate I and II, Advanced, and High School Basic Battery. The latter was added to the series in 1965 (Buros, 1972).

The Intermediate I Battery is used with students in grade 4 through the middle of grade 5. It measures reading, arithmetic, language, spelling, social studies, science, and word study skills. The items in this test battery are of a multiple choice variety. No questions are dictated.

The Intermediate II Battery is designed for use with students in the middle of grade 5 to the end of grade 6. Essentially the same areas are measured in this battery as in the Intermediate I Battery.

The Advanced Battery is designed for use with students in the 7th, 8th, and 9th grades. Reading is measured by a single test, Paragraph Meaning. Arithmetic is measured by three tests; and language, spelling, social studies, and science are measured by one test each.

The High School Basic Battery is for use with students in grades 9 through 12. Tests include English, Numerical Competence, Mathematics, Reading, Science, Social Studies, and Spelling.

A nationwide achievement testing program, conducted by the Office of Demographic Studies, Gallaudet College, compiled substantial data concerning achievement test results of hearing impaired students attending special education programs (Annual Survey, 1972). Some of the major findings in this extensive testing program should be noted. A survey conducted in 1968 indicated that the Stanford Achievement Test Series was the most widely used measure of academic achievement of hearing impaired students in the United States.

In 1969, more than 12,000 Stanford Achievement Tests were administered through the Office of Demographic Studies to hearing impaired students attending special educational programs. The results indicated that the hearing impaired students scored substantially below the average levels of attainment of their hearing agemates (Annual Survey, 1973b, p. 51).

In discussing the limitations of data from these tests and tests subsequently administered by the same group in 1971, DiFrancesca and Carey (1972) noted that:

> The directions for taking these tests are designed for oral dictation. . . . The language level and structure of the test questions may be biased against language handicapped students. A student may know the proper answer to a question but fail it because of inability to grasp the language complexity. (p. 2)

Experience gained in 1969 led to the conclusion that measuring instruments must be revised before an adequate measure of the academic achievement of hearing impaired students could be obtained. Of central importance was the finding that large numbers of students received test batteries too advanced for their achievement level; and, therefore, those tests failed to reveal true differences between the good and the poor students. By assigning tests on the basis of age or grade placement, many student scores were "at or below the level where guessing or random responses become a major determinant of obtained score" (Annual Survey, 1973b, p. 51). To alleviate this problem, a screening test procedure was inaugurated to determine the appropriate level at which the student should be tested.

In the present study, because of the age range and span of grade placement of the subjects, it was determined that the most efficient way to utilize the test results was in the form of national percentile ranks. In this way, hard of hearing students could be compared according to their respective rank among hearing students at their own grade level. No assumptions were made concerning equivalence of percentile ranks from grade to grade. The overall achievement test score was obtained by averaging the national percentile scores on all the subtests of the battery that was taken by each student. This score was used to represent academic performance in the present study. The reading ability of the subjects was measured by the Paragraph Meaning Subtest of the SAT Intermediate and Advanced Batteries and the Reading Subtest of the High School Basic Battery.

Current Stanford Achievement Tests were available for 21 of the 26 subjects. Seventeen subjects took the Intermediate or Advanced Batteries and four took the High School Basic Battery. The five subjects for whom current SAT scores were not available had taken either the Metropolitan Achievement Test, the Science Research Associates Achievement Test, or the Wide Range Achievement Test. The averaged national percentile rank for all subtests was reported for each of these five subjects and was used in determining correlations with other variables. Reading ability was measured by the appropriate subtest of each of these batteries.

Summary

The purposes of this study were (1) to describe selected characteristics of a group of hard of hearing children and youth and (2) to determine possible relationships between their academic performance and the following variables: sex, socioeconomic status, characteristics of hearing aid use, special training, severity of the hearing loss, performance intelligence, language comprehension and expression, and speechreading skill.

The procedures used in data collection, the experimental design of the research, and the instruments used in data collection were included in this chapter.

CHAPTER IV
RESULTS

Introduction

The purposes of this study were: (1) to describe selected characteristics of a group of hard of hearing school-age subjects and (2) to determine possible relationships between their academic performance and the following variables: sex, socioeconomic status, characteristics of hearing aid use, special training, severity of the hearing loss, performance intelligence, language comprehension and expression, and speechreading skill.

The study involved 26 children with sensorineural hearing impairments greater than 30 dB in the better ear who attended regular school classes in grades 4 through 12 in Duval County, Florida.

Presentation of the findings in this chapter is divided into two sections. The first section contains data that are descriptive of the subjects in the study and related to the first purpose of the study. The findings are presented as answers to four questions posed in Chapter I. These data concern the age, sex, socioeconomic status, etiology of the hearing loss, the use of amplification, special training, severity of the hearing deficits, performance intelligence, certain language skills, and academic performance of the subjects in the study. The second section concerns the relationships between the academic performance of the subjects and selected variables. Tables illustrating the mean academic performance of subjects according to various classification variables and tables illustrating correlations between academic performance and selected numeric variables appear in this section. A complete intercorrelation matrix of numeric variables in the study is found in Appendix D. Results concerning the hypotheses stated in Chapter I are presented in the second section of this chapter.

Findings Related to the First Purpose of the Study

The first purpose of the study was to describe selected characteristics of this group of hard of hearing school-age subjects. The following questions relate to that purpose.

Question One

What are the characterisitcs of the hard of hearing subjects in this study with regard to age, sex, socioeconomic status, etiology of the hearing loss, use of amplification, special training, severity of the hearing loss, performance intelligence, and speechreading skill?

Age of the hard of hearing subjects

The mean age of subjects in the study was 14.53 with a range in age from 9 years to 19 years.

Sex of the hard of hearing subjects

Sixteen of the 26 hard of hearing subjects in the study were males and 10 were females. Data in Table I demonstrate that the mean loss of hearing for females was 69.40 dB, and the mean hearing loss for males was 56.68 dB. The difference between means for males and females on average loss of hearing did not reach a significant level.

TABLE I
AVERAGE LOSS OF HEARING OF
FEMALE AND MALE SUBJECTS

SEX	AVERAGE LOSS OF HEARING (dB)
Females (N=10)	69.40
Males (N=16)	56.68
F Ratio*	3.82

*Critical *F* Ratio for significance at the .05 level = 4.26 (Ferguson, 1966, p. 409)

Socioeconomic status

Because it had been reported that socioeconomic status was directly related to academic performance in normal hearing students (Lavin, 1965) it was desirable to determine whether the subjects in this study were typical of the United States population in terms of socioeconomic status. The occupation of one of the parents of each subject was used to determine the socioeconomic status of that subject. The parent whose occupation represented the higher status was used in the tabulation. A description of the broad occupational groups used by the United States Bureau of the Census is found in Appendix A. Table II demonstrates the comparisons of percentages of parents in the study who were employed in four broad occupational groups to those of United States residents. No parent in the sample was a farm worker, although approximately 3 percent of the United States population was employed in that setting in 1970. Forty-two percent of the parents in this study were white collar workers, 39 percent were blue collar workers, and 19 percent were service workers. Forty-eight percent of the employed population in the United States in 1970 were white collar workers, 36 percent were blue collar workers, 3 percent were farm workers, and 13 percent were service workers.

TABLE II
PERCENT OF EMPLOYED PERSONS IN BROAD OCCUPATIONAL CATEGORIES IN THE UNITED STATES AND AMONG PARENTS OF HARD OF HEARING SUBJECTS

	WHITE COLLAR WORKERS	BLUE COLLAR WORKERS	FARM WORKERS	SERVICE WORKERS
United States*	48.2	35.9	3.1	12.8
Parents of Subjects	42.3	38.5	0.0	19.2

*Source: United States Bureau of the Census (1973)

The chi square test (Ferguson, 1966, p. 191) was used to determine whether the proportion of parents in this study who were employed in each of the occupational groups was different from that of United States residents. Data in Table III demonstrate that no significant differences existed between the proportion of subjects' parents in each occupational category and the proportion of United States residents who were employed in each occupational category.

TABLE III

COMPARISON OF THE OBSERVED FREQUENCY OF PARENTAL EMPLOYMENT IN FOUR OCCUPATIONAL CATEGORIES AND THE EXPECTED FREQUENCY OF SUCH EMPLOYMENT BASED ON PROPORTION OF UNITED STATES RESIDENTS EMPLOYED IN EACH CATEGORY

OCCUPATIONAL CATEGORY	OBSERVED FREQUENCY (Parents)	EXPECTED FREQUENCY*	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
White Collar Workers	11	13	2	4	0.31
Blue Collar Workers	10	9	1	1	0.11
Farm Workers	0	1	1	1	1.00
Service Workers	5	3	1	1	1.33
				Chi Square =	2.75**

*Based on proportions of U.S. residents employed in the four broad occupational categories (United States Bureau of the Census, 1973)

**Not significant at the .05 level of confidence (Ferguson, 1966, p. 407)

Table IV demonstrates that children whose parents were employed as white collar workers demonstrated consistently higher scores on four language tests than those whose parents were employed as blue collar workers and that children whose parents were employed as blue collar workers made higher scores on these tests than those whose parents were service workers. The differences among the occupational groups reached the 0.01 level of significance on receptive vocabulary and written language. The variation among groups on syntactic comprehension was significant at the 0.05 level.

TABLE IV
MEANS OF AVERAGE LOSS OF HEARING, AUDITORY LANGUAGE, RECEPTIVE VOCABULARY, SYNTACTIC COMPREHENSION, AND WRITTEN LANGUAGE OF HARD OF HEARING SUBJECTS BY PARENTAL OCCUPATION CATEGORY

PARENTAL OCCUPATION	AVERAGE LOSS OF HEARING (dB)	AUDITORY LANGUAGE (Raw Score)	RECEPTIVE VOCABULARY (Standard Score)	SYNTACTIC COMPREHENSION (Percent)	WRITTEN LANGUAGE (Percentile)
White Collar Worker (N=11)	60.45	28.63	83.00	13.72	43.54
Blue Collar Worker (N=10)	68.50	23.20	72.30	13.40	12.90
Service Worker (N=5)	50.20	17.60	55.20	9.80	2.60
F Ratio*	2.14	3.01	9.36	4.23	5.96

*Critical *F* Ratio:
For significance at the .01 level = 5.61
For significance at the .05 level = 3.40

Etiology of the hearing loss

The probable cause of the hearing impairment of 16 children, 61 percent of the subjects in this study, was unknown to their parents. Birth defects or prematurity were cited as the cause in four cases; maternal rubella and spinal meningitis accounted for two cases each. Measles was cited once, and kidney disease was named as the probable cause of the hearing loss of one subject. These data are presented in Table V.

TABLE V
NUMBERS AND PERCENTAGES OF SUBJECTS
BY PROBABLE CAUSE OF HEARING LOSS

PROBABLE CAUSE OF THE HEARING LOSS AS STATED BY THE PARENT	NUMBER	PERCENT
Unknown*	16	61.53
Birth Defect	3	11.53
Maternal Rubella	2	7.69
Meningitis	2	7.69
Prematurity	1	3.84
Measles	1	3.84
Kidney Disease	1	3.84

*This number includes 11 subjects whose parents indicated that the cause of the hearing loss was unknown, four subjects whose parents listed "nerve deafness" as the cause of the hearing loss, and one subject whose parent stated that the "ear grew in two parts because she put a string in it."

