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The Effects of Mild Hearing Loss on Academic Performance Among Elementary School Age Children

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THE EFFECTS OF MILD HEARING LOSS ON ACADEMIC PERFORMANCE AMONG ELEMENTARY SCHOOL AGE CHILDREN

by

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TABLE OF CONTENTS

LIST OF TABLES

Table — Page

LIST OF FIGURES

Figure Page

ABSTRACT

THE EFFECTS OF MILD HEARING LOSS ON ACADEMIC PERFORMANCE AMONG ELEMENTARY SCHOOL AGE CHILDREN

Research endeavoring to determine the effect of a mild sensorineural hearing-impairment on academic performance has resulted in conflicting conclusions. To date, there has been limited research on the educational implications of a mild hearing loss in the elementary grades but very few studies have utilized a normal-hearing control group to compare with the hearing-impaired and none have examined whether a relationship exists beyond sixth grade. This study measured the academic performance of mildly hearing-impaired children by comparing them with their normal-hearing counterparts. The achievement scores of the Iowa Test of Basic Skills from twelve pairs of children in the 5th through 8th grades were compared. The results revealed no statistical significance between the two groups for grade levels, age, or subject matter areas. However, the grade equivalent mean score of the hearing-impaired group was poorer than that of the normal hearing control group in 4th and 5th grade. Scores on sub-tests were also lower for the hearing-impaired students during these same grades. After 5th grade a pattern was not observed, with this small number of students. The study discusses the implications of these results indicating the hearing-impaired student is at academic risk through 5th grade.

INTRODUCTION

Children with mild sensorineural hearing loss experience academic delay that may become progressively more severe as these children progress through school (Blair, Peterson and Viehweg, 1985). During the past five years, the effects of mild sensorineural hearing loss on academic performance amongst school age children has received more attention than ever before. A few investigations have been conducted which have attempted to specifically focus on children with mild sensorineural hearing loss and their performance on standardized achievement tests (Sarff, 1981; Burgener & Mouw, 1982; Blair, Peterson & Viehweg, 1985; Davis, Elefenbein, Schum & Bentler, 1986; Schweigert, 1987). Much of the research that was reported prior to 1981 examined a broad area of hearing loss and its effect on academic performance, and not mildly impaired students alone (Quigley & Thormure, 1968; Goetzinger, Harrison & Baer, 1964; Kodman, 1963; Peterson, 1972).

Hard-of-hearing children (especially those with mild losses) are not easily recognizable and in many educational systems are the invisible (Anderson, 1978; Davis & Hardick, 1981). It has been estimated that the percentage of children with educationally significant hearing loss is probably close

to 30 per 1000 and that it is likely that at least one hearing-impaired child can be found in every school in the country (Ross, Brackett & Maxon, 1982). Ross and his colleagues also suggested these children are ignored and underserved by the educational system. The limited literature that is available does not clearly show the relationship of mild hearing-impairment to academic achievement. Because research has been so limited it has been difficult for speech language pathologists, audiologists and special educators to describe the probable effects of mild hearing losses, as well as plan programs of treatment to enhance communication and educational performance (Davis, et al., 1986).

To date there have been no studies reported on the academic performance of mild sensorineural hearing-impaired students and their normally hearing controls enrolled in upper elementary grades (grades 5 to 8). There is some controversy in the literature regarding the actual effects of mild hearing-impairment on the educational performance of children. Most of the literature supports the assumption that mildly hearing-impaired children are more susceptible to delays in communication and academic performance than their normally-hearing peers (Kodman, 1963; Goetzinger, et al., 1964; Quigley et al., 1968; Sarff, 1981; Burgener et al., 1982). This research, however, has been criticized for its examination of a broad area of hearing loss, its inadequate

examination of mild hearing loss over time, or its exclusion of normal hearing control groups (Blair, et al., 1985).

Recent studies report that there is no significant difference between mildly hearing-impaired children and the national norms (Davis, Shepard, Stelmachowicz & Gorga, 1981; Blair, et al., 1985; Davis, et al., 1986). However, Blair et al., (1985) found that by the fourth grade, statistically significant differences were observed between mildly hearing-impaired children and their normally hearing controls in academic performance. Therefore, there was a need for a study to determine if upper elementary children with mild sensorineural hearing losses continue to experience delays and if they do, are these delays continuous over time. The results from this study could be used to facilitate a better understanding of mildly hearing-impaired children so that more efficient and appropriate services can be provided, if necessary, to this population.

REVIEW OF THE LITERATURE

Educators and audiologists have attempted to define the relationship between academic achievement and hearing-impairment amongst children. There is an abundance of literature which discusses the effects of mild fluctuating conductive hearing loss on communicative and academic achievement amongst children; however, it will not be included in this review for two reasons. First, this

literature has been criticized extensively for its numerous limitations in design (Paradise, 1983; Bess, 1985). Secondly, the effects of permanent mild sensorineural hearing loss should not be considered the same as the effects of fluctuating mild conductive hearing-impairment simply because of the difference in duration between the two types of losses. Several studies conducted during the 1960's and 1970's reported delays in language and academic achievement in children with a broader range of hearing loss when compared to national norms (Kodman, 1963; Goetzinger, et al., 1964; Quigley et al., 1968; Peterson, 1972; Goetzinger, 1978). These results, based on data gathered from large groups of children suggested that mildly hearing-impaired children were delayed in academic achievement from 1.0 to 2.4 years. There is also evidence to suggest that children with mild hearing losses can experience difficulties in auditory perception, as well as, social and emotional difficulties (Bothwell, 1968; Ross & Giolas, 1971; Goetzinger & Proud, 1976).

Sarff, as cited in Roeser and Downs (1981) stated that fifty-seven percent of the 197 children who failed audiometric screening with hearing losses up to 40 dB PTA exhibited academic delays of at least .6 years below their actual grade level. As a result of these findings, he suggested that a cumulative effect of minimal hearing loss on academic performance may exist.

In contrast, Shepard, Davis, Gorga & Stelmachowicz, (1981) conducted a survey with various educational professionals employed in the state of Iowa and reported there was no significant correlation established between mild hearing loss and academic achievement. They also gathered data which suggested that children with a mild to moderate hearing loss up to 50 dB PTA generally did not wear amplification perhaps because "many audiologists did not consider these children appropriate candidates for the use of hearing aids."

Four years later, Blair, et al., (1985) suggested that permanent mild hearing loss in children during the early school years has a negative effect on general performance which may increase as the children get older. The mildly hearing-impaired students' scores were not noticeably different from the national norms; however, significant differences were noticed between them and the normal hearing controls by the end of the fourth grade. They also reported that the hearing-impaired group generally performed poorer than the normal group for all ages compared, and that the hearing-impaired group's increase was almost always poorer than the normal control group's increase over the period of a year.

Schweigert's (1987) results were similar to Blair et al., (1985) when she concluded that there was a tendency for hearing-impaired students to attain progressively lower

achievement scores as they proceed through school up to fifth grade. She examined a school district's hearing screening records and achievement test results and found that there was a relationship for those children who failed hearing screening bilaterally for two consecutive years. She also concluded that there was a significant relationship between academic performance of third and fifth graders and mild hearing loss as evidenced by third grade math scores and by fifth grade math, reading, language arts, science and social studies scores on Criterion Referenced Tests.

A recent study conducted by Davis, et al., (1986) suggested that no significant differences were found among the academic achievement scores for hearing loss or age categories. The researchers reported that although mild to moderate hearing-impaired children demonstrated scores indicative of delays of a year or more in language development, they did not exhibit depressed test scores on standardized tests for reading, math and spelling. They concluded that the level at which there was a relationship between hearing loss and academic achievement was 50 dB. This study and the study conducted by Shepard et al., (1981) may not accurately reflect the abilities of the the hearing-impaired since both studies were conducted in Iowa and used a standardized sample as the group to compare with the hearing-impaired. Iowa has an unusually comprehensive identification and follow up program for the hearing-impaired

involving employment of about 70 audiologists, 500 speech-language pathologists and 100 teachers of the hearing-impaired (Shepard, et al., 1981). It might be hypothesized that the achievement scores of the hearing-impaired children in Iowa are unique and possibly elevated since these children are fortunate to receive unusually comprehensive services.

Furthermore, only two studies (Reynolds, 1955; Blair, et al., 1985) used a normal-hearing control group to compare with the hearing-impaired. Blair, et al., (1985) suggests that most studies use a standardized sample to compare with the hearing-impaired and thus some research may not accurately reflect the abilities of the hearing-impaired when compared to the peer group with whom they are educated.

