DOCUMENT RESUME

ED 082 436 EC 060 223

AUTHOR Monsees, Edna K.
TITLE Predicting Language Performance in Hearing Impaired Children.
INSTITUTION Children's Hearing and Speech Center, Washington, D.C.; Prince George's County Board of Education, Upper Marlboro, Md.
PUB DATE [71]
NOTE 111p.

EDRS PRICE MF-$0.65 HC-$6.58
DESCRIPTORS *Aurally Handicapped; Correlation; Early Childhood; *Exceptional Child Research; Language Tests; Prediction; *Rating Scales; *Rubella

ABSTRACT

The 2-year study evaluated the language performance of 69 hearing impaired, preschool children born following the rubella epidemic of the early 1960's in order to develop an instrument for objectively assessing language achievement and a predictive index of language achievement. Two language rating scales were developed which were tied to the specific curriculum used in the program and measured only oral language reception and expression. The scales were found to be valid instruments for the particular group of hearing impaired Ss assessed. Major factors found to be significant predictors of language performance were home environment (particularly the mother-child relationship), creativity, degree of hearing impairment, prematurity, and coordination of the oral speech mechanism. (Appended are checklists and rating scales, study tables, the language rating scales, and sources of tests used in the study). (DB)

ED 082456

Prince George's County Public Schools

Upper Marlboro, Maryland

Predicting Language Performance in Hearing Impaired Children

by Edna K. Monsees, Ph. D.

Children's Hearing and Speech Center
Children's Hospital of
The District of Columbia
Washington, D.C.

Office of the Superintendent of Schools

Speech and Hearing Program

CS 060223

FILMED FROM BEST AVAILABLE COPY

ED 082436

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRO
DUCED EXACTLY AS RECEIVED FROM
THE PERSON OR ORGANIZATION ORIGIN
ATING IT. POINTS OF VIEW OR OPINIONS
STATED DO NOT NECESSARILY REPRE
SENT OFFICIAL NATIONAL INSTITUTE OF
EDUCATION POSITION OR POLICY

PREDICTING LANGUAGE PERFORMANCE

IN

HEARING IMPAIRED CHILDREN

Edna K. Monsees, Ph.D.

Prince George's County
Public Schools
Upper Marlboro
Maryland

Children's Hearing and
Speech Center
Children's Hospital of D.C.
Washington, D.C.

This study was supported from funds pursuant to a grant under Part B of the Education of Handicapped Act from the U.S. Office of Education, Department of Health, Education, and Welfare, PL 91-230 Maryland Project Number 10-73-HI.

FOREWORD

This study was conducted by the staff of the Title VI, Elementary and Secondary Education Act Project, 1968-1971, under the direction of Dr. Edna K. Monsees, who at the time was also associate director of the Children's Hearing and Speech Center. It represents an effort to explore the nature of the differences in language-learning abilities manifested in a group of post-rubella, hearing impaired children. The study sought to delineate which of the many variables affecting language performance are the most important as predictors of success or failure.

Dr. Monsees and her staff have made an excellent beginning in this important area of exploration and inquiry. The study points up some of the urgent research needs as well as some of the educational/rehabilitative applications of the current research findings.

In my opinion, this study is a milestone on the way to understanding language behavior of hearing impaired children.

Gilbert R. Herer, Ph.D., Director
Children's Hearing and Speech Center
Children's Hospital of the District of Columbia
Washington, D.C. 20001

ACKNOWLEDGMENTS

This study was made possible by the enthusiasm and hard work of the many members of Title VI project staff.

Dr. Robert M. Dowling helped to plan the initial study, assisted in the review and evaluation of the findings of the 1969 Study, supervised the doctoral students who administered the tests, and developed the Creativity Rating Scale used in the 1970 Study.

Mrs. Beth Noujaim and Mrs. Cora Fischer helped materially in the planning and testing, and in the review of test results.

Mr. Burton Gray gave major guidance and time in developing the research design and statistical analysis of the data.

Dr. Victor Small also helped, particularly in the interpretation of the findings as to intelligence and creativity.

The efforts of Miss C. Elizabeth Rieg, Supervisor of Special Education for the Prince George's County Public Schools, in working out the details and sponsoring of this unusually fine cooperative effort between public schools and the Children's Hearing and Speech Center, a private nonprofit health-related agency, were of major importance. The cooperation of Dr. Ruth P. Daugherty, Supervisor of Speech and Hearing Programs in the Prince George's Public Schools, in continuing the project has also been essential to its completion.

Dr. Gilbert R. Herer, in addition to cosponsoring the project and the study, supervised the audiological assessments, and gave invaluable guidance to the entire undertaking.

As director of the Title VI project, I learned a great deal from all of these devoted co-workers, and take this occasion to express my thanks and to acknowledge their contributions to this study.

Edna K. Monsees, Ph.D.*

*Dr. Monsees is now Supervisor of Auditory Services, Montgomery County Public Schools, Rockville, Maryland.

TABLE OF CONTENTS

INTRODUCTION

Birthdates between January 1, 1964, and March 31, 1965, are within the critical period following the rubella epidemic on the East Coast. By the first of 1965, these post-rubella children began to appear in unprecedented numbers in the hearing and speech clinics. And by November 1965, when the oldest of this group of children were already almost two years of age, the existing centers that were physically and professionally equipped to deal with problems of deafness in children were inundated.

In 1965, the Children's Hearing and Speech Center expanded its program to the limits of its capacity by providing parent counseling and small class sessions two or three half-days per week for the children. The service provided to parents and children at that time was admittedly inadequate, since one teacher and an aide had responsibility for as many as 40 to 50 children. The children were seen for half-day periods in two morning groups or two afternoon groups. The alternative to this situation was no help at all for either parents or children. At that time parents were being turned away from many centers and no space was available at the clinical centers to which they were referred.