Use of amplification

Twenty-three of the 26 subjects had previously been fitted with hearing aids; however, parents of five subjects who had hearing aids stated that their children never wore their aids. No child in the study had been fitted with an aid before the age of two years. Eleven subjects had been fitted before the age of 6 years,and 12 were fitted after the age of 6 years. The variance in the severity of the hearing losses of subjects fitted at different ages did not reach significance.

TABLE VI
PERCENT OF SUBJECTS AND AVERAGE HEARING LOSS OF SUBJECTS BY AGE OF FIRST HEARING AID FITTING

AGE AT WHICH A HEARING AID WAS FIRST FITTED	PERCENT OF SUBJECTS	AVERAGE HEARING LOSS (dB)
Before age 2 (N=0)	0.0	———
Between ages 2 and 4 (N=4)	15.38	67.50
Between ages 4 and 6 (N=7)	26.92	62.28
Between ages 6 and 10 (N=11)	42.30	65.63
Between ages 10 and 15 (N=1)	3.84	55.00
Never (N=3)	11.53	39.33
F Ratio*		1.80

*Critical *F* Ratio for significance at the .05 level = 2.84 (Ferguson, 1966, p. 409)

Parents of nine subjects stated that their children wore their hearing aids "over 12 hours a day." Another five were said to wear hearing aids from "6 to 12 hours a day," while four wore their aids "3 to 6 hours a day." There was a trend for more consistent hearing aid use among those subjects with greater hearing losses. There were significant differences between the mean hearing losses of subjects in the various categories concerned with consistency of hearing aid use. Data in Table VII indicate that the average loss of hearing of children wearing their hearing aids "3 to 6 hours a day" was 51.75 dB while those who wore aids "over 12 hours a day" had a mean loss of 74.11 dB.

TABLE VII
PERCENT OF SUBJECTS AND AVERAGE HEARING LOSS OF SUBJECTS BY CONSISTENCY OF HEARING AID USE

NUMBER OF HOURS A DAY THE HEARING AID IS PRESENTLY WORN	PERCENT OF SUBJECTS	AVERAGE HEARING LOSS (dB)
Never (N=8)	30.76	47.87
3 to 6 hours a day (N=4)	15.38	51.75
6 to 12 hours a day (N=5)	19.23	68.80
Over 12 hours a day (N=9)	34.61	74.11
F Ratio*		7.10

*Critical *F* Ratio:
For significance at the .05 level = 3.05
For significance at the .01 level = 4.76
(Ferguson, 1966, p. 409)

Table VIII compares the consistency of present hearing aid use with the age at which a hearing aid was first fitted. There is some indication that the earlier the hearing aid was fitted, the greater the likelihood that it was consistently worn at the time of this study. Three out of four children fitted before the age of 4 years wore their hearing aids over 12 hours a day while only three out of seven children fitted between 4 and 6 years of age wore their aids over 12 hours a day. Only three out of 11 who were fitted between the ages of 6 and 10 wore their aids over 12 hours a day.

TABLE VIII
CONSISTENCY OF PRESENT HEARING AID USE BY AGE OF FIRST FITTING OF A HEARING AID

AGE OF FIRST FITTING OF A HEARING AID	CONSISTENCY OF PRESENT HEARING AID USE			
	Never (N=5)	3-6 Hours a Day (N=4)	6-12 Hours a Day (N=5)	Over 12 Hours a Day (N=9)
Between ages 2-4 (N=4)	——	1	——	3
Between ages 4-6 (N=7)	1	——	3	3
Between ages 6-10 (N=11)	3	3	2	3
Between ages 10-15 (N=1)	1	——	——	——

Special training

Four types of special training were considered in the study: attendance at a preschool for the hearing impaired; speech, hearing, or language therapy; full-time enrollment in a class for school-age hearing impaired children; and assistance provided by a resource teacher. Parents were asked to indicate which of these services, if any, their child had received and the length of time the service had been provided. No attempt was made to define or control the "quality" of special training provided.

Six of the 26 subjects had attended a preschool for the hearing impaired. The mean hearing loss of students attending a preschool for the hearing impaired was 79 dB whereas the mean loss of hearing of those not attending a preschool was 56 dB. Length of attendance varied from 2 months to two years. Twenty-three of the 26 subjects had been enrolled in speech therapy programs, and 13 had at one time been enrolled in a full-time class for school-age hearing impaired children. Twenty-one of the 26 subjects had received special help from a resource teacher while attending classes with normal hearing students.

Table IX illustrates the fact that the mean hearing loss of those children receiving special help was greater than that of the children not receiving special help. This was true for each type of special assistance provided. Because the distribution of the numbers of subjects in most of these special training categories was skewed, tests for significance of the difference between means would not produce meaningful data.

TABLE IX
NUMBERS AND MEAN HEARING LOSS OF SUBJECTS WHO RECEIVED SPECIAL TRAINING AND SUBJECTS WHO DID NOT RECEIVE SPECIAL TRAINING

SPECIAL TRAINING	NUMBER	MEAN LOSS OF HEARING (dB)
Attended preschool	6	79.33
Did not attend preschool	20	56.25
Enrolled in speech therapy	23	64.04
Never enrolled in speech therapy	3	42.66
Enrolled in a full-time class for the hearing impaired	13	66.53
Never enrolled in a full-time class for the hearing impaired	13	56.61
Received special assistance from a resource teacher	20	65.45
Never received special assistance from a resource teacher	6	48.66

Severity of the hearing impairment

The three measures relating to the severity of the hearing impairment of subjects in the study were: average loss of hearing, speech reception threshold, and speech discrimination score. Table X illustrates that the mean loss of hearing in the better ear for the subjects in this study was 61.57 dB,with a range from 30 dB to 88 dB. The average speech reception threshold was 51.61 dB,and the mean discrimination score was 74.23 percent. Seven subjects in the present study had losses greater than 70 dB. Davis (1970) stated that within the range of 70 dB to 90 dB, some people are socially deaf but most are merely very hard of hearing. The mean hearing loss of subjects in this study was more severe than that of the subjects in 9 of the 11 studies of hard of hearing children cited in Chapter II.

TABLE X
MEANS, RANGE, AND STANDARD DEVIATIONS FOR AVERAGE LOSS OF HEARING, SPEECH RECEPTION THRESHOLD, AND SPEECH DISCRIMINATION SCORE OF HARD OF HEARING SUBJECTS

SEVERITY OF THE HEARING LOSS	MEAN	MINIMUM VALUE	MAXIMUM VALUE	STANDARD DEVIATION
Average Hearing Loss (dB)	61.57	30.00	88.00	17.02
Speech Reception Threshold (dB)	51.61	10.00	99.00	21.41
Speech Discrimination Score (percent)	74.23	20.00	100.00	21.21

Performance intelligence

The performance section of the WISC was administered to subjects who were 16 years old and younger, and the performance section of the WAIS was given to those subjects who were 17 years old and older. Data presented in Table XI indicate that the mean performance IQ of this group of subjects was 100.30, with a range from 74.00 to 136.00. It should be noted that criteria set for selection of subjects specified that no children with discernible multiple handicapping conditions would be included for study. Therefore, no child known to be mentally retarded was selected as a possible subject.

TABLE XI
MEAN, RANGE, AND STANDARD DEVIATION OF PERFORMANCE INTELLIGENCE OF HARD OF HEARING SUBJECTS

	MEAN	MINIMUM VALUE	MAXIMUM VALUE	STANDARD DEVIATION
Performance IQ (WISC, WAIS)	100.30	74.00	136.00	15.39

Speechreading

Speechreading skill was assessed by a live presentation of the Utley Lipreading Test, Part I, Sentence Test, Form A. The score reported was the percentage of the test sentences perceived with reasonable accuracy. Table XII demonstrates that the mean score for subjects in the study was 41.34 on this test of speechreading ability. The scores ranged from 0.0 percent to 78 percent.

TABLE XII

MEAN, RANGE, AND STANDARD DEVIATION OF SPEECHREADING SCORES OF HARD OF HEARING SUBJECTS

	MEAN	MINIMUM VALUE	MAXIMUM VALUE	STANDARD DEVIATION
Speechreading Skill (Utley Lipreading Test, Part I, Sentence Test, Form A) Percent correct	41.34	0.0	78.00	21.46

Table XIII compares the speechreading scores of hard of hearing subjects in this study to a value scale suggested by Jeffers and Barley (1971) based on their experience with lipreading ability of college students and hard of hearing adults. According to this interpretation, 15 of the subjects in this study could be considered poor lipreaders, 10 subjects might be described as average, and one would be considered a good lipreader.

The speechreading scores of older subjects in this study were not significantly better than those of younger students. The intercorrelation matrix in Appendix D illustrates that the correlation between age and speechreading ability was insignificant.

TABLE XIII
INTERPRETATION OF UTLEY LIPREADING TEST SCORES ACCORDING TO VALUE JUDGMENTS PROPOSED BY JEFFERS AND BARLEY

PERCENT CORRECT ON UTLEY LIPREADING TEST, SENTENCE FORM	NUMBER OF SUBJECTS	INTERPRETATION*
90 to 100	0	Excellent
78 to 87	1	Good
53 to 74	10	Average
Below 49	15	Poor

*Source: Jeffers, Janet, and Barley, Margaret, Speechreading. Springfield, Illinois: Charles Thomas (1971, p. 341).

Question Two

What are the language characteristics of hard of hearing children in the study with regard to receptive vocabulary, syntactic comprehension, auditory language, reading ability, speech articulation proficiency, and written language?

Receptive vocabulary

The Peabody Picture Vocabulary Test (Dunn, 1959) was administered to each subject in the study. Test procedures were modified to allow for presentation of the stimulus word in written as well as in vocal form. Results were reported as standard scores. Standard scores of 100 on the PPVT represent the mean raw score of the standardization sample with the standard deviation set at 15 (Dunn, 1959).

Only one of the 26 hard of hearing subjects scored at or above the mean for normal hearing children in the standardization sample. Table XIV illustrates that the mean standard score for hard of hearing subjects was 73.53, almost two standard deviations below the mean for normal hearing students of comparable age. It was previously demonstrated that the hard of hearing subjects performed as well as their normal hearing agemates on the nonverbal Performance Section of the Wechsler Intelligence Scales.

Receptive vocabulary (PPVT) scores of subjects in this study were shown to be significantly related to the socioeconomic status of the subjects. Similar relationships existed between socioeconomic status and three other measures of verbal ability.

TABLE XIV
MEAN, RANGE, AND STANDARD DEVIATION OF RECEPTIVE VOCABULARY SCORES OF HARD OF HEARING SUBJECTS

	MEAN	MINIMUM VALUE	MAXIMUM VALUE	STANDARD DEVIATION
Receptive Vocabulary (PPVT Standard Score)	73.53	42.00	109.00	15.45

Syntactic comprehension

A test for comprehension of indirect and direct objects (Scholes, 1973) was used to examine the ability of hard of hearing subjects to utilize syntactic clues to interpret the meaning of sentences having double object predicate constructions.