The purpose of this study was to follow up on an earlier report of academic delay which may become progressively more severe as mildly hearing-impaired children advance through school (Blair, et al., 1985). This study was designed to more clearly define the relationship between mild hearing-impairment and academic achievement. The following four research questions were addressed:

1) Do children in the upper elementary grades (grades five through eight) with mild hearing-impairment (20 - 45 dB) experience significant academic delay when compared to normal hearing peers, nationally and to those with whom they are educated as indicated by standard achievement test scores?

2) If there is delay, does the magnitude of difference over time remain constant, increase or decrease when compared to achievement tests administered at the end of the school year, to those obtained the year before?

3) Does the academic performance of the two groups of children change or remain constant over a one year period?

4) Is there an interaction between grade level and hearing status on the achievement test scores?

METHODOLOGY

Subjects

The subjects of this study were a group of 24 children, an experimental group consisting of 12 mildly hearing-impaired children and a control group, with whom they are educated, consisting of 12 normal-hearing children. Children enrolled in fifth, sixth and eighth grade attending schools in Jordan School District, for at least three years, were selected for this investigation. Only one seventh grade hearing-impaired student met the criteria for this study, consequently, this grade was not included. The hearing-impaired group consisted of 12 children who met the following criteria:

1) Each child, according to the school records, had a long-standing sensorineural hearing loss which had

been identified prior to the child's sixth birthday.

2) The most recent follow-up evaluation revealed that each child had a stable mild hearing loss (20 - 45 dB) in the better ear.

3) The hearing loss configuration was basically flat.

4) Each child exhibited normal bilateral tympanograms, and did not have an air-bone gap greater than 5 dB, nor a history of recurrent middle ear problems.

5) Each child demonstrated normal intelligence as measured by a nonverbal intelligence test.

6) Each child was not registered for financial assistance with the federally funded hot lunch program at the school.

7) Each child was enrolled in regular education and did not receive resource, enrichment or language services.

The subjects in the control group were obtained using a combined matched-random selection from children of the same sex and in the same classroom as the hearing-impaired children in order to control for factors of age, sex, socioeconomic status and school experience. The following additional criteria were also met by the children selected for this control group:

1) Each child did not have a history of middle ear

problems as determined by the audiologists' records and a parental report.

2) Each child demonstrated normal hearing acuity, bilaterally, as measured by puretone screening at 20 dB.

3) Each child exhibited normal tympanograms and static compliance measures, bilaterally.

4) Each child demonstrated normal intelligence as determined by the school records, or a non-verbal screening instrument for intelligence.

5) Each child was not registered for financial assistance in the Federal Hot Lunch Program provided at the school.

6) Each child was enrolled in the same regular education classroom and did not receive resource, enrichment or language services.

Procedures

A proposal of the study was sent and approved by the research committee of Jordan School District. This district was selected since it employs full time educational audiologists on staff as well as this author. Once approval was obtained from the district, twenty-two mildly hearing-impaired children were identified from the district audiologists' records. Letters were sent to the principals and to the families and permission was granted to access school records and screen eighteen hearing-impaired children

for participation in the study. Three children had moved out of the school district and parent permission was denied for one subject. There was only one seventh grader which met the criteria for this study, and thus this subject was not included. Each of the records of the remaining seventeen students were reviewed to determine if the specified criteria was met.

The classroom teachers of these hearing-impaired children were contacted and informed of the study. Four of the seventeen children did not meet the criteria to be included in this study. Two students were enrolled in intellectually handicapped cluster units, one student received resource services and another was enrolled in the gifted and talented program. The school records of the remaining thirteen students were then examined; however, since current nonverbal intelligence test scores were not available the investigator administered the Test of Non-verbal Intelligence (TONI). The TONI was selected since it is a language-free measure designed to be used with subjects 5-0 through 85-11 years (Brown, Sherbenou & Johnsen, 1982). It consists of two equivalent forms (A and B), each containing 50 items arranged in order of difficulty. The TONI is not timed, takes approximately 15 minutes to administer and requires only pointing on the part of the subject. The equivalent forms were randomly selected using the 10,000 random numbers chart, when administered to the

subjects. All of the students scores were within the normal range of intelligence except one fifth grader who attained a TONI quotient of 125 and thus was not included in the study.

Once the eligible hearing-impaired children were selected the classroom teachers were then asked to identify children in the classrooms that were of the same sex, age, socioeconomic status and academic experience as the hearing-impaired children. Since children enrolled at any given school in Jordan School District must live within the school's geographic boundary, it is probable that the socioeconomic status of the families in the jurisdiction, was similar. The school's Federal Hot Lunch Program records were reviewed to ensure that all children selected were not recipients of financial aid.

Once the classroom teachers identified the normal-hearing students in their rooms that were matched according to the age, sex, socioeconomic status and academic experience as the hearing-impaired child, one child was randomly selected from the same classroom as the hearing-impaired child. Parental consent to access school records and screen each child for participation in the study was obtained through a signed parental information and consent letter (see Appendix C). Each hearing child's records were reviewed to determine if the criteria for the study was met. If all other criteria was met, the investigator screened the hearing of all children and administered the TONI. The hearing

screening was conducted at the child's school using a Maico, model MA-39, audiometer terminated in Telephonics TDH-39 earphones. The audiometer was calibrated to ANSI-1969 standards. Puretone sweep frequency screening technique was used at 1000, 2000 and 4000 Hz at 20 dB. This puretone screening was selected to be consistent with that currently being practiced by the audiologists in Jordan School District.

All twelve students in the control group passed the hearing screening. The investigator then administered the TONI to the students, to ensure that the subjects selected for the control group demonstrated normal intelligence. All hearing students attained scores within the normal range of intelligence.

Once all 24 children were selected for both the control and the experimental groups, achievement test scores were then obtained from the school administrative records for the previous and current school years. The achievement test that was used by Jordan School District is the Iowa Test of Basic Skills (ITBS). Two forms of the Iowa Test were used in the elementary and middle schools. The second form was used to assess children in third through eighth grade. This form included subtests on vocabulary, reading comprehension, language, math concepts and math problems. Total language, work study skills, math and composite scores were computed from these subtests.

The raw scores, percentiles and grade equivalent scores from the Iowa Test of the two groups were analyzed using a two-way analysis of variance with repeated measures for each grade level. The mean scores were calculated for the hearing-impaired and hearing students across years, grades and subtests for both percentiles and grade equivalent scores to facilitate comparison. This determined whether or not there were significant differences between the mildly hearing impaired subjects and their normal hearing counterparts as they progressed through upper elementary school.

RESULTS

The raw scores, percentiles and grade equivalent scores from the ITBS of the two groups were analyzed using a two-way analysis of variance. No significant differences were found for grade levels, age, or subject matter areas.

The results of this study as evidenced by the grade equivalent scores in Table 1 as well as Figures 1 and 2 revealed that the hearing-impaired students in fourth and fifth grade basically score at a level consistently below their hearing counterparts. It was noted that with the exception of one subtest in the 5th grade, the normal hearing students scored higher on all the subtests of the Iowa Test of Basic Skills.

Table 1. Comparison of grade equivalent test scores for normal-hearing and mildly sensorineural hearing-impaired children (4th to 8th grades).