It is to the credit of the Board of Trustees of the Center that it responded promptly to the appeal of the parents of these post-rubella epidemic children. The Board voted to obtain the funds to add a third floor to its building which would then house additional facilites for preschool and primary age hearing impaired children. In January 1968 the new and enlarged facilities at the Center were ready, enabling the Center to schedule half-day classes five days per week, and by September 1968 most of the children age 4 and over were in full-time classes.

Since 1968, through a Title VI Elementary and Secondary Education Act grant, the Center has been engaged in a cooperative project with the public schools of Prince George's County, Maryland. With the impetus provided in this project, the County was able to establish its first preschool classes for hearing impaired children in 1968.

The director of the Title VI project, as early as 1958, had called attention to the problem of hearing impaired children who fail to learn to speechread and to speak when taught by a traditional "natural language" approach (Monsees, 1958). Early in this program it became evident that some of the children were developing the communicative skills of speechreading and speech at a satisfactory rate, while others were not. The presence of so large a group of hearing impaired children, homogeneous as to age and probable etiology, and being instructed under the same general philosophy and supervision, provided an excellent opportunity for meaningful research. Therefore, the present study was designed to inquire into the individual differences in language achievement in the group, and into the factors that might be related to these differences in language-learning ability among deaf children.

This study was initiated in the spring of 1969, and the testing and analyses done at that time served as the pilot and first phase of this research. Test instruments and procedures were refined and improved, and a second testing program was undertaken in the spring of 1970. These two phases of the study are reported in this monograph as the 1969 Study and the 1970 Study.

The final section of this report presents some of the educational implications and applications of the research findings. The need for additional research is also discussed.

BACKGROUND AND OBJECTIVES OF THE STUDY

Delineation of Unmet Needs

Two related tasks and objectives were delineated for this study based upon the following needs:

1. The need to develop an instrument for objectively assessing the language achievement of hearing impaired children; and

2. The need to study the differences in language-learning ability among hearing impaired children, and to search for a predictive index of language achievement. Such a predictive index is essential for early identification of children with secondary language-learning problems or disorders, as a basis for early differentiation of educational-rehabilitative approach.

These two needs are discussed below:

Assessment of Language Performance

Teacher and clinician evaluations of the language development of young hearing impaired children have in the past been largely a matter of intuitive judgment. There are no objective criteria of the adequacy or inadequacy of a preschool deaf child's language-learning ability and achievement. However, the need for reliable and valid instruments for evaluation is becoming more acute as we seek to compare the relative achievements of children in different educational settings, being instructed according to different methodologies and communication media.

In the absence of suitable tests or guides for evaluating language performance in young hearing impaired children, the project undertook to develop such an instrument. The evolution of this effort is shown in the Language Rating Scales that comprised the criterion variable in the predictive studies reported in the 1969 and 1970 studies, respectively.

Prediction of Language-Learning Ability and Achievement

In addition to the need for reliable instruments for evaluating and documenting the differences in language-learning ability in hearing impaired children, there was also a need to study the nature of these differences, and if possible, to develop an instrument for predicting language performance in very young hearing impaired children. Early identification of those children likely to have difficulty in learning language is essential for the early differentiation of educational-rehabilitative approach to meet the needs of the individual child.

Objectives of the Study

The objectives of this study, in summary, were as follows:

1. To develop an objective and valid instrument for evaluating language performance of hearing impaired children along a continuum from poor to excellent achievement.

2. To develop a predictive index for estimating a deaf child's language-learning potential at an early age.

Review of Related Literature

Incidence of language disability among hearing impaired children

Studies and reports on the language performance of deaf children in a variety of educational settings indicate substantial agreement as to the proportion of children with severe language learning problems.

In a retrospective study of 20 deaf children who entered Clarke School for the Deaf in 1951, Fiedler (1969) revealed that at least a third of the children had made only minimal progress in learning language.

Vernon reported the incidence of aphasia or aphasoid involvement as 25.2 percent in a population of 345 pupils in the California School for the Deaf at Riverside (Vernon, 1967). In these studies, aphasia was defined as "a marked difficulty with language greater than that expected due to deafness or level of intelligence" (Vernon,

1969a, p. 83). When the teachers in Vernon's study were asked to rate each child's language achievement without regard to levels of hearing and intelligence, the percentage of "poor" language ratings increased to 60.3 percent (Vernon, 1969a).

In a study designated as Project CREED (Cooperative Research Endeavors in Education of the Deaf), which was carried out in all of the eleven public and State supported private schools for the deaf throughout New York State, teachers were asked to classify all of the 3-through-8-year-old children in their classes as "typical" deaf or as "special" deaf according to criteria set in each school (Restaino and Socher, 1969). Of the total of 960 children in the study, the "special" group made up 27.4 percent. These children were referred to in the study as deaf children with special learning disabilities.

Differences between good and poor language achievers

Several reports have described the characteristics of poor and good language learners among the deaf population. Mulholland discussed the variables that affect language acquisition in deaf children, and classified these as intrinsic factors -- hearing loss, mental capacities and function, physical defects, and personality -- and extrinsic factors -- socioeconomic level, parental attitudes, age of diagnosis and initiation of parental counseling, and restrictions in experience (Mulholland, 1964).

Fiedler, in her study of the Clarke School children, described the three poorest achievers, and reported that they (a) were all boys, (b) included atypical kinds of deafness, (c) exhibited emotional problems, and (d) ranged from superior intelligence to slow-normal (Fiedler, 1969).