The subjects' interpretation of the unambiguous sentences with regard to type of disambiguating clue (article or disjuncture) formed the basis of the analysis of the results. Comprehension of the major lexical items in the sentences and interpretation of the ambiguous sentences were also noted. Table XV indicates that the mean score obtained by hard of hearing subjects on this test was 12.84 out of a possible 20 points.

TABLE XV
MEAN, RANGE, AND STANDARD DEVIATION OF SYNTACTIC COMPREHENSION SCORES OF HARD OF HEARING SUBJECTS

	MEAN	MINIMUM VALUE	MAXIMUM VALUE	STANDARD DEVIATION
Syntactic Comprehension	12.84	6.00	19.00	2.93

On this test the subjects heard a sentence, saw the same sentence written without punctuation, were shown a page with four pictures, and were asked to point to the picture that corresponded to the sentence. Two of the pictures were totally inappropriate, referring to completely different sentences than the stimulus. Two pictures corresponded to different interpretations of the stimulus sentence. Subjects in this study pointed to totally inappropriate pictures only 1.4 percent of the time, indicating that they had no difficulty in comprehending the major lexical items in the sentences. These types of inappropriate responses were therefore ignored in the analysis of the results. The subjects had substantial difficulty, however, in selecting between the two pictures representing different interpretations of each stimulus sentence. Their mean performance of 12.84 out of a possible 20 suggests that some of the subjects could have made choices on a purely random basis.

Other analyses of these results include the subjects' interpretation of ambiguous sentences. Table XVI demonstrates that 70 percent of the ambiguous sentences such as:

he showed her baby pictures

were interpreted by the hard of hearing students to mean:

he showed her the baby pictures.

This is the interpretation which Scholes (1973) referred to as a "B" interpretation. An "A" interpretation would translate this sentence to mean:

he showed her baby the pictures.

The hard of hearing subjects in this sample demonstrated a bias toward a "B" interpretation of ambiguous sentences. The normal hearing subjects in Scholes' study who were 13 years old and younger demonstrated a similar bias.

As would be expected, the hard of hearing students interpreted the "B" readings of unambiguous sentences more accurately than the "A" readings. In fact, when only "A" readings were considered, the hard of hearing subjects performed at a "chance" level (49 percent) in choosing the appropriate interpretation.

The hard of hearing students correctly interpreted 63 percent of the 20 unambiguous sentences. This performance is comparable to that of the 5-to 7-year-old normal hearing children in the Scholes study. The type of clue, disjuncture or article placement, was apparently not important to the correct interpretation of the sentences. Table XVI illustrates that hard of hearing subjects correctly interpreted article placement clues 63.84 percent of the time and correctly interpreted disjuncture clues 63.07 percent of the time. Since the disjuncture clue was strictly auditory and the article placement clue was visual and auditory, this finding is surprising.

In the sample of normal hearing subjects (Scholes, 1973) the ability to use the syntactic clues of article placement and disjuncture increased gradually over the age groups. No such increase in this ability was observed as a function of age in the hard of hearing subjects in this study. The intercorrelation matrix in Appendix D illustrates an insignificant negative correlation between age and score on the Test for Comprehension of Indirect/Direct Object Constituents (syntactic comprehension).

TABLE XVI
INTERPRETATION OF AMBIGUOUS AND UNAMBIGUOUS SENTENCES
BY HARD OF HEARING AND NORMAL HEARING SUBJECTS

	HARD OF HEARING N=26 MEAN AGE 14.4	NORMAL* HEARING N=20 AGE 5	NORMAL* HEARING N=20 AGE 7	NORMAL* HEARING N=20 AGE 9	NORMAL* HEARING N=20 AGE 11	NORMAL* HEARING N=20 AGE 13
	Percent	Percent	Percent	Percent	Percent	Percent
AMBIGUOUS SENTENCES						
B Interpretation	70.0	54.0	64.5	80.0	76.0	84.5
A Interpretation	28.5	43.0	35.0	16.5	18.5	15.5
UNAMBIGUOUS SENTENCES						
Correct B Interpretations	77.3	59.0	78.0	91.0	88.0	96.0
Correct A Interpretations	49.6	63.5	64.0	71.5	71.0	85.5
Correct Interpretation of Article Placement	63.8	58.5	74.5	86.0	83.5	94.5
Correct Interpretation of Disjuncture Clue	63.0	64.0	67.5	76.5	75.5	86.0
Total Correct Interpretations	63.4	61.25	71.0	81.25	80.5	90.5

*Source: Scholes (1973)

Auditory language

Because the scoring procedures used with the subjects in this study may have differed from those used with the standardization sample, present scores on auditory language were not compared to test norms (Myklebust, 1973). The most important use of the auditory language scores in this study involved their correlations with other variables in the study. The comparison and contrast between the ability to follow oral directions (auditory language) and speechreading skill was interesting. These data are presented in a later section of this chapter.

Under the scoring procedure used in this study, Test One and Test Two of the Auditory Language Test were combined to yield a possible total raw score of 46. Table XVII illustrates that the mean score of subjects in this study was 24.

TABLE XVII
MEAN, RANGE, AND STANDARD DEVIATION OF AUDITORY LANGUAGE SCORES OF HARD OF HEARING SUBJECTS

	MEAN	MINIMUM VALUE	MAXIMUM VALUE	STANDARD DEVIATION
Auditory Language (Raw Score)	24.42	5.00	43.00	9.23

Reading ability

Reading ability was measured by the Paragraph Meaning Subtest of the SAT Intermediate and Advanced Achievement Test Batteries and the Reading Subtest of the High School Basic Battery. On these subtests, which measured reading skill, the mean national percentile rank of hard of hearing subjects in the study was 17.30, with a range from the 1st percentile to the 94th percentile. Stated differently, the mean reading score of hard of hearing subjects represented a score which was exceeded by 83 of 100 students in the standardization sample. These data are presented in Table XVIII.

TABLE XVIII
MEAN PERCENTILE RANK, RANGE, AND STANDARD DEVIATION
OF SAT READING SUBTEST SCORES
OF HARD OF HEARING SUBJECTS

	MEAN NATIONAL PERCENTILE RANK	MINIMUM VALUE	MAXIMUM VALUE	STANDARD DEVIATION
Reading Subtest Score	17.30	1.00	94.00	22.51

Speech articulation proficiency

A modified version of the Screening Deep Test of Articulation (McDonald, 1965) was administered to the hard of hearing subjects in the study. In this test, nine frequently misarticulated consonant phonemes are tested in 10 phonetic contexts. Results are reported as total number of correctly articulated consonant phonemes. Table XIX illustrates that the mean score for subjects was 75.88 out of a possible 90, with a range from 36.00 to 90.00. The speech of eight subjects was judged by the investigator to be within the range of normal.

The most frequently misarticulated consonants were: [s], [ch] [sh], [th], and [r]. The voiced cognates of the voiceless phonemes listed are not tested in the Screening Deep Test. The mean number of correct productions of each of the phonemes tested are listed below:

[s] = 6.88	[sh] = 7.84
[l] = 9.46	[k] = 8.23
[r] = 8.92	[f] = 9.46
[ch] = 7.34	[t] = 9.38
[th] = 7.92	

The same information is illustrated graphically in Figure 1.

TABLE XIX
MEAN, RANGE, AND STANDARD DEVIATION OF SPEECH ARTICULATION PROFICIENCY SCORES OF HARD OF HEARING SUBJECTS

	MEAN	MINIMUM VALUE	MAXIMUM VALUE	STANDARD DEVIATION
Speech Articulation Proficiency (Screening Deep Test Total Correct)	75.88	36.00	90.00	12.69

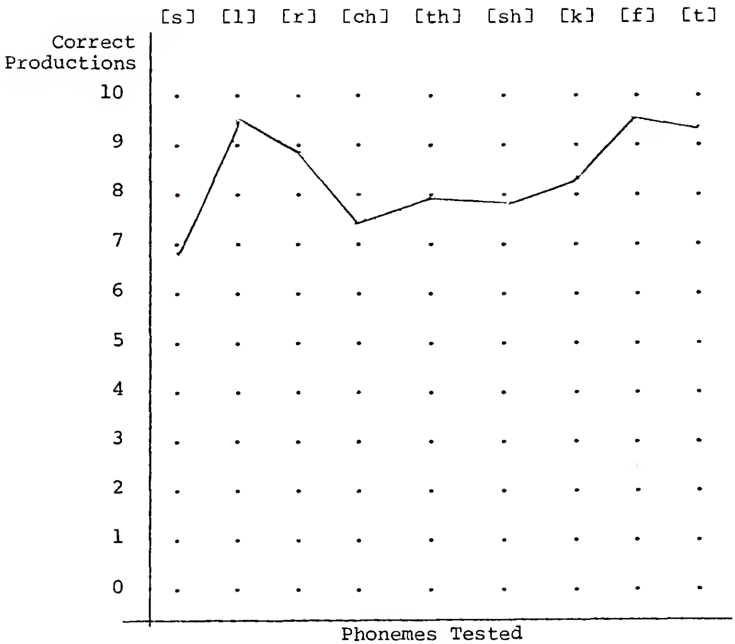


FIGURE 1
MEAN CORRECT PRODUCTIONS OF EACH CONSONANT PHONEME
BY HARD OF HEARING SUBJECTS ON THE
SCREENING DEEP TEST OF ARTICULATION

Written language

The Picture Story Language Test (Myklebust, 1965) was administered to the hard of hearing subjects in the study as a measure of the accuracy of their written language. In order to measure the correlations between written language ability and other variables in the study, the syntax quotient for each subject was converted to a percentile rank for age and sex using the tables provided by the test author (Myklebust, 1965). The mean of the percentile ranks of hard of hearing subjects for syntax quotient was 23.88, with the minimum value at the 2nd percentile and the maximum at the 98th percentile. These data are presented in Table XX.

TABLE XX
MEAN, RANGE, AND STANDARD DEVIATION OF WRITTEN LANGUAGE SCORES OF HARD OF HEARING SUBJECTS

	MEAN	MINIMUM VALUE	MAXIMUM VALUE	STANDARD DEVIATION
Written Language (Syntax Quotient, Picture Story Language Test) Percentile Rank	23.88	2.00	98.00	30.07

Table XXI illustrates the means of the subjects' raw scores on the productivity scale, the syntax scale, and the abstract-concrete scale of the Picture Story Language Test. Comparisons of these means to normative data provided by Myklebust (1965) demonstrate that the written language performance of these hard of hearing subjects with a mean chronological age of 14.5 was comparable to that of 7-to 9-year-old normal hearing children.