Grade Level	Vocabulary	Reading	Language Total	Math Concepts	Math Problem Solving	Math Total	Composite
HI-4	4.5	5.6	5.4	5.7	5.0	5.4	5.3
H-4	5.9	6.1	6.1	6.4	5.5	5.7	5.9
HI-5	5.4	6.2	6.8	6.4	5.9	6.1	6.3
H-5	7.1	7.2	6.9	6.8	6.0	7.0	7.0
HI-6	7.2	5.6	7.9	7.8	6.9	7.1	7.5
H-6	6.5	5.8	6.9	7.2	6.8	7.0	6.6
HI-7	10.0	9.1	9.9	8.1	8.8	8.2	9.0
H-7	8.7	9.0	10.3	10.5	9.7	9.4	9.3
HI-8	9.6	9.6	10.9	9.7	9.7	9.4	9.8
H-8	10.1	9.3	11.0	10.1	9.3	9.5	10.5

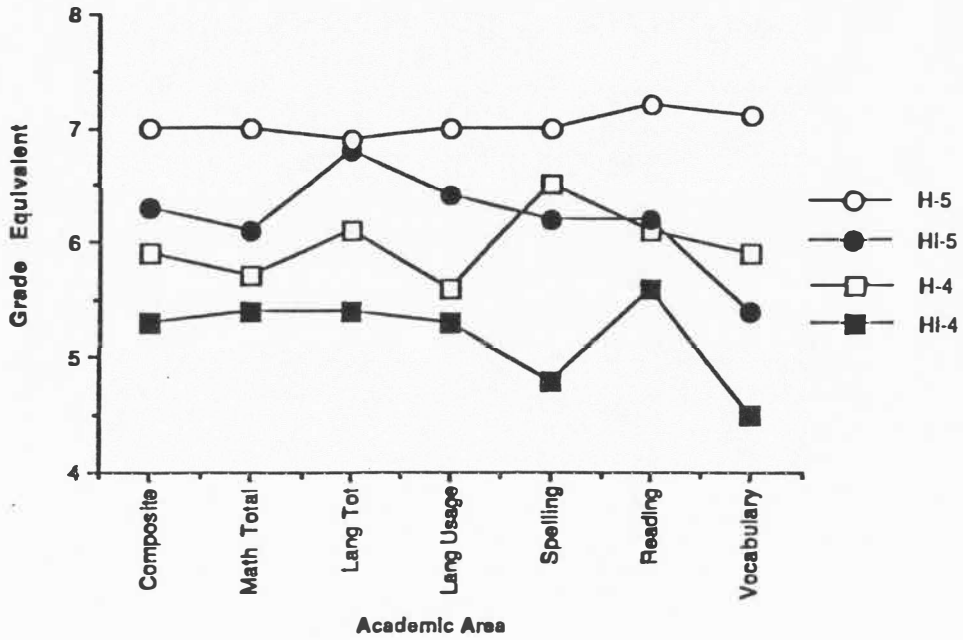


Figure 1. Comparison of the grade equivalent test scores on the ITBS for normal-hearing and mildly hearing-impaired children in fourth and fifth grade.

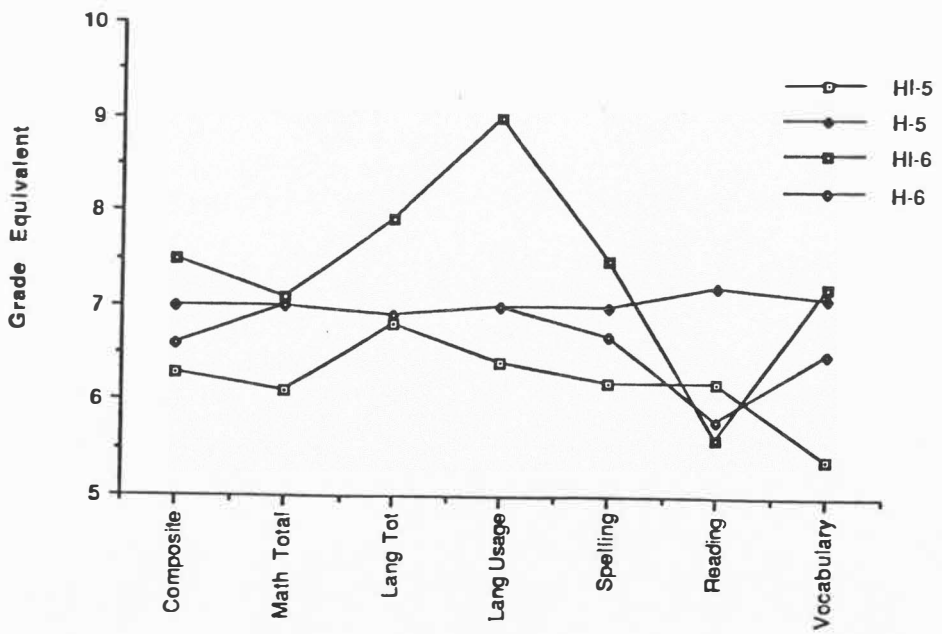


Figure 2. Comparison of the grade equivalent test scores on the ITBS for normal-hearing and mildly hearing-impaired children in fifth and sixth grade.

Figures 3 and 4 show that this pattern was not demonstrated in the sixth, seventh and eighth grade results, in fact, the sixth grade hearing impaired students usually performed better than their hearing counterparts, particularily in language. Although composite scores were slightly better for the normal-hearing students in the seventh and eighth grade, as shown in Figure 5, the performance on the ITBS subtests was scattered and did not reveal a pattern.

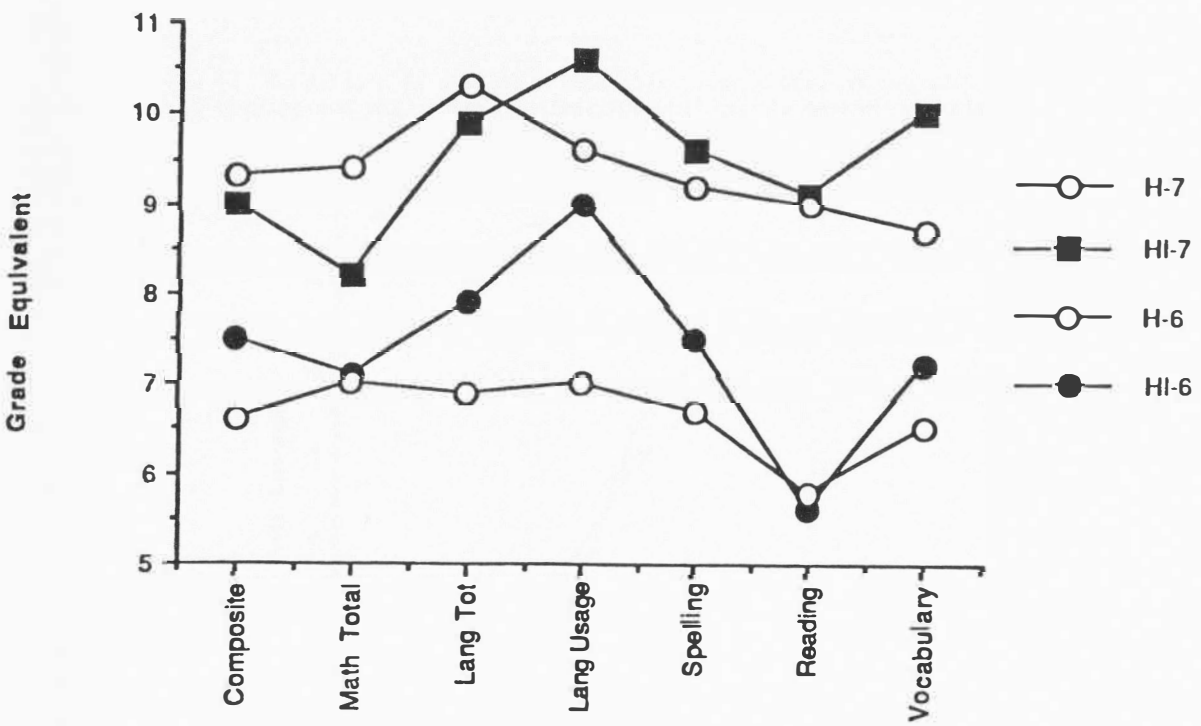


Figure 3. Comparison of the grade equivalent test scores on the ITBS for normal-hearing and mildly hearing-impaired children in sixth and seventh grade.

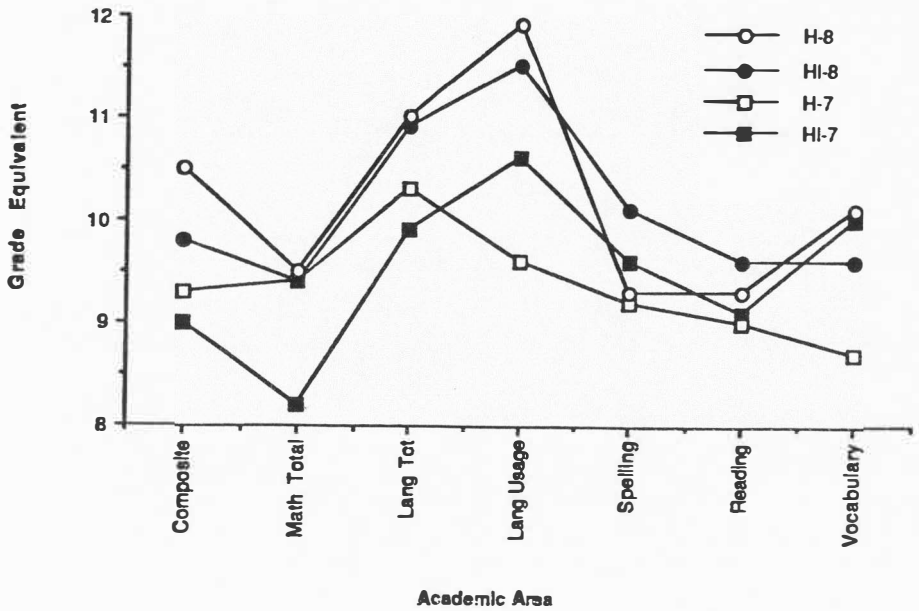


Figure 4. Comparison of the grade equivalent test scores on the ITBS for normal-hearing and mildly hearing-impaired children in seventh and eighth grade.