Vernon compared the language achievement of five etiologic groups of children -- the hereditary group (deaf children of deaf parents), and four other groups deafened by diseases that are known to result in central nervous system damage in some cases, namely Rh incompatibility, prematurity, meningitis, and rubella. The percentage of poor language learners among the latter four groups was predictably higher than for the hereditary group in which intact central nervous system is presumed (except in a few rare genetic syndromes). Thus, although these group differences are statistically

significant, etiology is a poor predictor of language potential in any given individual case, as the results of the present study reveal. For example, only 21.9 percent of Vernon's rubella group were reported as having aphasia. That is, about 78 percent were making satisfactory progress in learning language.

In the Project CREED studies, a battery of tests and rating scales was used to determine the types and degrees of differences between the "typical" and "special" groups on a number of variables, including tests of gross motor functioning, sensorimotor integration, visual analysis, conceptual ability, attention, and memory. Behavioral rating scales, visual screening examinations, and tests of communication behavior were also given. The special children showed poorer performance on most of the tests and ratings.

From the foregoing review of the most important related studies available, it may be noted that the percentage of children with special language and learning problems is about 30 percent in one educational setting classified as oral, as well as in those schools known to rely upon manual or simultaneous communication media.

Unlike these studies, the present study does not classify the children into the two dichotomous groups of typical and special, but rather attempts to study the continuum of performance from poor to very good which better reflects the reality situation.

Criteria and instruments for evaluating language performance

A search of the literature turned up no norms or standards for assessing the rate and level of language acquisition by hearing impaired children in this 3 to 5 years age range. The Watson and Pickles Scale (Ewing, 1957) which had been developed for deaf infants was reviewed and considered to be inapplicable to the higher age preschool group. Project CREED (Rosenstein, Lowenbraun, Jones, 1967) had adapted the Watson and Pickles Scale for classroom use and for that research. It was decided, however, that the categories in this adaptation were too broad and too vaguely defined to be suitable for use in this research.

The Project CREED 3 report (Restaino and Socher, 1969) published a scale for "Evaluation of Communication Behaviors" developed by Pauline M. Jenson. This 19-point scale included a broader range of communication behaviors than did the earlier instrument, and is based upon an assumed order of communication development, with isolated vocalizations at the beginning level, through gestures, single signs and spoken words, and finally to self-generated sentences at the highest level. The Jenson scale revealed significant differences in communication behaviors between the deaf children designated as "typical" and "special."

The categories in the Jenson scale were considered to be too broad to make this an appropriate instrument to use as the primary instrument for assessing language performance in this study.

Design of the Study

This research was divided into two major parts, as follows:

The 1969 Study. In the spring of 1969, the first full-scale evaluation was undertaken. A Language Achievement Rating Scale was developed. A battery of tests was administered and case histories were reviewed for completeness. In some instances, parents were re-interviewed to fill in needed information.

The Language Rating was designated as the criterion variable in a stepwise multiple regression analysis, and 42 items from the case history and test battery were designated as the predictor variables. The University of Chicago B34T, 8 Mar 66, computer program was used. The variables were selected for order of entering the regression by the computer in accordance with their F levels.

The 1970 Study. The design of the 1970 Study was essentially the same as for the 1969 Study. A new Language Rating Scale was developed, which expanded and improved the earlier scale. The results of the 1969 Study were carefully examined, and those items that had appeared as statistically significant at one or more stages of the program were selected for the new study. These are discussed in the report. The same computer program was used. Age was forced into the equation as a control variable, and the other variables

were again selected for order of entering by the computer. An examination of the "under-achievers" and "over-achievers," as revealed by the table of residuals, was made.

The final section of this report discusses the educational implications and uses of the predictive index, as well as the needs for further research as revealed in this study.

THE 1969 STUDY

During the 1968-69 school year, there were 75 children enrolled in the preschool classes at the Children's Hearing and Speech Center and in the public schools of Prince George's County, Maryland. As indicated in the Introduction, supervision of both of these programs was provided under a Title VI ESEA grant through a cooperative arrangement between the two agencies. All hearing impaired children who had applied for admission to these classes were accepted, with the exception of about five children who were referred to other programs because of severe visual, developmental, or behavioral deviations.

For a variety of reasons, most of which related to the unavailability of information, it became necessary to eliminate seven children from the study. The remaining 69 were included in the first phase of this study, designated as the 1969 Study.

Description of Subjects

Age, sex, and race

Sixty-nine children born between the period January 1, 1964, and December 31, 1965, comprise the subject population of this study. The 15-month critical post-rubella period was extended by 7 months in order to include all of the children enrolled in the preschool classes at the time.

The ages of the subjects at the time of testing in May 1969, ranged from 40 months (3 yrs. 4 mos.) to 64 months (5 yrs. 4 mos.) with mean age of 54 months (4 yrs. 6 mos). Figure 1 shows the distribution of the subjects by age in months, as of May 1969.

There were 35 males and 34 females; 51 white and 18 non-white.