TABLE XXI
MEANS AND AGE EQUIVALENTS ON THE PICTURE STORY LANGUAGE TEST FOR PRODUCTIVITY, SYNTAX QUOTIENT, AND ABSTRACT-CONCRETE SCORES BY HARD OF HEARING SUBJECTS

	RAW SCORE MEAN	AGE EQUIVALENT*
PRODUCTIVITY		
Total Words	75.08	8 to 9
Total Sentences	7.52	8
Words Per Sentence	9.52	9
SYNTAX QUOTIENT	85.96	7
ABSTRACT - CONCRETE	10.88	8

*Source: Myklebust (1965)

The types of grammatical errors made by the hard of hearing subjects are summarized in Table XXII. Omissions and substitutions were the most common errors involving the use of words. Omissions were also the most common errors involving word endings and punctuation.

TABLE XXII
CATEGORIES AND TYPES OF ERRORS MADE BY HARD OF HEARING SUBJECTS ON THE PICTURE STORY LANGUAGE TEST

PICTURE STORY LANGUAGE TEST	CATEGORIES					
	WORD USAGE		WORD ENDINGS		PUNCTUATION	
Error Type:	Total Errors	Mean No. Errors	Total Errors	Mean No. Errors	Total Errors	Mean No. Errors
Additions	25.0	1.0	4.0	0.16	9.0	0.36
Omissions	56.0	2.2	43.0	1.72	109.0	4.36
Substitutions	46.0	1.84	11.0	0.44	0.0	0.0
Word Order	5.0	0.19	———	———	———	———

Question Three

How do hard of hearing children rank academically in comparison to national norms for students at their grade level?

Academic performance

The principal source of data concerning the academic performance of subjects in this study was results of the Stanford Achievement Tests. For the purpose of determining correlations between academic performance and other variables in the study, the average of the percentile scores for all subtests of the most current achievement test available was reported as "academic performance" for each subject.

Table XXIII illustrates that the mean percentile rank for hard of hearing subjects in this sample was 16.15. Stated differently, 83 out of every 100 students in the national standardization sample scored higher on overall academic achievement than did the hard of hearing subjects in this study even though the performance intelligence of the hard of hearing subjects was within the range of average.

TABLE XXIII
MEAN, RANGE, AND STANDARD DEVIATION OF ACADEMIC PERFORMANCE OF HARD OF HEARING SUBJECTS

	MEAN	MINIMUM VALUE	MAXIMUM VALUE	STANDARD DEVIATION
Academic Performance (Average of the National Percentile Scores on All Subtests of the SAT)	16.15	3.00	78.00	16.29

Table XXIV illustrates the national percentile rank for each subject on each subtest of the SAT. Five subjects for whom current SAT scores were not available were not included in this tabulation.

The highest mean percentile rank obtained by hard of hearing students taking the Intermediate and Advanced Batteries of the SAT was the 22nd percentile on the spelling subtest. The highest mean percentile rank obtained by the four students taking the High School Basic Battery was the 30th percentile on the math subtest. The lowest scores obtained on the tests were in the areas of science and social studies.

TABLE XXIV

NATIONAL PERCENTILE SCORES OF HARD OF HEARING SUBJECTS ON STANFORD ACHIEVEMENT TEST BATTERIES

INTERMEDIATE AND ADVANCED BATTERIES

SUBJECT	PARAGRAPH MEANING	SPELLING	LANGUAGE	ARITH. COMPUT.	ARITH. CONCEPT.	ARITH. APPLIED	SOCIAL STUDIES	SCIENCE	WORD MEAN.
1	.02	.08	.26	.04	.34	.01	.12	.22	
2	.10	.16	.01	.14	.30		.08	.08	.16
3	.40	.18	.18	.01	.12	.04	.38	.06	.18
4	.02	.02	.01	.02	.18	.08	.10	.14	.02
5	.94	.68	.84	.86	.80	.86	.76	.78	.58
6	.06	.01	.01	.01	.04	.01	.01	.01	.04
7	.20	.72	.46	.30	.14	.02	.11	.12	
8	.08	.23	.04	.06	.10	.02	.01	.10	
9	.11	.06	.04	.28	.16				
10	.14	.22	.02	.14	.22	.06	.12	.04	
11	.12	.70	.16	.08	.04	.04	.04	.01	
12	.10	.04	.01	.01	.06	.02	.04	.04	
13	.06	.10	.06	.14	.20	.04	.02	.01	
14	.04	.06	.10	.14	.14	.24	.12	.04	
15	.06	.10			.17		.01	.02	
16	.06	.06	.04	.10	.10	.10	.01	.06	
17	.18	.46	.18	.50	.18	.22	.32	.04	
Mean	.15	.23	.15	.18	.19	.13	.14	.11	.20

HIGH SCHOOL BASIC BATTERY

SUBJECT	ENGLISH	NUM. COMP.	MATH	READING	SCIENCE	SOCIAL STUDIES	SPELLING
1	.01	.01	.02	.01	.01	.02	.12
2	.24	.04	.38	.16	.08	.02	.56
3	.01	.04	.22	.01	.01	.02	.06
4	.04	.24	.56	.62	.10	.14	.20
Mean	.08	.08	.30	.20	.05	.05	.24

Question Four

What significant correlations exist among the following variables: average hearing loss, speech reception threshold, speech discrimination, receptive vocabulary, auditory language, syntactic comprehension, reading ability, speech articulation proficiency, written language, performance intelligence, age, speechreading skill, and grade point average?

The data presented in answer to this question concern correlations among variables. A complete intercorrelation matrix of all numeric variables in the study may be found in Appendix D. All tabulations illustrating the correlations between variables include the coefficient of correlation and the significance level of each coefficient of correlation. In each table the coefficient of correlation appears first and the significance level appears directly under it.

In order to facilitate discussion and illustration, a certain number of variables have been arranged in clusters. (A cluster is an arrangement of variables that have some common bond.) These variables have been identified as clusters:

Severity of the hearing loss:

Average loss of hearing
Speech reception threshold
Speech discrimination score

Receptive language:

Receptive vocabulary
Auditory language
Syntactic comprehension
Reading ability

Expressive language:

Speech articulation proficiency
Written language

Because they were not easily grouped, the variables performance intelligence, age, speechreading skill, and grade point average were illustrated individually.

Severity of the hearing loss

Variables which measured the severity of the hearing loss were average loss of hearing, speech reception threshold, and speech discrimination score. All three of these variables were significantly related to speechreading skill. The subjects with more severe hearing impairments were apparently better speechreaders than were the subjects with less severe hearing impairments. Average loss of hearing and SRT were positively correlated with speechreading while speech discrimination score and speechreading skill were negatively correlated. These data are illustrated in Table XXV.

TABLE XXV
CORRELATIONS BETWEEN THE VARIABLES ASSOCIATED WITH THE SEVERITY OF THE HEARING LOSS AND SPEECHREADING SKILL

	SPEECHREADING SKILL*
SEVERITY OF THE HEARING LOSS:	
Average Loss of Hearing	0.551 0.007
Speech Reception Threshold	0.393 0.044
Speech Discrimination	-0.417 0.032

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

There was no significant relationship between the severity of the hearing loss and any type of linguistic skill measured in this study even though the 30 dB to 88 dB range of hearing impairments in the study is relatively large. This finding supports the position that the degree of actual hearing deficit is less important than other factors may be in determining the language facility of the individual.

A significant negative correlation existed between speech discrimination score and age. This unexpected relationship may be attributed to the fact that one 18-year-old subject was unable to respond to the discrimination test at the limits of the audiometer. This subject was assigned an arbitrary discrimination score of 20 percent, which was considerably lower than any other score on the test. This extreme score may have distorted the relationship between the variables of age and discrimination score.

Receptive language

The variables representing receptive language were: receptive vocabulary, syntactic comprehension, auditory language, and reading. Receptive vocabulary, represented by the PPVT score, measures one-word receptive vocabulary, and the other three variables assess the ability to comprehend sentences. It has been previously demonstrated that the hard of hearing subjects in this study performed well below the established means for normal hearing students on these receptive language variables, that socioeconomic status was significantly related to two of the four receptive language variables, and that the severity of the hearing loss was not significantly related to any of the receptive language variables.

Significant positive correlations existed between most of the language variables in the study. Tables XXVI, XXVII, and XXVIII illustrate the correlations between the receptive language variables and other variables in the study. Significant positive relationships existed between the subjects' understanding of the meaning of single words (receptive vocabulary) and their ability to comprehend syntactic clues to sentence meaning, their ability to follow oral directions (auditory language), and their ability to read. Table XXVI demonstrates that the significance level of the relationship between receptive vocabulary and other receptive language variables ranged from 0.001 to 0.009.

TABLE XXVI
INTERCORRELATIONS AMONG RECEPTIVE LANGUAGE VARIABLES

	RECEPTIVE* VOCABULARY	SYNTACTIC COMPREHENSION	AUDITORY LANGUAGE	READING ABILITY
RECEPTIVE VOCABULARY		0.620 0.001	0.497 0.009	0.568 0.002
SYNTACTIC COMPREHENSION	0.620 0.001		0.326 0.099	0.584 0.002
AUDITORY LANGUAGE	0.497 0.009	0.326 0.099		0.417 0.031
READING ABILITY	0.568 0.002	0.584 0.002	0.417 0.031	

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

The only intercorrelation between the receptive language variables that failed to reach significance at the 0.05 level was that between auditory language and syntactic comprehension. All other variables representing receptive language abilities were significantly correlated.

Table XXVII illustrates the coefficients of correlation between receptive and expressive language variables. Expressive language was assessed by speech articulation proficiency and written language. Speech articulation proficiency refers to the total articulation score on the Screening Deep Test of Articulation, and written language is represented by the syntax quotient on the Picture Story Language Test.

TABLE XXVII
CORRELATIONS BETWEEN THE RECEPTIVE LANGUAGE VARIABLES
AND THE EXPRESSIVE LANGUAGE VARIABLES

	SPEECH ARTICULATION* PROFICIENCY	WRITTEN LANGUAGE
RECEPTIVE VOCABULARY	0.447 0.013	0.752 0.0001
SYNTACTIC COMPREHENSION	0.220 0.278	0.382 0.051
AUDITORY LANGUAGE	0.392 0.044	0.625 0.0009
READING ABILITY	0.219 0.280	0.385 0.049

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

A positive correlation, significant at the 0.0001 level, existed between the subjects' receptive vocabulary and the grammatical accuracy of their written language. The ability to follow oral directions (auditory language) and the grammatical accuracy of the subjects' written work were significantly correlated at the 0.0009 level. Receptive vocabulary was significantly related to speech articulation proficiency at the 0.02 level, and auditory language and speech articulation proficiency were correlated at the 0.05 level.

Table XXVIII demonstrates the correlations between the receptive language variables and age, performance IQ, and grade point average. No coefficient of correlation between the receptive language variables and age reached significance; however, in each case the correlation was in a negative direction. Receptive vocabulary and performance IQ were significantly correlated at the 0.039 level. Receptive vocabulary was also related significantly to grade point average at the 0.02 level.