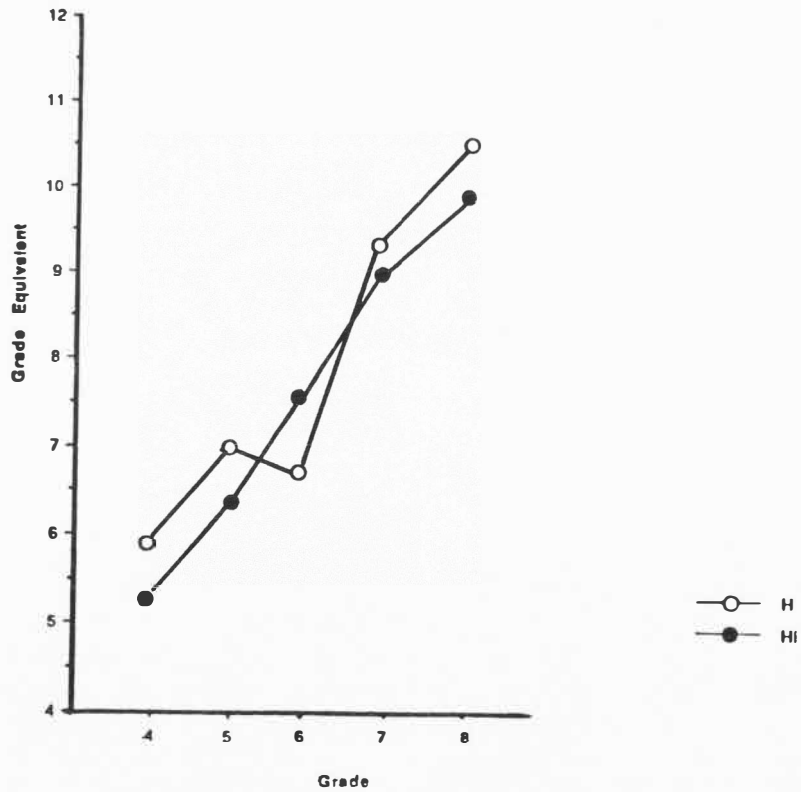


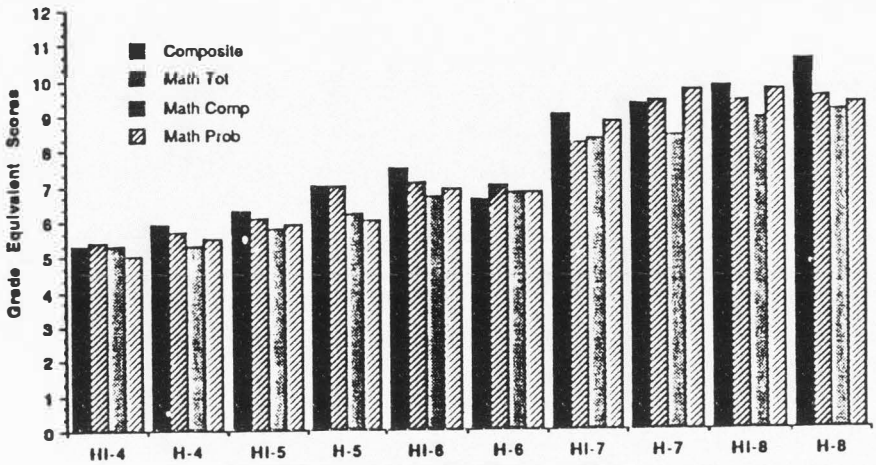
Figure 5. Comparison of mean composite grade equivalent scores for normal-hearing and hearing-impaired students on ITBS (4th to 8th grade).

Figures 1 through 4 also show that both the hearing-impaired and control subjects scored at or above grade level on almost all of the subtests of the ITBS. Both groups scored below grade level in reading in sixth grade while the hearing-impaired students scored below grade level on the reference subtest in sixth grade. It was also noted that the hearing-impaired students' scores were not noticeably different from the national norms.

Table 2 shows that the hearing-impaired group's growth was relatively linear ranging from .8 to 1.2 years for each academic year while the normal hearing group's increase was sporadic ranging from -.4 to 2.7 with minimal gains being observed during the sixth grade.

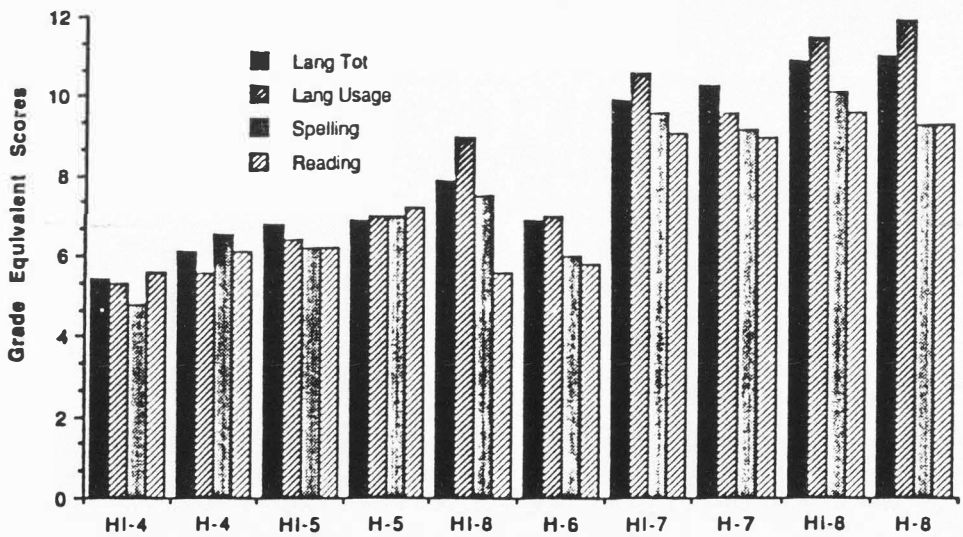
Table 2. Comparison of yearly gains from grade equivalent scores for normal-hearing and mildly sensorineural hearing-impaired children (4th to 8th grade).

	Vocabulary	Reading	Language Total	Math Concepts	Math Problem Solving	Math Total	Composite
HI 4-5	.9	.6	1.4	.7	.9	.7	1.0
H 4-5	1.2	1.1	.8	.4	.5	1.3	1.1
HI 5-6	1.8	1.4	1.1	1.4	1.0	1.0	1.2
H 5-6	-.6	-1.4	0	.4	.8	0	-.4
HI 6-7	2.8	3.5	2.0	.3	1.9	1.1	1.5
H 6-7	2.2	3.2	3.4	3.3	2.9	2.4	2.7
HI 7-8	-.4	.5	1.0	1.6	.9	1.2	.8
H 7-8	1.4	.3	.7	-.4	-.4	.1	1.2



Hearing-impaired students compared with hearing students in math achievement across grades.

Figure 6



Hearing-impaired students compared with hearing students in language achievement across grades.

Figure 7

DISCUSSION

The results of the investigation agree with the Blair et al., (1985) and Schweigert (1987) studies since the hearing-impaired students basically scored at a level consistently below their hearing counterparts up to fifth grade. However, by the time they are in eighth grade their scores are generally very similar. This study suggests that once the hearing-impaired have completed the fifth grade there do not appear to be any differences. It also suggests that permanent mild hearing loss in children during the early school years has a negative effect, especially through fourth and fifth grade, but that it may not increase as the child gets older. The data also revealed no significant difference between the hearing-impaired group and standardized norms for the test. These results are in agreement with Davis et al. (1986). The data in this research suggests that a mildly hearing-impaired student is at academic risk in the fourth and fifth grade, but after the fifth grade there do not appear to be any differences. However, because there were few subjects in the study and the students were enrolled in one school district in Utah, the results must be viewed with caution. This study may have reflected the data only from those students who were academically successful, because the criterion for subject inclusion may have been too rigid and/or a significant number of hearing-impaired may have dropped out by sixth grade. It is interesting to note that

the Blair et al., (1985) study had a larger experimental group than this study using the same school district. Approximately half of the hearing-impaired subjects had moved or dropped out of school during the interim between the Blair et al., study (1985) and this study.