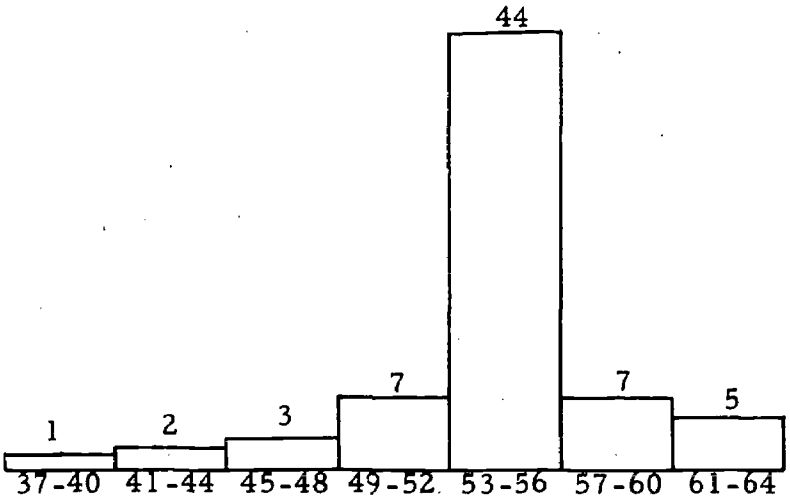


Figure 1. Age of subjects, in months, as of May 1969
N = 69. Mean 54 months. SD 4.38.
Range 40 to 64 months.

Intelligence

Standardized intelligence test results were available for only 37 of the children. For these, the mean IQ was 108.94, and SD 17.87. All of the subjects were judged by the staff to have intelligence at least within normal limits. Tests done in subsequent years confirm these judgments on 60 of the 69 subjects. Five of the children were later shown to have IQ's in the 80's and four in the 70's.

Hearing

All of the children were tested by the Center's audiologists in the sound-treated audiology test suites at the Children's Hearing and Speech Center. For this study, the Fletcher Average, the average of the two best thresholds for the frequencies 500, 1000, and 2000 Hz in the better ear was used. A rating of 109 dB was arbitrarily assigned in 10 cases where the audiograms showed hearing at only one of these three frequencies. An arbitrary rating of 110 dB was assigned to three cases where testing was attempted in at least two sessions, but where threshold measurements could not be made because the child could not be conditioned.

The range of hearing loss for the group was from 50 dB to 110 dB, with a mean of 87.94 dB, and SD 18.77. Figure 2 shows the distribution of subjects by hearing levels. All hearing loss data reported in this study are based on ISO levels.

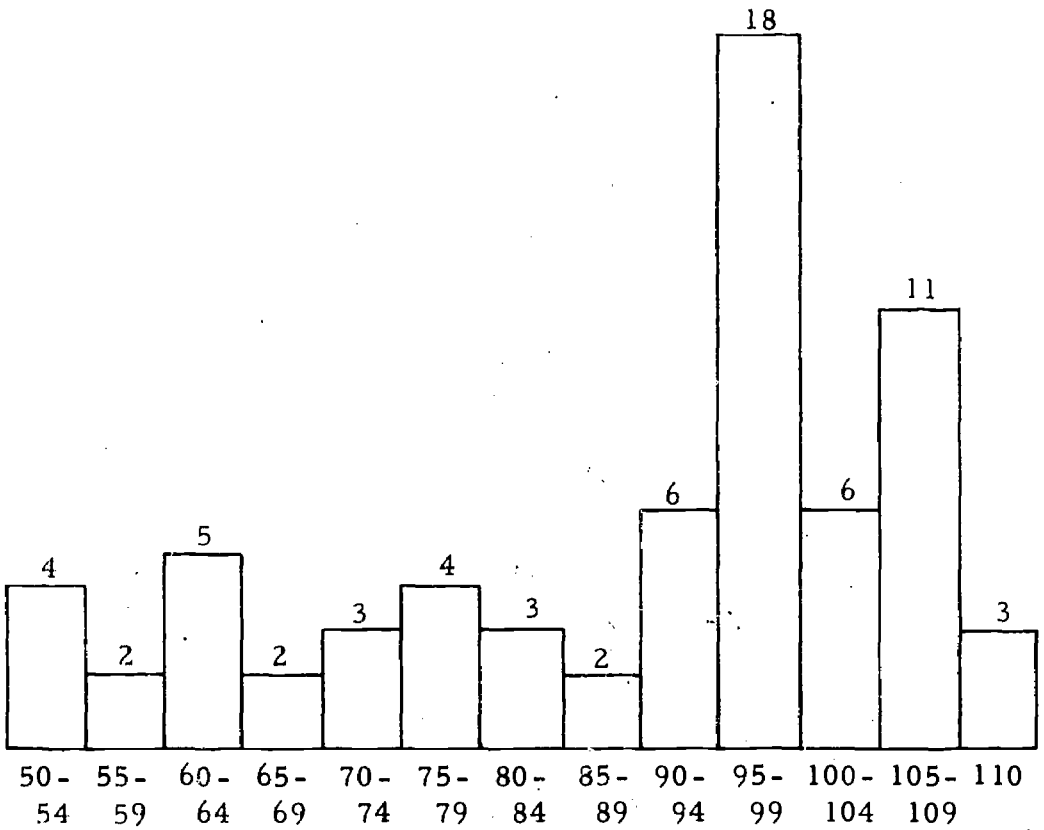


Figure 2. Hearing level of subjects. 1969 Study
N = 69. Mean 87.94. SD 18.77.
Range 50 dB - 110 dB*

*109 dB - arbitrariiv assigned; hearing response at only one frequency in the 500, 1000, 2000 Hz range.