TABLE XXVIII
CORRELATIONS BETWEEN THE RECEPTIVE LANGUAGE VARIABLES
AND AGE, PERFORMANCE INTELLIGENCE,
AND GRADE POINT AVERAGE

	AGE*	PERFORMANCE INTELLIGENCE	GRADE POINT AVERAGE
RECEPTIVE	-0.245	0.401	0.444
VOCABULARY	0.224	0.039	0.021
SYNTACTIC	-0.289	0.326	0.299
COMPREHENSION	0.148	0.099	0.134
AUDITORY			
LANGUAGE	-0.057	0.172	0.292
	0.775	0.597	0.144
READING	-0.134	0.152	0.013
ABILITY	0.517	0.537	0.944

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

Expressive language

The two measures of expressive language in this study were speech articulation proficiency and written language. As stated previously, speech articulation proficiency was correlated significantly with auditory language and with receptive vocabulary. Written language was also significantly correlated with these two receptive language measures. The relationship between written language and reading was also significant. This correlation reached the 0.05 level of significance and is illustrated in Table XXVII on page 90. The students' ability to write grammatically was the single variable most highly correlated with grade point average. This correlation, significant at the 0.001 level, is illustrated in Table XXIX.

TABLE XXIX
CORRELATIONS BETWEEN EXPRESSIVE LANGUAGE VARIABLES AND GRADE POINT AVERAGE

	GRADE POINT AVERAGE*
SPEECH ARTICULATION PROFICIENCY	0.051 0.796
WRITTEN LANGUAGE	0.607 0.001

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

Performance intelligence

The performance sections of the WISC and the WAIS were used to assess the subjects' performance intelligence. It has been previously demonstrated that the mean score of hard of hearing subjects in this study was within average range. Table XXX illustrates that this measure of ability was significantly correlated with receptive vocabulary at the 0.04 level of confidence and with the subjects' academic grades at the 0.04 level. No other coefficients of correlation between performance IQ and other variables reached significance at the 0.05 level.

TABLE XXX
CORRELATIONS BETWEEN PERFORMANCE INTELLIGENCE AND RECEPTIVE VOCABULARY AND GRADE POINT AVERAGE

	RECEPTIVE VOCABULARY*	GRADE POINT AVERAGE
PERFORMANCE INTELLIGENCE	0.401 0.039	0.397 0.042

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

Age

It has been stated in the literature that as they grow older, hard of hearing children may fall proportionately further behind normal hearing children in certain skills (Hine, 1970). In the present study only one variable was significantly related to age; this was speech discrimination, and a possible explanation for this unlikely negative relationship was stated previously. In the present study, however, all correlations between age and language variables were negative, but none reached significance. Table XXXI illustrates the correlations between age and the receptive and expressive language variables.

TABLE XXXI
CORRELATIONS BETWEEN AGE AND RECEPTIVE AND EXPRESSIVE LANGUAGE VARIABLES

	AGE*
RECEPTIVE LANGUAGE VARIABLES:	
Auditory Language	-0.057 0.775
Receptive Vocabulary	-0.245 0.224
Syntactic Comprehension	-0.287 0.148
Reading	-0.134 0.517
EXPRESSIVE LANGUAGE VARIABLES:	
Written Language	-0.252 0.212
Speech Articulation Proficiency	-0.045 0.818

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

Findings Related to the Second Purpose of the Study

The second purpose of the study was to determine possible relationships between the academic performance of hard of hearing subjects in the study and the following variables: sex, socioeconomic status, characteristics of hearing aid use, special training, severity of the hearing loss, performance intelligence, language comprehension and expression, and speechreading skill.

The variables sex, socioeconomic status, age at which the subject first wore a hearing aid, the consistency of the subject's present hearing aid use, and special training were classification variables. The mean academic performance of subjects in various classification categories is compared statistically by use of a one-way analysis of variance technique (Ferguson, 1966). It was impossible to make statistical comparisons between the categories of special training because the distribution of subjects in the various categories was skewed.

The variables concerning the severity of the hearing loss, performance intelligence, language comprehension and expression, and speechreading skill were numeric variables. Relationships between these variables and academic performance were examined by determining the coefficients of correlation between these variables and academic performance. Seven null hypotheses were stated in Chapter I, which related to the correlations between these numeric variables and academic performance.

The final method of analyzing the relationship between numeric variables and academic performance was the development of a regression model designed to predict academic performance of the subjects. Null hypothesis eight concerns the significance of any predictor variables of academic performance.

Table XXXII demonstrates that although the mean academic performance of males was somewhat higher than that of females in the study, the difference was not significant.

TABLE XXXII
COMPARISON OF THE MEAN ACADEMIC PERFORMANCE OF FEMALE AND MALE SUBJECTS

	ACADEMIC PERFORMANCE (National Percentile) Mean
SEX	
Females (N=10)	12.10
Males (N=16)	18.68
F Ratio*	1.00

*Critical *F* Ratio for significance at the .05 level = 4.26

Table XXXIII illustrates that the *F* Ratio between means of the academic performance of the subjects in the various occupational categories was not significant at the 0.05 level. This indicates that although children of white collar workers scored higher than children of blue collar workers, who in turn scored higher than children of service workers, these differences were not significant.

TABLE XXXIII
COMPARISON OF THE MEAN ACADEMIC PERFORMANCE OF SUBJECTS WHOSE PARENTS WERE EMPLOYED IN THREE DIFFERENT OCCUPATIONAL CATEGORIES

	ACADEMIC PERFORMANCE (National Percentile) Mean
OCCUPATIONAL CATEGORY	
White Collar Worker (N=11)	20.81
Blue Collar Worker (N=10)	15.80
Service Worker (N=5)	6.60
F Ratio*	1.34

*Critical *F* Ratio for significance at the .05 level = 3.40

Table XXXIV demonstrates no significant differences among means of the academic performance of subjects categorized according to the age at which they first wore a hearing aid.

TABLE XXXIV

COMPARISON OF THE MEAN ACADEMIC PERFORMANCE OF HARD OF HEARING SUBJECTS ACCORDING TO AGE AT WHICH A HEARING AID WAS FIRST FITTED

	ACADEMIC PERFORMANCE (National Percentile) Mean
AGE AT WHICH A HEARING AID WAS FIRST FITTED	
Before age 2 years (N=0)	——
Between ages 2 and 4 years (N=4)	14.50
Between ages 4 and 6 years (N=7)	23.85
Between ages 6 and 10 years (N=11)	14.09
Between ages 10 and 15 years (N=1)	3.00
Never (N=3)	12.33
F Ratio*	0.60

*Critical *F* Ratio for significance at the .05 level = 2.84

Table XXXV illustrates no significant differences among means of the academic performance of subjects categorized as to the consistency of their hearing aid use.

TABLE XXXV
COMPARISON OF THE MEAN ACADEMIC PERFORMANCE OF HARD OF HEARING SUBJECTS ACCORDING TO THE CONSISTENCY OF HEARING AID USE

	ACADEMIC PERFORMANCE (National Percentile) Mean
NUMBER OF HOURS A DAY A HEARING AID IS PRESENTLY WORN	
Never (N=8)	15.75
3 to 6 Hours a Day (N=4)	13.25
6 to 12 Hours a Day (N=5)	11.20
Over 12 Hours a Day (N=9)	20.55
F Ratio*	0.38

*Critical *F* Ratio for significance at the .05 level = 3.05

Seven null hypotheses related to the correlations among certain numeric variables and academic performance were stated in Chapter I.

Null Hypothesis One

There is no significant correlation between the severity of the hearing impairment, stated as an average loss of hearing, and the academic performance of hard of hearing subjects.

Although the correlation between average loss of hearing and academic performance was negative, the coefficient of correlation was negligible. No significant relationship existed between academic performance and any of the measures of severity of the hearing loss. These data are illustrated in Table XXXVI.

TABLE XXXVI
CORRELATIONS BETWEEN THE VARIABLES ASSOCIATED WITH SEVERITY OF THE HEARING LOSS AND ACADEMIC PERFORMANCE

	ACADEMIC PERFORMANCE* (National Percentile)
AVERAGE HEARING LOSS	-0.113 0.521
SPEECH RECEPTION THRESHOLD	-0.044 0.821
SPEECH DISCRIMINATION SCORE	0.237 0.242

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

The null hypothesis must be accepted and the conclusion drawn that there is no significant relationship between the severity of the hearing loss and the academic performance of subjects in this study.

Null Hypothesis Two

There is no significant correlation between the performance intelligence of hard of hearing subjects and their academic performance.

Academic performance in this study was defined as the average national percentile score on all subtests of the Stanford Achievement Test. Table XXXVII illustrates that the correlation between performance intelligence, as measured by the WISC or the WAIS, and academic performance, as measured by the SAT, was insignificant.

TABLE XXXVII
CORRELATIONS BETWEEN PERFORMANCE INTELLIGENCE AND ACADEMIC PERFORMANCE

	ACADEMIC PERFORMANCE* (National Percentile)
PERFORMANCE INTELLIGENCE	0.133 0.521

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

The null hypothesis must be accepted and the conclusion drawn that no significant relationship exists between the performance intelligence of the subjects in this study and their academic performance as measured by the Stanford Achievement Tests.

Null Hypothesis Three

There is no significant correlation between the receptive vocabulary of hard of hearing subjects and their academic performance.

Table XXXVIII illustrates a correlation coefficient of 0.67 between academic performance and receptive vocabulary. This correlation coefficient was significant at the 0.0003 level of significance.

TABLE XXXVIII
CORRELATION BETWEEN RECEPTIVE VOCABULARY AND ACADEMIC PERFORMANCE

	ACADEMIC PERFORMANCE* (National Percentile)
RECEPTIVE VOCABULARY	0.672 0.0003

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

The null hypothesis must be rejected and the conclusion drawn that receptive vocabulary of the subjects and their academic performance were significantly related.

Null Hypothesis Four

There is no significant correlation between the syntactic comprehension of hard of hearing subjects and their academic performance.

Table IXL illustrates that the correlation that existed between the subjects' ability to obtain meaning from syntactic clues (syntactic comprehension) and their academic performance was significant at the 0.002 level.

TABLE IXL
CORRELATION BETWEEN SYNTACTIC COMPREHENSION AND ACADEMIC PERFORMANCE

	ACADEMIC PERFORMANCE* (National Percentile)
SYNTACTIC COMPREHENSION	0.574 0.002

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

The null hypothesis must be rejected and the conclusion drawn that syntactic comprehension and academic performance were significantly related for subjects in this study.

Null Hypothesis Five

There is no significant correlation between the auditory language of hard of hearing subjects and their academic performance.

Data in Table XL demonstrate that the subjects' ability to comprehend oral instructions (auditory language) was significantly related at the 0.04 level to academic performance as measured by the Stanford Achievement Tests.

TABLE XL
CORRELATION BETWEEN AUDITORY LANGUAGE
AND ACADEMIC PERFORMANCE

	ACADEMIC PERFORMANCE* (National Percentile)
AUDITORY LANGUAGE	0.401 0.040

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

The null hypothesis must be rejected and the conclusion drawn that auditory language and academic performance were significantly correlated for students in this study.

Null Hypothesis Six

There is no significant relationship between the written language of hard of hearing subjects and their academic performance.

Table XLI illustrates that the coefficient of correlation between written language and academic performance of subjects in this study was 0.57. This coefficient was significant at the 0.002 level.