Another trend that was observed was the interaction between the two groups. As previously mentioned, the hearing-impaired group's increase was linear while the normal-hearing group's increase was sporadic. Minimal growth was demonstrated during the sixth grade. Perhaps minimal gains were observed with the normal hearing subjects in sixth grade because peer pressure and attitude negatively impacted on the students' desire to show their actual skill level or attain the best scores possible.

Two factors that should be discussed are the change in the curriculum and the presentation of curriculum as the child advances through school. As Sarff, cited in Roeser and Downs (1981), mentions it might be the critical language skills required for successful performance in the third to fourth grade period and the change in the delivery of the curriculum at the beginning of fourth grade that accounts for the hearing-impaired child's deficiencies through fifth grade. Initially, in the lower grades, much of the teacher's instructions and lessons are presented verbally while many of the workbooks contain illustrations and visual cues to facilitate independent work skills. Then in the fourth

grade, much of the visual illustrations and cues are removed, and the child is required to do more reading and abstract thinking. As the child begins to read, write and the teachers begin to use an auditory and visual approach to instruction in the upper elementary grades, the hearing-impaired students experience initial difficulty but might be able to compensate and eventually bridge the gap as the results of this study suggested they were able to do by eighth grade. Also the curriculum may not be truly linear as the child advances through upper elementary and middle school, since concepts previously taught are often reviewed in later grades. Perhaps the review and reduplication of materials taught from year to year may also enable the hearing-impaired subjects to bridge the gap.

A third factor may also be that itinerant help given in early years is enough to help the hearing-impaired child learn enough to reduce the differences as the child proceeds through eighth grade. Amplification may also be a factor that helps reduce the differences, however; it was interesting to note that four of the twelve students had worn amplification, but only two were using it at the time of this study. These findings suggesting children with mild hearing losses are less likely to use amplification, than those children with more severe hearing losses, are consistent with those reported by Shepard et al., (1981). The two students wearing hearing aids had pure tone averages of 45 dB HL in

the better ears and the scores on the ITBS were consistently among the lowest for either group.

IMPLICATIONS

The results of this study have implications that relate to the relationship between academic achievement and mild hearing-impairment. The data confirms that mildly hearing-impaired children are at academic risk through fifth grade. The data also suggest that hearing-impaired students should be compared with their hearing counterparts in the same school district since many of the differences this researcher observed in the fourth and fifth grades would not have been apparent using just standardized norms. Although the results of this study, with a small number of students in each group, suggest the effect on academic performance may not get progressivley worse over time, specialists serving the hearing-impaired population in the public schools need to monitor the children identified as having a mild hearing loss and determine their educational needs especially through sixth grade. If hearing-impaired students are entering into sixth grade and are still experiencing academic delays, they may need a more individualized educational program.

There are some variables not previously discussed in this study that limit the validity and the reliability of the investigation's results. The following are concerns of validity:

1) The Iowa Test of Basic Skills may not accurately reflect the results of very high and very low achievers when the raw scores are converted to standard scores and stanines to compare with national norms. This validy concern was somewhat offset since raw scores were obtained as well as grade equivalent scores for both groups.

2) The sex, age, socioeconomic and academic experience factors of the control group were attempted to be closely matched to those of the experimental group using teachers' judgments. The teachers' judgments could have affected the reliability and validity of identifying matched control subjects; however, further rigorous attempts to control these factors might have negatively reduced the number of participants in the control group and thus been detrimental to the study. Use of the school Hot Lunch Program records helped ensure that those students receiving financial assistance were not included in this study and, therefore, eliminated those who were having serious financial problems. There was also an attempt made to control these factors when comparing the experimental group to the control group, even though these variables were uncontrolled when comparing mildly hearing-impaired subjects to the national norms.

3) The sample size was certainly a validity concern since only 12 hearing-impaired children were examined.

The following are concerns of reliability:

1) Many school personnel were involved in the administration of the school achievement tests. However, Salvia and Ysseldyke (1985) report that the internal consistency reliabilities for major parts of the battery beyond the second grade exceed .87 for the ITBS. Equivalent-forms reliabilities range from .82 to .92 for all major skill areas.

2) Several personnel administered the hearing tests which might affect the reliability of the results. However, this investigation considered results from audiological testing performed either by a certified audiologist or testing conducted under the direct supervision of the audiologist.

3) There is a tendency for older children who have educational deficits to yield relatively lower scores than their peers on tests that measure school achievement or general knowledge than do younger students because the knowledge base for achievement tests for children increases as they grow older (Davis et al., 1986). This remained an uncontrolled

variable.

4) The TONI might not accurately reflect intellectual ability since the basis for all TONI items was problem solving. Support for the use of the TONI as a control for intellectual ability was derived from its high correlation with other proported measures of non-verbal potential. Brown, et al., (1982) reported that the TONI correlated to the Leiter International Performance Scale .89 and .83 for forms A and B, respectively when administered to deaf subjects.

These results indicate a need for further research, with a larger number of students in the elementary grades and with subjects in secondary school. There is also a need to include mildly hearing-impaired students from many school districts as well as several states. It would also be advantageous to collect similar data for a much longer period of time, correlate Grade Point Averages (GPA's) with standardized tests and look at sex differences as well as learning styles within the hearing-impaired population.

In summary, this investigation suggests that a mild hearing loss affects academic achievement through the fifth grade. The study also suggests that youngsters with mild hearing losses may be able to compete well with their hearing peers by the time they are in seventh and eighth grade. There is also ample evidence to suggest that youngsters with

mild losses should be monitored during the school years to be certain they are able to make the academic progress necessary to compete with their hearing peers.

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APPENDIX A

LETTER TO SCHOOL DISTRICT TO REQUEST PERMISSION

APPENDIX A

LETTER TO SCHOOL DISTRICT TO REQUEST PERMISSION

To whom it may concern:

I am currently employed by your school district as a speech language pathologist, and am persuing an Educational Specialist degree in the field of Communicative Disorders at Utah State University. I am interested in conducting a study on the effects of mild hearing loss on academic achievement amongst upper elementary school age children. I need to know the possibility of obtaining the information and successfully completing this study in your school district.

This study would involve a group of children enrolled in 5th through 8th grade with a mild hearing loss (20 - 45 dB), that have been previously identified, and a comparison of these children to a normal-hearing group of the same size. The comparison between the two groups would consist of their academic performance and the amount of gains made over one year. A study conducted in your school district five years ago was published in the February 1985 edition of the Volta Review. This study suggested that the mildly hearing-impaired children experience academic delay that may become progressively more severe as the children progress through school. My study would serve as a follow up study.

The information required for the study would need to come from school records related to achievement and intellectual tests as well as hearing screening results. Also, permission to administer a screening test of nonverbal ability individually, as well as hearing screening tests in some instances for those normal-hearing children not in a screening grade would be needed.

A response at your earliest convenience regarding your district's decision to support or reject this proposed study would be greatly appreciated.

Sincerely,

Donna Massine

APPENDIX B

LETTER GRANTING PERMISSION FROM JORDAN SCHOOL DISTRICT

APPENDIX B

LETTER GRANTING PERMISSION
FROM JORDAN SCHOOL DISTRICT

Board of Education

Jordan School District

Dr. Raymond W. Whittenburg — Superintendent of Schools
9361 SOUTH 300 EAST • SANDY, UTAH 84070
PH. (801) 565-7100

Marlin A. Fairbourn
Assistant Superintendent

R. Gene Ball, Ph.D.
Director

South Area

January 19, 1988

Ms. Donna Massine
825 East Dry Creek Road
Sandy, Utah 84070

Dear Donna:

Your request to conduct a research project in Jordan School District to determine the effects of mild hearing loss on academic performance among elementary school age children has been approved by the district research review committee.

In order for you to gather the data you need, it will be necessary for you to obtain parent permission to conduct audiological testing on the control group students. It is assumed that you will not report your findings by referring to or identifying individual students. If your findings are reported as group data, you may wish to work with Mr. Ernest Bianchi at the district office regarding achievement test scores. If your findings will be reported by individual students, obviously parent permission will be needed.

In that you have identified the students you wish to include in your study, it will be necessary for you to contact each principal involved to explain your research and to obtain their approval.

We desire that you are successful in this endeavor and if we can be of assistance or answer questions, please contact us.