110 dB - arbitrarily assigned; could not condition

Presumed etiology of the hearing impairment

The case histories of the subjects provided information on their prenatal, perinatal, and postnatal medical backgrounds. Where necessary, special parent interviews were scheduled in order to fill in any missing data. From these histories, a number of items were excerpted and recorded, including the following possible etiological factors: (a) maternal rubella suspected or confirmed during the first or second trimester of this pregnancy; (b) blood incompatibility, reported as Rh negative blood in the mother or by the ABO blood combination in the parents; and (c) other serious problems of pregnancy or birth, which included serious illness of the mother during pregnancy, drugs ingested during pregnancy, previous history of miscarriage or threatened miscarriage during this pregnancy, prematurity (birth weight less than 5 pounds, 8 ounces), prolonged labor (over 24 hours), precipitous delivery (labor less than 2 hours), breech or Caesarian delivery, infant cyanotic or jaundiced, blood transfusions or exchange at birth, or trouble breathing or sucking. (See Appendix A-2, Case History Coding Checklist II.)

Appendix B, Table 1, shows the presumed etiology of hearing impairment based on this information from the case history. As may be seen from this table, the largest number of subjects evidenced possible multiple causation for the hearing loss -- 44 subjects, or 63.8 percent.

Table 2, Appendix B, which provides a regrouping of data on etiology, shows rubella alone as opposed to no history of rubella in 51 cases, or 73.9 percent. Blood incompatibility alone or in combination accounted for 16 cases, or 23.1 percent (as compared with an estimated 10 percent among married couples in the total population). Only 3 of the 16 cases of blood incompatibility were reported as jaundiced and requiring blood transfusions at birth.

Appendix B, Table 3 shows "Global" Ratings assigned on the basis of number of items of presumed etiology reported.

A tabulation was made of the postnatal and developmental backgrounds of the subjects, but the small number of instances reported on each of the items made statistical treatment unfeasible. Two

cases of meningitis at age of 6 months were arbitrarily grouped with "Other." Similarly, one child who was reported as normal prior to treatment of a severe "virus infection" at 18 months, was also grouped with "Other." Prematurity was also included with "Other" in the 1969 Study.

Language Achievement Rating Scale, the Criterion Variable

In the absence of other objective instruments for evaluating the language performance of the children, an empirical procedure was followed in developing the Language Achievement Rating Scale used in this study. A preliminary nine-point scale was drawn up on the basis of the teachers' monthly reports showing new vocabulary, expressions, and other linguistic material taught, and upon observation of the language usage of the children in the classrooms and on the playground. Teachers were asked to rate each child on this scale and to write in additional specific information desoribing each child's language performance in the following three dimensions: (1) comprehension through speechreading and audition, (2) oral recall in response to questions or other stimuli in the classroom lesson situation, and (3) spontaneous expressive usage.

Subsequently, the rating scale was posted horizontally on a chart with the children's names listed under each rating, followed by a notation of the specifics of each child's language performance. The teachers and project staff inspected this chart, and names were rearranged as necessary until teachers and supervisors agreed that each child was appropriately placed on this scale with reference to his demonstrated language performance and in relation to the other children in the group. The descriptions and the numerical ratings on the scale were then revised to reflect the language of the children in each rating group. The verbal descriptors "excellent, very good, good, fair, and poor" were added as the staff's subjective evaluation of the language performance ratings.

The completed scale, designated as the Language Rating Scale for Hearing Impaired Children Age 3 to 5, is given in Appendix C-1.

Appendix B, Table 4, shows the language achievement of the 69 children in this study as of May 1969. The ratings of "9" for four children who had been in the program less than six months were changed to 0 to 3 respectively on the basis of their language performance in order to include them in the statistical analysis of the study.

The ratings assigned on this scale constituted the criterion variable in the multiple regression analysis.

The Predictor Variables

Four types of data were scored and included as the 42 predictor variables in this study, namely: (1) demographic and descriptive data; (2) relevant information from the case history; (3) results of a battery of tests of motor-perceptual and psycholinguistic functioning, social maturity, and intelligence; and (4) ratings of home environment, behaviorial characteristics, and a global rating on presumed etiology. Following is a discussion of these four categories:

Demographic and descriptive data. These items were excerpted from the child's case history form and clinical and educational records. Audiological evaluations were conducted as a part of this project, as described above. These items included sex, race, age, hearing level, auditory discrimination, ability to imitate speech, and measurements of height, weight, and head circumference. (See Checklist I, Appendix A-1.) Upon inspection of the data, however, only the first five listed seemed worthy and feasible of inclusion as predictor variables. They are recorded as variables number 1, 2, 4, 24, and 25 on the list shown in Appendix B, Table 5.

Relevant information from the case history. Case history information was recorded on a yes-no checklist under the following headings: (1) family history, (2) pregnancy and birth history, (3) medical history, (4) developmental history, and (5) therapy and educational background. See Appendix A-2 for Case History Coding Checklist II.

Two variables were excerpted from the family history section, and designated as 37--family history of hearing impairment, and 38 -- family history of speech and language problems. In the initial

correlations, family history of hearing impairment appeared with a positive correlation of .366 (a negative r had been expected), with a significant P. Upon re-interviewing of parents in preparation for the 1970 Study, however, this was found to be in error. The word "congenital" has been disregarded by the teachers who recorded the parent interviews, and as a result, a number of relatives who had acquired hearing losses in adulthood were erroneously reported. In any case, the r was so low that the variable did not enter the regression equation until late, and, of course, did not show as a significant predictor. There were only three subjects in the study who had congenitally deaf siblings, and there were no children having either one or both deaf parents.

Pregnancy and birth history items were excerpted and included as variables 39 - 42, dealing with etiology.

Developmental history did not lend itself to statistical treatment, upon inspection of the data.

From the information reported in the section on therapy and educational background, the item shown as "age in months when child was first enrolled in a parent-training or nursery program for hearing impaired children" was considered the most important and reliable item. This was included as variable 43.