TABLE XLI
CORRELATION BETWEEN WRITTEN LANGUAGE
AND ACADEMIC PERFORMANCE

	ACADEMIC PERFORMANCE* (National Percentile)
WRITTEN LANGUAGE	0.567 0.002

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

The null hypothesis must be rejected and the conclusion drawn that academic performance was significantly correlated with the written language of the subjects in this study.

Null Hypothesis Seven

There is no significant correlation between the speechreading skill of the hard of hearing subjects and their academic performance.

Table XLII demonstrates that the relationship between speechreading skill and academic performance was not significant. The coefficient of correlation between these two variables was 0.095 and the significance level was 0.646.

TABLE XLII
CORRELATION BETWEEN SPEECHREADING SKILL AND ACADEMIC PERFORMANCE

	ACADEMIC PERFORMANCE* (National Percentile)
SPEECHREADING SKILL	0.095 0.646

*The upper number in each pair represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

The null hypothesis must be accepted and the conclusion drawn that the speechreading skill of the subjects in this study was not significantly correlated with their academic performance.

Null Hypothesis Eight

Regression of selected predictor variables on the criterion variable, academic performance, will result in no significant Beta coefficients.

The Forward Selection STEPWISE Procedure of the Statistical Analysis System (SAS) (Service, 1972, p. 127) was used to select the numeric variables that were of value in predicting the criterion variable, academic performance. The selected variables were included in a regression model by the Forward Selection STEPWISE procedure if they reached the 0.50 level of significance.

Table XLIII demonstrates that the best single-variable model calculated by this procedure was receptive vocabulary, which produced an R^2 of 0.45. The Beta coefficient of 0.60 yielded a t value which was singificant at the 0.007 level. Addition of the syntactic comprehension variable to the single-variable receptive vocabulary model increased the R^2 to a total of 0.49. The t value for the Beta coefficient was not significant at the 0.05 level for syntactic comprehension, however. The combination of the performance intelligence variable with receptive vocabulary and syntactic comprehension produced a three-variable model with an R^2 of 0.52. The Beta coefficient for the performance intelligence variable resulted in a t value which was not significant at the 0.05 level. No other variable met the 0.50 level of significance necessary for inclusion in the model.

The best regression model developed in this manner was a three-variable model including receptive vocabulary, syntactic comprehension, and performance intelligence. The model produced an R^2 of 0.52 indicating that it would account for 52 percent of the variance occurring in the criterion variable, academic performance. The F Ratio for this model was significant at the 0.001 level.

The Beta coefficient for receptive vocabulary was 0.60,which resulted in a t value significant at the 0.007 level. The null hypothesis must be rejected on the basis of the single variable receptive vocabulary model and the conclusion drawn that the receptive vocabulary score of the hard of hearing subjects was a significant predictor of their academic performance.

Although the null hypothesis was rejected on the basis of the single variable model, receptive vocabulary, it should be noted that a three-variable regression model composed of receptive vocabulary, syntactic comprehension, and performance intelligence was identified which would predict 52 percent of the variance of the dependent variable, academic performance,and that this regression model was significant at the 0.001 level.

TABLE XLIII

REGRESSION MODEL FOR THE DEPENDENT VARIABLE, ACADEMIC PERFORMANCE, AS SELECTED BY THE FORWARD SELECTION STEPWISE PROCEDURE OF THE SAS

	R^2	*F* RATIO	PROBABILITY $>$ *F*
VARIABLES IN THE MODEL			
Receptive Vocabulary	0.45		
Receptive Vocabulary, Syntactic Comprehension	0.49		
Receptive Vocabulary, Syntactic Comprehension, Performance Intelligence	0.52	8.00	0.001

VARIABLES	BETA COEFFICIENTS	*t* STATISTIC HO: B=0	PROBABILITY $>$ *t*
Receptive Vocabulary	0.60	2.94	0.007
Syntactic Comprehension	1.54	1.47	0.15
Performance Intelligence	-0.19	-1.16	0.25

Summary

The findings in this chapter were presented in two sections. The first section contained data that were descriptive in nature and corresponded to the first stated purpose of the study: to describe selected characteristics of a group of hard of hearing school-age subjects. The findings were presented as answers to four questions that were posed in Chapter I. The second section corresponded to the second purpose: to determine the possible relationships between sex, socioeconomic status, characteristics of hearing aid use, special training, severity of the hearing loss, performance intelligence, language comprehension and expression, and speechreading skill.

CHAPTER V
SUMMARY AND DISCUSSION

Summary

The effect of a permanent, long-standing, partial loss of hearing on the language behavior and academic performance of hard of hearing individuals is not well documented in published research. The paucity of research in this area may be due in part to the fact that the incidence of this type of handicap is low. Johnson (1962) cited an incidence figure of 0.2 percent of children in "ordinary" schools with a marked bilateral sensorineural or mixed hearing impairment severe enough to require some form of special help but not requiring special schooling.

There are well-established programs that provide assistance to hard of hearing children in many metropolitan school systems in the United States, but these types of programs are difficult to maintain in school districts of moderate size. Where such programs do exist, the methods used appear to be based primarily on tradition rather than on research.

The purposes of this study were: (1) to describe selected characteristics of a group of hard of hearing school-age subjects and (2) to determine possible relationships between their academic performance and the following variables: sex, socioeconomic status, characteristics of hearing aid use, special training, severity of the hearing loss, performance intelligence, language comprehension and expression, and speechreading skill.

Based on the review of the literature, 22 variables were selected for use in the study. The nature of the variables required their separation into two types: classification variables and numeric variables. The classification variables were:

1. Sex of the subject
2. Socioeconomic status of the subject's family
3. Age at which the subject first wore a hearing aid
4. The consistency of the subject's present hearing aid use
5. Special training: preschool for the hearing impaired
6. Special training: speech, hearing, or language therapy
7. Special training: full-time class for the school-age hearing impaired
8. Special training: academic assistance from a resource teacher while the subject was enrolled in regular school classes

The numeric variables were:

1. Age
2. Average loss of hearing
3. Speech reception threshold (SRT)
4. Speech discrimination score
5. Performance intelligence
6. Receptive vocabulary
7. Syntactic comprehension
8. Auditory language
9. Reading ability
10. Speech articulation proficiency
11. Written language
12. Speechreading skill
13. Academic performance
14. Grade point average (GPA)

To complete the first purpose of the study, four questions were posed:

1. What are the characteristics of hard of hearing subjects attending regular classes with regard to age, sex, socioeconomic status, etiology of the hearing loss, use of amplification, extent of special training, severity of the hearing impairments, performance intelligence, and speechreading skill?

2. What are the language characteristics of these hard of hearing children with regard to receptive vocabulary, syntactic comprehension, auditory language, reading ability, speech articulation proficiency, and written language?

3. How do the hard of hearing children in this study rank academically in comparison to national norms for students at their grade placement level?

4. What significant correlations exist between the following variables: average loss of hearing, SRT, speech discrimination, receptive vocabulary, auditory language, syntactic comprehension, reading ability, speech articulation proficiency, written language, performance intelligence, age, speechreading skill, and grade point average?

To complete the second purpose of the study, seven null hypotheses were stated that concerned correlations between academic performance of the subjects and selected numeric variables.

Null hypothesis one. There is no significant correlation between the severity of the hearing impairment, stated as an average loss of hearing, and the academic performance of hard of hearing subjects.

Null hypothesis two. There is no significant correlation between the performance intelligence of hard of hearing subjects and their academic performance.

Null hypothesis three. There is no significant correlation between the receptive vocabulary of hard of hearing subjects and their academic performance.

Null hypothesis four. There is no significant correlation between the syntactic comprehension of hard of hearing subjects and their academic performance.

Null hypothesis five. There is no significant correlation between the auditory language of hard of hearing subjects and their academic performance.

Null hypothesis six. There is no significant correlation between the written language of hard of hearing subjects and their academic performance.

Null hypothesis seven. There is no significant correlation between the speechreading skill of hard of hearing subjects and their academic performance.

Null hypothesis eight concerned the development of a regression equation for the criterion variable, academic performance.

> Null hypothesis eight. Regression of selected predictor variables on the criterion variable, academic performance, will result in no significant Beta coefficients.

The relationships between the classification variables and the dependent variable, academic performance, were studied by comparing the mean academic performance of subjects in the various classification categories. The statistical procedures in the study included: (1) use of an analysis of variance technique to compare mean performance of subjects in various classification categories, (2) calculation of the coefficients of correlation between the numeric variables, (3) use of the chi square procedure to determine whether the differences between the expected and observed proportion of parent occupations were significant, and (4) development of a regression equation to predict the criterion variable, academic performance. The criterion for significance on all procedures was set at the 0.05 level.

This study involved 26 subjects with bilateral, sensorineural hearing impairments, greater than 30 dB, who attended regular school classes, grades 4 through 12, in Duval County, Florida, during the 1973-74 academic year. The prevalence of children apparently meeting these criteria in the Duval County Schools was 0.047 percent. This figure represented those hard of hearing children who had been identified by the Exceptional Child Division of the Duval County School District and included only those children who had no apparent additional handicap other than the loss of hearing.

Data were collected from questionnaires returned by parents of the subjects, from cumulative school records, from files maintained in the office of the school audiologist, and from tests administered by the investigator. The seven tests administered by the investigator were:

1. Performance sections of the Wechsler Intelligence Scale for Children and the Wechsler Adult Intelligence Scale
2. Peabody Picture Vocabulary Test
3. Test for Comprehension of Indirect/Direct Object Constituents
4. Test of Auditory Language
5. Screening Deep Test of Articulation
6. Picture Story Language Test
7. Utley Lipreading Test, Sentence Form A

Results

The mean age of subjects in this study was 14.5 years. Sixteen of the subjects in the study were males and 10 were females. The socioeconomic status of subjects, based on occupational category of their parents, was typical of that of the United States population. Parents of more than half of the subjects in the study did not know the cause of their child's hearing loss but those who stated a probable cause listed birth defects, maternal rubella, meningitis, prematurity, measles, and kidney disease in that order of frequency.

Twenty-three of the 26 subjects had been fitted with hearing aids but only 18 subjects consistently wore their aids at the time of the study. No child had been fitted with an aid before the age of 2 years. The largest proportion of subjects, 42 percent, had been fitted between the ages of 6 and 10 years. Subjects with more severe losses wore their hearing aids for longer periods of time each day than those whose losses were less severe.

Only six of the 26 subjects in this study had attended a preschool for the hearing impaired. The mean hearing loss of those six subjects was 79 dB, while the mean loss of those not attending a preschool was 56 dB. Twenty-three of the 26 subjects had been enrolled in speech, language, or hearing therapy programs. Thirteen of the subjects had at one time been enrolled in a full-time class for school-age hearing impaired children. Twenty of the 26 subjects had received help from a resource teacher while attending regular classes. Because of the uneven distribution of subjects in the special training categories, no statistical comparisons between the categories were attempted.

The mean hearing loss of the group of subjects was 61 dB, with a range of losses from 30 dB to 88 dB. The mean performance IQ of the subjects, as measured by the performance sections of the WISC or the WAIS, was 100.3.