Sincerely,

R. Gene Ball, Chairman
Research Review Committee

bk

APPENDIX C

LETTER REQUESTING PERMISSION FROM PARENTS

APPENDIX C

LETTER REQUESTING PERMISSION
FROM PARENTS

_____, 1988

Dear Parent,

Re:_____

Dr. James Blair and I of the Communicative Disorders department at Utah State University are conducting a study in conjunction with Jordan School District.

Permission has been granted by the District for Dr. Blair and myself to examine the achievement scores and administer a test of nonverbal ability to a group of mildly hearing impaired children and a randomly selected group of normal hearing children. Your permission is being requested to examine your child's recent achievement scores, hearing screening results and administer a test of nonverbal ability. All names and scores will be kept anonymous and administration of the nonverbal screening test will be approximately 10 minutes, per student. Should your child not have had his/her hearing tested in the last year, permission to screen your child's hearing will be needed as well.

If you have any questions or would like additional information, please contact Donna Massine at 565-7458.

Please return this form in the enclosed envelope at your earliest convenience. Thank you for your assistance to this very important project.

Sincerely,

Donna Massine

James C. Blair, Ph. D
Associate Professor

_____ I do grant my permission to have my child participate in this study which involves examination of achievement scores and administration of a nonverbal and/or hearing screening test.

____ I do not give permission to have my child participate in this study.

Pupil's Name _____ School _____

Date _____

_____
Signature--Parent or Guardian

Number of years _____ attended school in Jordan District.

APPENDIX D

LETTER REQUESTING PERMISSION FROM PRINCIPALS

APPENDIX D

LETTER REQUESTING PERMISSION FROM PRINCIPALS

_____, 1988

Dear Principal,

Re: Approval for Academic Performance Study at your school

R. Gene Ball, Chairman of the Research Committee, recently informed me that the district had approved my study on the effects of mild hearing loss on academic performance among upper elementary school age children. He suggested that I contact you, since _____ of the 22 mildly hearing-impaired children attend your school, to inform you about the study and hopefully obtain your approval.

This study would serve as a follow up study, to one that was conducted in your school six years ago and subsequently published in the February 1985 edition of the Volta Review. This study would involve a group of children currently enrolled in 5th through 8th grade with a mild hearing loss and a comparison between these children to a normal-hearing group of the same size. The comparison between the two groups would consist of their academic performance and the amount of gains made over one year.

The information required for this study would need to come from the school records, related to achievement (ITBS) and intellectual tests. After obtaining permission from you and then the parents of the hearing-impaired student, I would need to briefly visit with his/her classroom teacher to obtain a list of normal-heairng children, in order that a second child be randomly selected as a control (pending parent permission). In the event that current audiological and intellectual results would not be available for either student, I would need to obtain that information by administering an audiological assessment (requiring 5 minutes) and/or Test of Nonverbal Intelligence (10-15 minutes per student).

I will be contacting you via phone, in the near future, regarding your decision to support or reject this study. I would be glad to answer any questions you might have at this time.

Sincerely,

Donna Massine M.S. CCC-A/Sp
Majestic Elementary/Mt. Jordan Middle Schools

APPENDIX E

PURE TONE AUDIOLOGICAL TEST RESULTS FOR HEARING-IMPAIRED CHILDREN IN THE STUDY

APPENDIX E

PURE TONE AUDIOLOGICAL TEST RESULTS FOR HEARING-IMPAIRED CHILDREN IN THE STUDY

JORDAN SCHOOL DISTRICT

SUBJ.#	GRADE	EAR	500	1000	2000	4000	6000	8000	PTA
1	5	R	30	30	40	60			33
		L	30	30	50	50			37
2	5	R	25	35	20	5	10	20	27
		L	45	35	30	5	20	20	37
3	5	R	45	45	45	45	30		45*
		L	45	45	50	50	35		47
4	5	R	30	35	45	50	60		37
		L	30	40	45	60	60		35
5	6	R	25	30	20	40	40		25
		L	25	20	20	40	45		22
6	6	R	25	30	30	20		15	30
		L	25	30	30	15		20	30
7	6	R	35	45	55	55		65	45*
		L	45	55	60	65		75	52
8	6	R	35	55	55	55	65		49
		L	30	55	50	55	65		45
9	8	R	20	30	20	10	20		23
		L	20	35	30	15	20		28
10	8	R	15	35	20	0	10	0	24
		L	10	35	35	0	10	0	27
11	8	R	25	35	30	35	50		30
		L	20	45	40	45	55		35
12	8	R	35	35	40	45	40	50	30
		L	35	40	45	50	50	30	40

* Denotes Hearing aid users

APPENDIX F

JORDAN SCHOOL DISTRICT TESTING AND EVALUATION FORM THIRD THROUGH EIGHTH GRADE

APPENDIX F

JORDAN SCHOOL DISTRICT TESTING AND EVALUATION FORM FOR THIRD THROUGH EIGHTH GRADE

SUBJECT: Iowa Test of Basic Skills

GRADES: 3 through 8

The sections of the test battery are listed vertically down the page. Key to abbreviations used:

V	-Vocabulary
R	-Reading Comprehension
L1	-Language: Spelling
L2	-Language: Capitalization
L3	-Languge: Punctuation
L4	-Language: Usage
TL	-Total Language
W1	-Work Study Skills: Visual Materials
W2	-Work Study Skills: Reference Materials
TW	-Total Work Study Skills
M1	-Math Concepts
M2	-Math Problem Solving
M3	-Math Computation
TM	-Total Math

Listed horizontally across the top of the page are the types of scores provided. Key to interpretation is as follows.

RS	-Raw Score: Total number of correct answers.
GE	-Grade Equivalent: A number indicating the grade and month of performance. The last number represents the month and the preceding number(s) denotes the grade.
N%	-A percentile figure indicating how that students'score compares with standardized national norms. Fifty percent of all students fall between the 25th and 75th percentiles.

APPENDIX G

ACHIEVEMENT SCORES FROM THE IOWA TEST OF BASIC SKILLS FOR THE HEARING-IMPAIRED SUBJECTS

APPENDIX G

ACHIEVEMENT SCORES FROM THE IOWA TEST OF BASIC SKILLS FOR THE HEARING-IMPAIRED SUBJECTS

Hearing Impaired Subject	Grade	Year of Score	Type of Score							
1	5	87		V	R	L1	L2	L3	L4	TL
			RS	29	25	22	18	10	16	*
			GE	60	59	48	58	39	49	49
			N%	55	51	31	49	17	35	32
				W1	W2	TW	M1	M2	M3	TM	C
			RS	20	25	*	13	18	24	*	*
			GE	58	53	56	61	59	54	58	56
			N%	50	39	46	56	52	34	50	45
		86		V	R	L1	L2	L3	L4	TL
			RS	25	39	22	19	10	21	*
			GE	46	63	42	45	35	60	46
			N%	46	81	35	41	22	69	44
				W1	W2	TW	M1	M2	M3	TM	C
			RS	26	33	*	31	22	31	*	*
			GE	47	55	51	63	66	65	65	54
			N%	48	68	58	83	91	97	93	65
2	5	87		V	R	L1	L2	L3	L4	TL
			RS	25	42	27	20	17	16	*
			GE	60	73	57	66	58	51	58
			N%	55	78	48	64	50	38	50
				W1	W2	TW	M1	M2	M3	TM	C
			RS	28	35	*	18	13	22	*	*
			GE	64	66	65	53	51	50	51	61
			N%	63	67	66	36	33	23	31	57
		86		V	R	L1	L2	L3	L4	TL
			RS	25	26	24	22	18	12	*
			GE	46	46	46	57	50	36	47
			N%	46	45	44	68	54	29	46
				W1	W2	TW	M1	M2	M3	TM	C
			RS	27	32	*	15	14	22	*	*
			GE	54	55	55	40	47	43	43	47
			N%	64	68	68	26	47	28	34	46