Tests of motor-perceptual and psycholinguistic functioning, social maturity, and intelligence. Two major considerations operated in the selection of the test battery administered in this study: First, it was considered desirable to select the tests on the basis of a model of the psychological processes that are believed to underlie or to be related to communication behavior. Osgood's model (Osgood, 1957) and its adaptations by Wepman (1960) and by Carrow (1969) were reviewed. Kirk's adaptation of Osgood's model (Kirk, 1961, 1966), which forms the framework for the Illinois Test of Psycholinguistic Abilities, was also studied. Bang's concept of "avenues of learning," which forms a part of her Language and Learning Assessment for Training (Bangs, 1968), also became a part of the conceptual model developed for this study.

Secondly, consideration was given to the large body of textbook material and research studies concerning factors correlated with learning disabilities.

From these studies, a test profile of motor-perceptual and psycholinguistic behavior was developed, and subtests from various published tests, when available, were selected for assessment of the various items in this profile.

Following is the outline of the test profile: (The sources of the subtest items are given in parentheses.)

PERCEPTUAL-MOTOR PERFORMANCE

I. Memory-attention (short-term)

A. Auditory

1. Auditory sequential
2. Words and sentences (WPPSI)

B. Visual

3. Picture memory (SON)

C. Visual-motor

4. Sequential memory (SON-Knox Cubes)
5. Visual sequential memory (ITPA)

II. Visual-motor Perception (non-memory)

A. Basic Forms

6. Form board (M-P -- Sequin Form Board)
7. Geometric designs (WPPSI)

B. Form Combinations

8. Block design (WPPSI)
9. Form completion (Hiskey-Nebraska)
10. Visual closure (ITPA)*

III. Motor Expression

A. Fine Motor Coordination

11. Holding pencil
12. Cutting with scissors (M-P)
13. Buttoning (M-P)

B. Manual Expression

14. Manual expression (ITPA)

ASSOCIATION-CONCEPTUALIZATION (ABSTRACTING PRINCIPLES)

15. Visual reception (ITPA)
16. Visual association (ITPA)
17. Visual closure (ITPA)*
18. Analogies (SON)
19. Sorting (SON)

SOCIAL MATURITY

20. Rapport (PAR)
21. Responsibility (PAR)

*Items 10 and 17 are identical; the test appears under both headings because of the nature of the function assessed by it.

Individual test profiles were made for each of the children for use in educational diagnostic evaluation and remediation. The range of scores for the group on each subtest was used as the frame of reference in evaluating an individual child's performance, rather than the published test norms, because of statistical and other hazards involved in using and interpreting a subtest out of the context of the entire test.

A list of the sources of all the subtest items taken from published tests is presented in Appendix D.

Intelligence test scores from standardized intelligence tests were available for only 37 of the 69 subjects in the study. Two of the three subtests of the Preschool Attainment Record (PAR) included under the heading of "Intellectual," and designated as Ideation, and Creativity, were included as predictor variables in this study in lieu of complete psychometric data on all of the subjects. In addition, the subtests shown in the test profile under the heading "Association-Conceptualization-Abstracting Principles" are also tests of what is generally considered as intelligence.

Ratings of home environmental factors, behavioral characteristics, and a global rating of presumed etiology. A list of factors in the child's home environment that might have a detrimental effect on language acquisition was developed and checked for each child. Such factors as absence of a father, language other than English spoken, and others were listed. In addition, each subject was given a rating on a five-point scale to indicate the school's subjective evaluation of the parents' interest in and ability to provide language stimulation and practice in the home. (See Item 9 on Coding Checklist, Appendix A-1.) The tabulation of the listed items upon inspection did not lend itself to statistical treatment, and the ratings alone were used in studying this variable.

Five rating scales of behavioral characteristics were developed on the following: withdrawn - aggressive; passive - hyperactive; cooperative - uncooperative; rigid - flexible; and stable - unstable. (Appendix A-1, Item 10.) These ratings were entered as predictor variables.

Individual items of presumed etiology (rubella, Rh negative mothers, other problems of pregnancy and birth) constituted variables. In addition, each case was assigned a "global" rating based on the number of these factors present in the medical history.

Results and Discussion

Correlations

Appendix B, Table 5, is the list of variables, showing name, units, means, standard deviations, simple correlation with the criterion (variable number 3, Language Rating) and significance levels, as of May 1969.

The variables having the highest correlations, significant at the .001 level, are listed below in order of highest to lowest:

Variable Number	Name	r
29	Ideation (PAR)	.718
31	Unfavorable home environment rating	-.594
28	IQ*	.588
30	Creativity (PAR)	.554
22	Rapport	.529
8	Sequential Memory-Knox Cubes (SON)	.513
24	Hearing impairment	-.489
18	Visual Reception (ITPA)	.487
25	Auditory discrimination impairment rating	-.454
19	Visual Association (ITPA)	.438
20	Analogies (SON)	.427
9	Visual Sequential (ITPA)	.398
11	Geometric Design (MP or WPPSI)	.395
14	Visual Closure (ITPA)	.384

*N = 37

The variables having correlations significant at the .01 level are:

7	Picture Memory (SON)	.341
10	Sequin Form Board (MP)	.353
13	Completion of Drawings (Hiskey)	.328
21	Sorting (SON)	.330

Significant at the .02 to .05 level are the following:

Variable Number	Name	r
1	Sex (maleness)	-.278
2	Race (non-white)	-.262
12	Block Design (WPPSI)	.294
23	Responsibility (PAR)	.297
26	Ambulation (PAR)	.254
33	Behavior, Passive/Hyperactive	-.273

Four of the original 42 predictor variables were deleted for reasons discussed elsewhere, but of the remaining 38 variables, 23 were significantly correlated with the Language Ratings. It seems clear from this fact that language problems do not exist by themselves, but rather are accompanied by numerous other problems. This emphasizes the importance of the effort to develop a predictive index of a complex of factors with information as to the relative importance of each.