Hard of hearing subjects in the study were significantly retarded on all language measures. The mean standard score on receptive vocabulary (PPVT) was 73.53, which was almost two standard deviations from the mean for normal hearing subjects in the standardization sample. Hard of hearing subjects performed at a level similar to that of 5- to 7-year-old normal hearing subjects on syntactic comprehension. The mean national percentile score of hard of hearing subjects on reading subtests of the SAT was 17.30.

The mean articulation proficiency score (Screening Deep Test) was 75.8 out of a possible 90. The three most frequently misarticulated consonant phonemes on that test were [s], [ch], and [sh].

On written language, measured by the syntax quotient of the Picture Story Language Test, the mean percentile rank of hard of hearing subjects was 23.88. Omissions of words, word endings, and punctuation were the most common types of grammatical errors made by the subjects.

Academic performance of the hard of hearing subjects was measured by the average of the percentile scores for all subtests of the SAT. The mean national percentile rank of subjects in this study was 16.15.

Severity of the hearing loss and speechreading skill were significantly correlated. Those individuals with poorer hearing tended to be better speechreaders than those with better hearing. Neither of these variables was significantly related to other variables in the study.

The receptive language variables, receptive vocabulary, syntactic comprehension, auditory language, and reading, were positively correlated with each other. Only the relationship between auditory language and syntactic comprehension failed to reach significance at the 0.05 level.

Two measures of expressive language were employed: written language and speech articulation proficiency. The correlation coefficients between written language and the receptive language variables were consistently higher than those between speech articulation proficiency and the receptive language variables. Speech articulation proficiency was significantly correlated only with measures of auditory language and receptive vocabulary. Ability to write grammatically was the variable that was most significantly related to the grade point average of the subjects in the study.

Performance intelligence was significantly related only to receptive vocabulary and to grade point average.

No significant differences were demonstrated in the mean academic performance of subjects categorized as to sex, socioeconomic status, age at which a hearing aid was first fitted, or consistency of hearing aid use.

The null hypotheses in this study concerned the relationships between academic performance and selected numeric variables. Null hypothesis one was accepted when it was found that no significant correlation existed between the severity of the subjects' hearing losses and their academic performance. Null hypothesis two was accepted when it was demonstrated that no significant relationship existed between performance intelligence and the academic performance of the subjects. Null hypothesis three was rejected when it was demonstrated that the correlation between academic performance and receptive vocabulary was significant at the 0.0003 level. Null hypothesis four was rejected when it was demonstrated that the relationship between syntactic comprehension and academic performance was significant at the 0.002 level. Null hypothesis five was rejected when it was demonstrated that the correlation between academic performance and auditory language was significant at the 0.04 level. Null hypothesis six was rejected when it was demonstrated that written language and academic performance were significantly correlated at the 0.002 level. Null hypothesis seven was accepted when it was demonstrated that the relationship between speechreading skill and academic performance was not significant.

Null hypothesis eight stated that regression of selected predictor variables on the criterion variable, academic performance, will result in no significant Beta coefficient. This hypothesis was rejected when it was demonstrated that the Beta coefficient for the single-variable regression model, receptive vocabulary, was significant at the 0.007 level. In addition to the one-variable model, a three-variable model was identified which would account for 52 percent of the variance of the dependent variable, academic performance. This three-variable model included receptive vocabulary, syntactic comprehension, and performance intelligence and was significant at the 0.001 level of confidence.

Discussion

Results of this study suggest that among subjects identified in the 4th through the 12th grades in regular classes in the Duval County, Florida schools, a sensorineural hearing loss greater than 30 dB in the better ear was likely to be associated with both subtle and overt language deficiencies and with academic retardation.

The subjects in this study, with a mean hearing loss of 61 dB, represented a group of children whose hearing impairment was greater than that of the subjects in 9 of the 11 studies located in the literature concerning hard of hearing children. Criteria for selection of subjects in this study specified a minimum loss of hearing (30 dB) but no maximum loss. The criteria did state, however, that the hearing impaired subjects must attend regular school classes. No subject's hearing loss was as severe as the 93 dB criterion for deafness set by Davis (1970). The study did include several subjects whose hearing impairments were sufficiently severe for acceptance in a school or a class for the deaf but who nevertheless attended regular school classes. Considering this fact, it is important to note that the severity of the hearing loss of subjects in this study was not significantly related to any measure of their language ability or to their academic performance.

Although it was impossible to substantiate statistically, it appeared that those subjects who had the more severe hearing losses received more ancillary services than did subjects with less severe losses. If this is correct, at least two interpretations might be drawn from the finding. First, it might be stated that since the severity of the subjects' hearing losses was not a significant factor in their linguistic skill or their academic performance, it is difficult to justify provision of more services to children with more severe hearing losses than to those with less severe losses. On the other hand, it might be concluded that the special services received by the students with more severe hearing losses helped them to function at a linguistic and academic level comparable to that of subjects with less severe losses.

Linguistic skills of the subjects, involving receptive vocabulary, interpretation of syntactic clues, reading, and grammatical accuracy of written language were substantially below expectation on the basis of age of the subjects. The individual linguistic ability of the subjects was significantly correlated with their academic performance, as measured by national percentile score on achievement tests. It is possible to interpret this finding to indicate that because a student had greater linguistic skill, he was able to perform at a higher academic level. On the other hand, it may be that the achievement test scores simply provided an additional measure of the linguistic skill of the subjects. DiFrancesca and Carey (1972) pointed out that "A student may know the proper answer to a question but fail it because of inability to grasp the language complexity" (p. 2).

A continuous and long range program of language therapy including vocabulary development, written language, syntactic comprehension, reading skills, and speech improvement seems to be indicated for almost all of the students in this study regardless of the severity of their hearing impairments. Language ability, rather than severity of the hearing loss or the presence of a handicapping speech problem, should be the criterion for determining the need for these ancillary services.

Only one of the 26 hard of hearing subjects in this study achieved an overall percentile score greater than 50 on academic performance. Twenty-one of the 26 subjects scored within the lower 25 percent of the standardization population at their grade level, and 12 of the 26 scored in the lower 10 percent of the population. Because of the preponderance of low scores on academic performance, it is possible that achievement tests do not adequately separate poor students from good students in the hard of hearing population.

The ability to perceive meaning from lip movements, as measured by the Utley Lipreading Test, was not significantly related to the academic performance or to the linguistic abilities of subjects in this study, but the ability to follow oral directions (auditory language) was significantly related to both. The implication for aural habilitation programs for hard of hearing school children seems to be that emphasis should be placed on the vocabulary of directions, expressions in common use, and syntactic clues to the comprehension of oral directions rather than on voiceless speechreading drills. In this study speechreading skill, measured by the voiceless administration of a sentence lipreading test, was significantly related only to the severity of the hearing loss and perhaps represented a skill that was acquired by subjects with more severe hearing impairments because of the necessity of its use.

Although the correlation between performance intelligence and academic performance did not reach significance, this variable was one of the three best predictors of academic performance as measured by the SAT. The three-variable model of receptive vocabulary (PPVT, Dunn, 1959), syntactic comprehension (Test for Comprehension of Indirect/Direct Object Constituents, Scholes, 1973), and performance intelligence (WISC, WAIS, Wechsler, 1955) provided the best combination of numeric variables that could be used to predict the academic performance of subjects in this study. These variables were identified by the Forward Selection Procedure of the Statistical Analysis System (SAS).

Receptive vocabulary and the ability to comprehend sentences from syntactic clues represent skills that apparently can be manipulated. While the need for continuous, sequential vocabulary development activities for the hard of hearing student is evident, suitable materials are not presently available. No appropriate guidelines are presently available for developing comprehension of syntactic clues.

Schools for the deaf have long depended on highly skilled teachers who construct many of their own materials and design appropriate methods and techniques of instruction. Because the incidence of significant, but not profound, sensorineural hearing impairment is low, it is unlikely that continuous, habilitative programs, staffed by personnel trained specifically in the area of language development for the acoustically impaired, will be available to students except in metropolitan areas.

It becomes more essential, therefore, that guidelines and appropriate language development programs be developed that can be used by speech pathologists, audiologists, classroom teachers, teacher aides, parents, or volunteers who may have the responsibility of providing assistance for hard of hearing students enrolled in regular classes.

Implications for Linguistic Theory

The ability to decode syntactic information provided by article placement and intonation was significantly affected by significant, though not profound, hearing losses in the group of subjects studied. This was true even though clues were presented in both written and auditory form. Lenneberg's (1968) suggestion that deaf children "acquire language through the graphic medium without undue difficulty" (p. 33) was not supported in this research.

Any theory of language must take into account the necessity for intact auditory reception for normal, spontaneous, language acquisition.

Recommendations for Research

1. Linguistic analyses of the expressive and receptive language characteristics of hard of hearing children are needed to identify specific deficit areas so that appropriate procedures to alleviate these deficits may be designed.

2. Longitudinal treatment programs involving various methods of vocabulary enrichment are needed to determine what methods of vocabulary building are most efficient with hearing handicapped individuals.

3. Descriptive, predictive studies similar to the present research are needed with larger numbers of hard of hearing students.

4. More accurate prevalence figures for handicapping sensorineural hearing impairments among children attending regular classes need to be established.

APPENDIX A

BROAD OCCUPATIONAL GROUPS UTILIZED BY THE UNITED STATES BUREAU OF THE CENSUS

White Collar Workers

Professional, Technical and Kindred Workers
Managers and Administrators, except Farm
Sales Workers
Clerical and Kindred Workers

Blue Collar Workers

Craftsmen and Kindred Workers
Operatives, except Transport
Transport Equipment Operatives
Laborers, except Farm

Farm Workers

Farmers and Farm Managers
Farm Laborers and Farm Foremen

Service Workers

Service Workers, except Private Household
Private Household

Source: United States Bureau of the Census, 1973.

APPENDIX B

LETTER TO PARENTS, INSTRUCTION SHEET,
PERMISSION SLIP, AND QUESTIONNAIRE

Mr. and Mrs. John Doe
1234 Valley Drive
Jacksonville, Florida 5432

Dear Mr. and Mrs. Doe:

The Exceptional Child Division of the Duval County Schools, in cooperation with the University of Florida, is conducting a study concerning hard of hearing students.

Some students with hearing losses have very successful school experiences, some get along reasonably well, and others have a difficult time. We are interested in learning what special talents or experiences have helped hard of hearing students who achieve well in school and what kinds of help may be needed by others.

Your cooperation and Johnny's is requested so that this study may be as complete and as accurate as possible. It is important for the study to include students who have mild as well as severe hearing losses and those who are making good progress without any special help as well as those who need assistance.

Neither Johnny's grades nor his school placement will be affected as a result of his participation in this study. There is no charge for participation.

Please take a few minutes to read the enclosed information, complete the requested forms, and return them in the stamped, addressed envelope which is enclosed.

If you have questions about this project, please feel free to contact me (Mrs. Eunice Carter, telephone 663-5920).