* Scores not available

Hearing Impaired Subject	Grade	Year of Score	Type of Score								
3	5	87		V	R	L1	L2	L3	L4	TL	
			RS	7	24	20	21	23	11	*	
			GE	24	50	46	69	75	39	57	
			N%	2	33	27	69	79	20	48	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	24	20	*	22	12	24	*	*
			GE	56	46	51	61	49	52	54	47
			N%	45	24	35	56	29	28	39	25
		86		V	R	L1	L2	L3	L4	TL	
			RS	8	29	24	24	23	15	*	
			GE	30	52	36	68	58	51	53	
			N%	14	60	23	84	69	55	60	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	23	26	*	23	11	22	*	*
			GE	35	47	41	54	31	43	43	44
			N%	22	48	33	64	12	28	34	40
4	5	87		V	R	L1	L2	L3	L4	TL	
			RS	34	47	37	20	27	24	*	
			GE	69	82	82	66	88	76	78	
			N%	74	91	87	64	93	76	85	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	38	42	*	35	24	42	*	*
			GE	86	81	84	91	76	71	81	79
			N%	96	92	96	98	89	97	96	91
		86		V	R	L1	L2	L3	L4	TL	
			RS	32	37	32	26	26	23	*	
			GE	58	61	66	72	75	66	70	
			N%	75	78	82	89	92	78	90	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	36	41	*	29	19	39	*	*
			GE	75	73	74	72	55	61	63	65
			N%	96	96	98	94	69	91	90	88

* Scores not available

Hearing Impaired Subject	Grade	Year of Score	Type of Score								
5	6	87		V	R	L1	L2	L3	L4	TL	
			RS	29	33	17	16	18	21	*	
			GE	65	67	49	64	67	72	63	
			N%	45	46	20	43	48	56	41	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	13	30	*	19	9	23	*	*
			GE	47	69	58	63	51	60	58	62
			N%	16	51	30	38	18	27	26	38
		86		V	R	L1	L2	L3	L4	TL	
			RS	21	22	16	24	15	23	*	
			GE	51	47	43	79	53	72	62	
			N%	35	27	22	82	40	70	57	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	25	25	*	19	12	18	*	*
			GE	58	53	56	55	49	46	59	53
			N%	50	39	46	41	29	14	28	39
6	6	87		V	R	L1	L2	L3	L4	TL	
			RS	40	52	40	30	27	30	*	
			GE	92	100	97	114	96	110	104	
			N%	90	96	90	99	90	99	98	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	28	36	*	31	25	31	*	*
			GE	86	80	83	86	86	70	81	92
			N%	82	72	79	82	86	55	80	93
		86		V	R	L1	L2	L3	L4	TL	
			RS	37	48	37	28	29	28	*	
			GE	78	84	82	90	95	89	89	
			N%	88	92	87	94	98	92	96	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	36	39	*	30	24	36	*	*
			GE	82	74	78	77	76	66	73	80
			N%	92	82	89	86	89	76	86	93

* Scores not available

Hearing Impaired Subject	Grade	Year of Score	Type of Score								
7	6	87		V	R	L1	L2	L3	L4	TL	
			RS	27	29	32	14	19	20	*	
			GE	63	62	75	58	71	69	66	
			N%	41	38	62	34	54	51	49	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	18	31	*	30	17	18	*	*
			GE	65	70	68	84	69	54	69	66
			N%	44	53	52	79	52	16	54	46
		86		V	R	L1	L2	L3	L4	TL	
			RS	13	27	33	13	14	18	*	
			GE	39	53	71	43	50	57	55	
			N%	14	39	73	21	35	48	44	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	25	19	*	15	13	15	*	*
			GE	58	45	52	47	51	43	47	49
			N%	50	22	37	22	33	10	20	30
8	6	87		V	R	L1	L2	L3	L4	TL	
			RS	32	46	34	19	21	28	*	
			GE	70	85	80	74	77	99	83	
			N%	54	81	70	59	63	90	75	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	25	33	*	28	17	41	*	*
			GE	81	74	78	80	69	83	77	79
			N%	74	61	71	72	52	90	72	73
		86		V	R	L1	L2	L3	L4	TL	
			RS	26	38	28	21	20	23	*	
			GE	57	73	66	66	66	76	66	
			N%	48	81	69	62	66	78	70	
				93	W2	TW	M1	M2	M3	TM	C
			RS	27	37	*	26	17	30	*	*
			GE	64	68	69	60	62	59	70	75
			N%	64	83	77	54	61	54	57	68

* Scores not available

Hearing Impaired Subject	Grade	Year of Score	Type of Score								
9	8	87		V	R	L1	L2	L3	L4	TL	
			RS	33	27	37	25	26	25	*	
			GE	96	80	107	118	112	113	113	
			N%	65	39	79	87	84	81	87	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	28	37	*	32	24	32	*	*
			GE	98	103	101	105	106	95	102	98
			N%	68	75	75	79	84	72	82	70
		86		V	R	L1	L2	L3	L4	TL	
			RS	36	32	38	21	26	26	*	
			GE	93	78	101	92	103	111	102	
			N%	76	50	83	66	84	90	85	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	29	33	*	33	27	32	*	*
			GE	94	87	91	100	106	86	97	92
			N%	77	65	74	86	94	72	88	76
10	8	87		V	R	L1	L2	L3	L4	TL	
			RS	41	49	41	25	30	29	*	
			GE	116	117	120	118	127	127	123	
			N%	94	94	93	87	97	96	97	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	49	46	*	36	23	36	*	*
			GE	133	129	131	119	104	102	107	119
			N%	99	99	99	90	81	91	90	98
		86		V	R	L1	L2	L3	L4	TL	
			RS	38	57	37	29	28	27	*	
			GE	99	112	104	119	110	108	110	
			N%	85	95	86	96	91	87	93	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	40	42	*	32	20	40	*	*
			GE	109	108	109	98	85	94	92	104
			N%	95	94	96	83	63	91	80	93

* Scores not available

Hearing Impaired Subject	Grade	Year of Score	Type of Score								
11	8	87		V	R	L1	L2	L3	L4	TL	
			RS	34	42	39	20	22	23	*	
			GE	99	104	114	99	99	105	104	
			N%	70	79	87	63	66	71	75	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	21	28	*	*	*	32	*	*
			GE	84	83	84	*	*	95	*	*
			N%	44	42	45	*	*	72	*	*
		86		V	R	L1	L2	L3	L4	TL	
			RS	28	86	41	21	25	27	*	
			GE	74	84	111	92	100	108	103	
			N%	44	60	92	68	81	87	86	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	22	35	*	24	17	32	*	*
			GE	82	69	76	84	79	86	83	84
			N%	56	36	48	61	52	72	61	61
12	8	87		V	R	L1	L2	L3	L4	TL	
			RS	34	43	19	21	18	25	*	
			GE	99	105	66	103	85	113	92	
			N%	70	81	22	68	45	81	57	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	26	18	*	19	21	17	*	*
			GE	82	59	71	79	99	73	84	90
			N%	41	12	25	34	72	22	45	55
		86		V	R	L1	L2	L3	L4	TL	
			RS	41	28	21	14	16	28	*	
			GE	109	72	64	66	70	100	75	
			N%	94	40	31	34	38	78	45	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	16	16	*	6	15	14	*	*
			GE	65	50	58	45	74	59	59	75
			N%	29	10	18	3	42	13	12	45

* Scores not available

APPENDIX H

ACHIEVEMENT SCORES FROM THE IOWA TEST OF BASIC SKILLS FOR THE NORMAL-HEAING CONTROL SUBJECTS

APPENDIX H

ACHIEVEMENT SCORES FROM THE IOWA TEST OF BASIC SKILLS FOR THE NORMAL HEARING CONTROL SUBJECTS

Normal Hearing Subject	Grade	Year of Score	Type of Score							
1	5	87		V	R	L1	L2	L3	L4	TL
			RS	38	31	38	21	21	27	*
			GE	82	91	85	69	69	86	77
			N%	92	98	90	69	69	89	93
				W1	W2	TW	M1	M2	M3	TM	C
			RS	43	43	*	33	23	40	*	*
			GE	99	85	92	73	73	77	84	84
			N%	99	96	99	94	84	91	92	97
		86		V	R	L1	L2	L3	L4	TL	
			RS	34	43	32	25	22	26	*	
			GE	64	72	66	68	61	75	68	
			N%	86	92	82	84	75	90	87	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	35	38	*	31	23	36	*	*
			GE	72	66	69	80	70	56	69	68
			N%	94	88	93	99	95	81	97	92
2	5	87		V	R	L1	L2	L3	L4	TL	
			RS	29	37	28	22	20	*	*	
			GE	60	66	59	73	66	*	*	
			N%	55	64	51	74	64	*	*	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	28	30	*	24	18	37	*	*
			GE	64	59	62	65	61	68	65	*
			N%	63	51	60	65	58	82	68	*
		86		V	R	L1	L2	L3	L4	TL	
			RS	28	32	30	24	19	20	*	
			GE	50	54	60	65	53	57	59	
			N%	56	64	73	80	60	65	72	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	21	31	*	28	19	31	*	*
			GE	45	53	49	69	55	50	58	54
			N%	43	63	54	91	69	59	80	65