Age

Although there was a 24-month age range in this group of children (40 months to 64 months), Age showed a low negative correlation with Language Rating, not statistically significant. The age factor is discussed further in connection with the 1970 Study.

Age when training started

Similarly, the age at which rehabilitative training was started either through parent training or child nursery also showed a range from 12 months to 55 months (Mean = 30.58 months; SD 10.12), and this variable (number 43) was not significantly correlated with the language ratings.

The explanation for this may be that from one point of view, all of the children could be considered as having been identified and started on training at a sufficiently early age, or that the age range of 43 months was not great enough to be significant. Another possible explanation is that language disability in hearing impaired children is not dependent upon early identification and training of the type offered.

Figure 3 shows the age in months when training started.

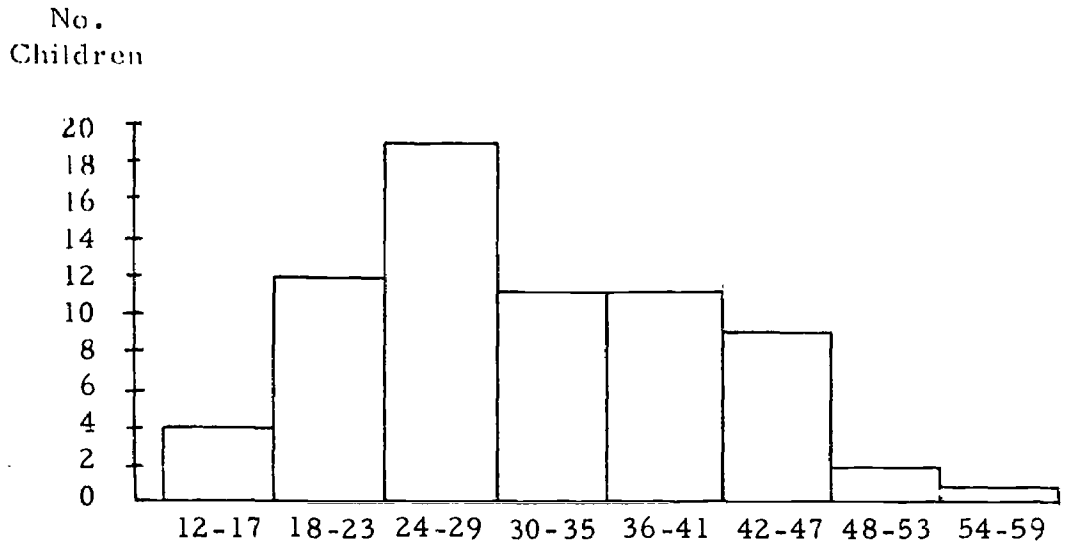


Figure 3. Age in Months When Training Started.
N = 69. Mean 30.58. SD 10.12.

Etiological factors

None of the variables 39 through 41 representing etiology of rubella, Rh negative blood, and problems of pregnancy and birth, were shown to be significantly correlated with language achievement. Even the global ratings, which were weighted and scored in terms of the number of unfavorable etiological factors listed for each child, were not significantly correlated.

Behavioral characteristics

All but one of the five behavior rating scales yielded insignificant correlations. Only the passive-hyperactive dimension achieved significance. This rating scale is shown in Appendix A-1, Item 10.

Motor coordination

Four of the tests dealing with motor coordination failed to reach significance levels of .05. These were: Holding a Pencil (DeHirsch), Buttons (MP), Manual Expression (ITPA), and Manipulation (PAR). Only Ambulation (PAR) reached the level of .05.

Stepwise Multiple Regression Analysis

Prior to the multiple regression analysis, several of the variables listed in Appendix B, Table 5, were arbitrarily deleted because they were considered to be tests of language performance rather than non-verbal predictors of language. These were Variables 5 and 6, Repetition of Digits or of Words and Sentences, respectively, and Variable 29, the Ideation subscale from the Preschool Attainment Record. Thus, 39 predictor variables and the criterion variable of Language Achievement Rating were subjected to stepwise multiple regression analysis. (Variable 37 was deleted also later in the study.)

Appendix B, Tables 7, 8, and 9, shows the significant predictor variables after Steps 10, 20, and 30, respectively. Variables that did not achieve a significance level of .05 or better have been omitted from these tables. Inspection of these tables reveals that the three variables of Hearing, Home Environment, and Creativity, have markedly lower chance probability levels than the other variables, and these three remained throughout the entire 30-step analysis at the top of the list of significant predictors.

Two variables appeared significant after Step 10, but then dropped out, namely, Visual Association and Manual Expression.

Visual Reception remained among those with the highest significance levels throughout the 30 steps, at levels from .025 to .05.

Completion of Drawings was significant at the .025 level at Step 10, dropped out at Step 20, but appears again at the .05 level at Step 30.

Sex (maleness) was not at a significant level at Step 10, but came in later and remained at .025 in Step 20 through 30, with a negative t, indicating that the girls as a group had better language ratings than the boys.

The Unstability Rating also entered late, but remained at the .05 level at Steps 20 and 30.

Buttoning appeared briefly around Step 20 at the .05 level, but dropped out before Step 30.