Very truly yours,

(Mrs.) Eunice Carter, M.S.
Coordinator
Language, Speech, and Hearing Services
Duval County Schools

(Mrs.) Martha W. Anderson, M.Ed.
Department of Speech
University of Florida

Enclosures: 3

CC: T.B. Abbott, Ph.D.
Director
Speech Pathology and Audiology
Department of Speech
University of Florida

Instructions

This project will study the language skills, the lipreading ability, the performance ability, the degree of hearing loss, the history, and the school achievement of hard of hearing students in the Duval County Schools. It will be necessary to see each student for approximately three and one-half hours. The results of the study will help our schools as well as other schools to make better plans for the special needs of students who are hard of hearing.

1. If your child has had a recent, complete hearing evaluation there will be no need for additional hearing tests. All other information can be gained by seeing him or her at his/her own school for approximately three hours. This time will be arranged with the principal and the student will be excused from classes to complete the testing.

2. If your child has not had a recent, complete hearing test, an appointment will be made for him/her to come to Darnell Cookman School, 1701 Davis Street, where the hearing testing will be conducted. At that time the additional testing will also be completed. This should take approximately three and one-half hours. Students will be excused from classes for this purpose.

- -

PLEASE CHECK THE APPROPRIATE BLANK AND RETURN ALONG WITH THE COMPLETED QUESTIONNAIRE IN THE ENCLOSED, STAMPED ENVELOPE

If additional hearing testing is necessary:

_____ I will take my child to Darnell Cookman School at the appointed time.

_____ I cannot provide transportation for the hearing testing but if transportation can be arranged, my child has my permission to be transported to Darnell Cookman School and returned to his/her school.

_________________________ has my permission to participate in the
(child's name)
Duval County School Exceptional Child Division-University of Florida study concerning students who are hard of hearing. I understand that there will be no charge to me.

(Signed) ______________________________
Parent/Guardian

(Date) ______________________________

PARENT QUESTIONNAIRE

Child's name ______________________ Birthdate ______________

Address ____

Father's occupation ________________ Employed by ____________

Mother's occupation ________________ Employed by ____________

1. Please state the probable cause of your child's hearing loss if known.

____

2. At what age was the hearing loss first diagnosed?

____Before age 2
____Between ages 2 and 4
____Between ages 4 and 7
____Between ages 6 and 10
____Between ages 10 and 15

3. Has your child ever owned a hearing aid? ____ (yes) ____ (no)

4. When did your child first begin wearing a hearing aid? (Disregard if he/she has never worn a hearing aid.)

____Before age 2
____Between ages 2 and 4
____Between ages 4 and 6
____Between ages 6 and 10
____Between ages 10 and 15

5. How much of the time does he/she wear a hearing aid now?

____Never
____Less than three times a week
____3 to 6 hours every day
____6 to 12 hours every day
____Over 12 hours a day

6. Please check the kinds of special help your child has received and the length of time that this help has been provided.

	No	Yes	For How Long?*
Speech, hearing, or language therapy	____	____	____________
Preschool class for the hearing impaired	____	____	____________
Full-time enrollment in a class for the school-age hearing impaired	____	____	____________
Help with school work by a special teacher while enrolled in regular classes	____	____	____________

*Please estimate as closely as possible the total length of time that each type of assistance was given to your child.

APPENDIX C
SENTENCES CONSTRUCTED FOR USE WITH THE SCREENING DEEP TEST OF ARTICULATION

1. When did you see the bus fish?
2. The ball chain was never in a hurry.
3. Betty asked for a watch lock for her birthday.
4. We flew our house flag on the Fourth of July.
5. On Halloween the Ring Witch flys high in the sky.
6. What is the chair sun doing these days?
7. Sam went to visit the book shoe during the holidays.
8. Who likes cat leaf tea?
9. He had the star thumb on the football team.
10. The salesman lost his horse key.
11. The cat sheep performed at the circus.
12. Don't put that ear bell on your poor dog.
13. Have you ever seen a tree thumb ride.
14. The tooth lock is ready for the fat lady.
15. Her tooth brush is on the table.
16. The man invented a knife spoon.
17. Her mother makes leaf chairs.
18. The glove thumb kept her hands warm.
19. The book said brush five times.
20. Don't lock fish in the closet.
21. Maybe a mouth tie would work.
22. The watch fork may stick you.
23. Sam found a fish tooth in the lake.
24. The sled sheep had their wool taken.
25. The match kite won't fly.
26. The sheep chains keep rattling.
27. His father built a fish house.
28. My thumb saw a car go by.
29. Have you ever seen a saw-tooth shark?
30. Which key should I take?
31. Who is your mouth match?

APPENDIX D
INTERCORRELATION MATRIX OF NUMERIC VARIABLES

INTERCORRELATION MATRIX OF NUMERIC VARIABLES

	* Age	Performance Intelligence	Average Loss of Hearing	Auditory Language	Receptive Vocabulary	Syntactic Comprehension	Written Language	SRT	Discrimination	Speechreading	Speech	Reading	Academic Performance	GPA
Age	1.0000 0.0000	-0.2276 0.2626	0.1539 0.5410	0.0578 0.7756	0.2454 0.2249	-0.2891 0.1487	-0.2520 0.2120	0.2231 0.2726	-0.4599 0.0172	0.3076 0.1228	-0.0458 0.8186	-0.1348 0.5179	0.2147 0.2921	0.1317 0.5278
Performance Intelligence	-0.2276 0.2626	1.0000 0.0000	0.1301 0.5329	0.1728 0.5973	0.4016 0.0398	0.3269 0.0996	0.3075 0.1229	0.2179 0.2847	0.1852 0.6322	-0.0522 0.7952	0.1809 0.6203	0.1528 0.5379	0.1335 0.5219	0.3971 0.0422
Average Loss of Hearing	0.1539 0.5410	0.1301 0.5329	1.0000 0.0000	-0.2366 0.2431	-0.0241 0.9025	0.0306 0.8764	-0.0716 0.7276	0.8518 0.0001	-0.4880 0.0111	0.5113 0.0075	-0.0741 0.7194	-0.1557 0.5468	0.1338 0.5211	0.1236 0.5538
Auditory Language	-0.0578 0.7756	0.1728 0.5973	-0.2366 0.2431	1.0000 0.0000	0.4979 0.0094	0.3269 0.0996	0.6255 0.0009	-0.0785 0.7042	0.0309 0.8754	0.1686 0.5851	0.3929 0.0446	0.4175 0.0319	0.4011 0.0400	0.2922 0.1441
Receptive Vocabulary	0.2454 0.2249	0.4016 0.0398	-0.0241 0.9025	0.4979 0.0094	1.0000 0.0000	0.6207 0.0010	0.7524 0.0001	0.0512 0.7988	0.2302 0.2568	0.1283 0.5388	0.4779 0.0130	0.5681 0.0028	0.6726 0.0003	0.4441 0.0218
Syntactic Comprehension	-0.2891 0.1487	0.3269 0.0996	0.0306 0.8764	0.3269 0.0996	0.6207 0.0010	1.0000 0.0000	0.3822 0.0513	0.0193 0.9222	0.0294 0.8810	0.2434 0.2289	0.2206 0.2784	0.5842 0.0020	0.5740 0.0025	0.2993 0.1340
Written Language	-0.2520 0.2120	0.3075 0.1229	-0.0716 0.7276	0.6255 0.0009	0.7524 0.0001	0.3822 0.0513	1.0000 0.0000	0.0172 0.9310	0.2594 0.1981	0.0658 0.7475	0.2184 0.2835	0.3855 0.0492	0.5675 0.0028	0.6074 0.0013
SRT	0.2231 0.2726	0.2179 0.2847	0.8518 0.0001	-0.0785 0.7042	0.0512 0.7988	0.0193 0.9222	0.0172 0.9310	1.0000 0.0000	-0.5599 0.0032	0.3931 0.0445	-0.1492 0.5266	-0.0439 0.8255	0.0449 0.8217	0.0741 0.7191
Discrimination	-0.4599 0.0172	0.1852 0.6322	-0.4880 0.0111	0.0309 0.8754	0.2302 0.2568	0.0294 0.8810	0.2594 0.1981	-0.5599 0.0032	1.0000 0.0000	-0.4173 0.0321	0.2475 0.2208	0.1653 0.5752	0.2371 0.2420	0.1441 0.5111
Speechreading	0.3076 0.1228	-0.0522 0.7952	0.5113 0.0075	0.1686 0.5851	0.1283 0.5388	0.2434 0.2289	0.0658 0.7475	0.3931 0.0445	-0.4173 0.0321	1.0000 0.0000	0.2645 0.1888	0.1064 0.6105	0.0957 0.6462	0.0012 0.9910
Speech	-0.0458 0.8186	0.1809 0.6203	0.0741 0.7194	0.3929 0.0446	0.4779 0.0130	0.2206 0.2784	0.2184 0.2835	-0.1492 0.5266	0.2475 0.2208	0.2645 0.1888	1.0000 0.0000	0.2198 0.2803	0.2351 0.2462	0.0518 0.7966
Reading	-0.1348 0.5179	0.1528 0.5379	-0.1557 0.5468	0.4175 0.0319	0.5681 0.0028	0.5842 0.0020	0.3855 0.0492	-0.0439 0.8255	0.1653 0.5752	0.1064 0.6105	0.2198 0.2803	1.0000 0.0000	0.9166 0.0001	0.0139 0.9447
Academic Performance	-0.2147 0.2921	0.1335 0.5219	-0.1338 0.5211	0.4011 0.0400	0.6726 0.0003	0.5740 0.0025	0.5675 0.0028	-0.0449 0.8217	0.2371 0.2420	0.0957 0.6462	0.2351 0.2462	0.9166 0.0001	1.0000 0.0000	0.1527 0.5375
GPA	-0.1317 0.5278	0.3971 0.0422	0.1236 0.5538	0.2922 0.1441	0.4441 0.0218	0.2993 0.1340	0.6074 0.0013	0.0741 0.7191	0.1441 0.5111	0.0012 0.9910	0.0518 0.7966	0.0139 0.9447	0.1527 0.5375	1.0000 0.0000

*The upper number in each pair of numbers represents the coefficient of correlation between the two variables and the lower number represents the corresponding significance level.

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BIOGRAPHICAL SKETCH

Martha Williamson Anderson was born in El Dorado, Arkansas, in 1936. She attended public schools in that community and graduated from El Dorado High School in 1954. Mrs. Anderson received the baccalaureate degree in Speech Correction from East Texas State University in 1959.

From 1959 until 1964 she was engaged in public school speech therapy in Beaumont, Texas. Experience gained with hard of hearing children in that setting contributed to a long-standing concern for their problems. From 1964 to 1966 she taught young deaf children in the Bi-County School for the Deaf in Beaumont, Texas.

Her master's degree is in Special Education with emphasis on Education of the Deaf from the University of Houston in 1966.

Mrs. Anderson was an instructor in speech pathology and audiology at the University of Arkansas from 1966 to 1969. From 1969 to the present time she has directed the pre-professional program in speech pathology at Henderson State College in Arkadelphia, Arkansas.

Mrs. Anderson holds the Certificate of Clinical Competence in Speech Pathology from the American Speech and Hearing Association and represents Arkansas on the Legislative Council of that organization.

Mrs. Anderson is married to Gary Donald Anderson and they have two children, Donny and Andrea.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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