* Scores not available

Normal Hearing Subject	Grade	Year of Score	Type of Score								
3	5	87		V	R	L1	L2	L3	L4	TL	
			RS	38	46	34	26	27	29	*	
			GE	82	80	74	85	88	93	85	
			N%	92	89	77	89	93	96	93	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	33	43	*	36	25	41	*	*
			GE	75	85	80	97	80	75	84	82
			N%	83	96	92	99	93	94	98	95
		86		V	R	L1	L2	L3	L4	TL	
			RS	36	44	36	24	20	47	*	
			GE	76	75	84	65	61	48	65	
			N%	97	95	99	80	75	49	83	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	28	38	*	27	22	41	*	*
			GE	56	66	61	66	66	65	66	69
			N%	69	88	81	88	91	97	94	94
4	5	87		V	R	L1	L2	L3	L4	TL	
			RS	30	26	30	17	10	16	*	
			GE	61	52	63	54	39	51	52	
			N%	57	37	59	41	17	38	38	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	21	22	*	12	8	17	*	*
			GE	50	49	50	42	38	45	42	51
			N%	33	30	33	12	12	12	9	35
		86		V	R	L1	L2	L3	L4	TL	
			RS	27	22	26	20	23	16	*	
			GE	49	41	51	50	65	45	53	
			N%	54	33	56	53	81	44	60	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	24	29	*	14	6	20	*	*
			GE	49	50	50	39	27	41	36	36
			N%	53	55	56	24	6	22	13	45

* Scores not available

Normal Hearing Subject	Grade	Year of Score	Type of Score								
5	6	87		V	R	L1	L2	L3	L4	TL	
			RS	21	29	26	16	20	23	*	
			GE	56	50	64	64	74	80	71	
			N%	29	19	43	43	59	66	54	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	23	26	*	24	19	29	*	*
			GE	77	65	71	73	72	68	71	64
			N%	67	44	58	59	59	49	59	42
		86		V	R	L1	L2	L3	L4	TL	
			RS	24	20	24	21	20	12	*	
			GE	54	45	52	69	66	41	57	
			N%	41	23	38	69	64	23	48	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	27	29	*	27	17	33	*	*
			GE	62	57	60	71	59	62	64	56
			N%	58	47	55	77	52	63	66	45
6	6	87		V	R	L1	L2	L3	L4	TL	
			RS	18	17	15	13	15	12	*	
			GE	52	45	45	55	58	46	51	
			N%	22	13	16	29	33	19	21	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	14	14	*	18	10	25	*	*
			GE	51	41	46	61	54	63	59	51
			N%	20	8	10	33	22	34	29	17
		86		V	R	L1	L2	L3	L4	TL	
			RS	25	10	13	11	13	11	*	
			GE	55	27	35	43	48	39	41	
			N%	43	2	11	21	31	20	17	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	17	16	*	19	12	12	*	*
			GE	42	40	41	55	49	38	47	42
			N%	19	14	14	41	29	4	20	14

* Scores not available

Normal Hearing Subject	Grade	Year of Score	Type of Score								
7	6	87		V	R	L1	L2	L3	L4	TL	
			RS	34	34	32	16	16	22	*	
			GE	73	68	75	64	61	76	69	
			N%	60	60	62	46	38	61	51	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	19	26	*	27	18	26	*	*
			GE	68	61	65	78	70	67	72	69
			N%	50	38	45	69	54	46	61	52
		86		V	R	L1	L2	L3	L4	TL	
			RS	13	27	33	13	14	18	*	
			GE	63	60	61	51	53	65	58	
			N%	61	53	55	36	40	60	50	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	25	19	*	15	13	15	*	*
			GE	66	60	63	75	67	60	67	62
			N%	67	54	62	83	72	56	73	59
8	6	87		V	R	L1	L2	L3	L4	TL	
			RS	37	41	36	25	23	23	*	
			GE	80	77	86	92	83	80	85	
			N%	74	67	79	83	72	66	78	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	29	39	*	26	22	35	*	*
			GE	88	87	88	77	78	76	77	81
			N%	85	83	87	67	72	74	72	77
		86		V	R	L1	L2	L3	L4	TL	
			RS	36	39	29	22	15	20	*	
			GE	74	68	61	78	63	62	62	
			N%	83	70	55	74	40	55	57	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	27	38	*	24	16	42	*	*
			GE	62	72	67	65	57	77	66	67
			N%	58	78	70	65	47	97	71	70

* Scores not available

Normal Hearing Subject	Grade	Year of Score	Type of Score							
9	8	87		V	R	L1	L2	L3	L4	TL
			RS	34	33	26	12	20	22	*
			GE	99	90	80	62	92	101	84
			N%	70	55	39	20	55	66	45
				W1	W2	TW	M1	M2	M3	TM	C
			RS	17	30	*	20	13	14	*	*
			GE	73	88	81	81	76	65	74	86
			N%	29	49	40	38	37	12	21	48
		86		V	R	L1	L2	L3	L4	TL	
			RS	27	37	30	19	21	18	*	
			GE	75	85	80	85	86	73	81	
			N%	46	62	53	59	61	44	54	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	24	36	*	19	23	21	*	*
			GE	86	93	90	74	93	72	80	82
			N%	63	74	72	42	78	36	54	58
10	8	87		V	R	L1	L2	L3	L4	TL	
			RS	20	20	23	*	17	*	*	
			GE	71	66	73	*	82	*	*	
			N%	24	20	30	*	40	*	*	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	*	21	*	23	12	28	*	*
			GE	*	67	*	85	73	91	84	*
			N%	*	20	*	50	27	60	45	*
		86		V	R	L1	L2	L3	L4	TL	
			RS	24	25	23	31	21	22	*	
			GE	71	67	67	128	86	88	92	
			N%	38	32	35	99	61	63	71	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	24	25	*	30	20	25	*	*
			GE	101	69	85	95	85	78	86	80
			N%	87	36	63	79	63	50	68	54

* Scores not available

Normal Hearing Subject	Grade	Year of Score	Type of Score								
11	8	87		V	R	L1	L2	L3	L4	TL	
			RS	39	35	38	29	29	29	*	
			GE	112	93	110	130	124	127	123	
			N%	88	60	83	98	96	96	97	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	29	36	*	34	23	25	*	*
			GE	100	101	101	109	104	87	100	106
			N%	72	72	75	85	81	50	78	85
		86		V	R	L1	L2	L3	L4	TL	
			RS	36	42	43	31	28	26	*	
			GE	93	93	122	120	110	111	118	
			N%	76	75	99	99	91	90	98	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	30	33	*	38	25	36	*	*
			GE	95	87	91	115	99	89	101	99
			N%	78	65	74	98	87	80	93	87
12	8	87		V	R	L1	L2	L3	L4	TL	
			RS	42	52	38	27	30	29	*	
			GE	122	124	110	124	127	127	122	
			N%	97	97	83	94	97	96	96	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	49	42	*	41	28	45	*	*
			GE	133	114	124	130	119	121	123	123
			N%	99	91	99	99	97	99	99	99
		86		V	R	L1	L2	L3	L4	TL	
			RS	41	52	37	28	29	28	*	
			GE	109	114	98	116	113	111	110	
			N%	94	96	79	94	94	90	93	
				W1	W2	TW	M1	M2	M3	TM	C
			RS	38	42	*	40	28	42	*	*
			GE	106	108	107	122	112	98	111	110
			N%	93	94	94	99	97	96	99	97

* Scores not available

APPENDIX I

COMPARISON OF FOURTH GRADE IOWA TEST OF BASIC SKILLS SCORES BETWEEN BLAIR ET AL. 1985 AND CURRENT STUDY

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COMPARISON OF FOURTH GRADE IOWA TEST OF BASIC SKILLS SCORES BETWEEN BLAIR ET AL. 1985 AND CURRENT STUDY

Blair et al. (1985)	Vocabulary	Reading	Math Concepts	Math Problem Solving	Math Total	Composite
Hearing Impaired	4.5	4.5	4.3	4.2	4.3	4.5
Normal Hearing	5.9	6.3	5.3	5.4	5.4	6.5
Current Study	**Vocabulary**	**Reading**	**Math Concepts**	**Math Problem Solving**	**Math Total**	**Composite**
Hearing Impaired	4.5	5.6	5.7	5.0	5.4	5.3
Normal Hearing	5.9	6.1	6.4	5.5	5.7	5.9