Discussion of the Significant Predictor Variables

Hearing. This variable ranked first in importance as a predictor of language achievement as measured by the Language Rating Scale. This was an unexpected result, in that teachers of hearing impaired children frequently comment upon the seeming lack of correlation between degree of hearing loss and language performance.

In order to clarify this finding, a scattergram relating hearing impairment and language achievement was made, and is shown in Figure 4. From this scattergram, it can be seen that all of the 11 subjects having hearing losses of 65 dB or less had language ratings of 4 or better. Thus, all of the "hard of hearing" children were making good or better progress in language development.

Among the remaining subjects, those with hearing losses of 66 dB or worse, there was wide dispersal of language scores. The children with the most severe impairment, but having hearing at the three frequencies used in obtaining a Fletcher Average (500, 1000, and 2000) are shown on the 95 to 100 dB loss range. They appear at all levels on the language scale from 1 to 8.

The children whose hearing level was arbitrarily assigned as 109 on the basis of audiometric responses at only one of the three FA frequencies, also are shown at all levels of language achievement from 0 to 7. The three subjects rated arbitrarily as 110 dB because they could not be conditioned in the hearing test situation, show language ratings at 1, 2, and 5.

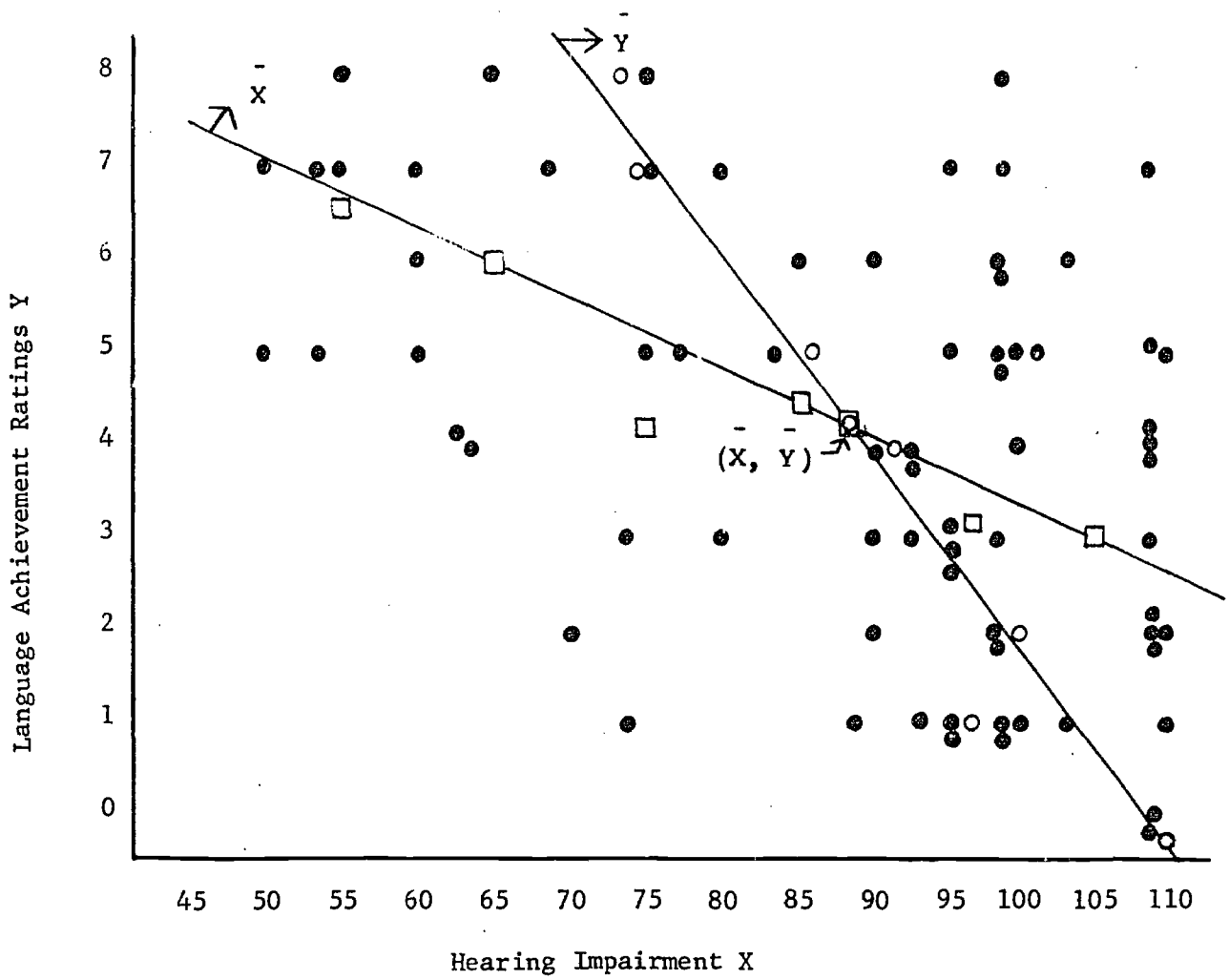


Figure 4. Scattergram Showing Correlation Between Hearing Impairment and Language Rating, 1969
N = 69

Similarly, when one looks at the high and low language ratings on the vertical columns of the scattergram, a wide dispersal of dB levels may be noted. At language ratings 7 and 8, for example, the hearing levels range from 50 to 109. At the poorest language rating levels 1 and 2, the dB levels are from 70 to 103, but the concentration of scores at 90 dB and worse can be visualized.

The factual basis for the teachers' intuitive feeling that hearing impairment is not all-important is thus evident; there are children with profound hearing losses who make excellent language progress, and there are children with relatively moderate hearing losses who make poor progress. Nevertheless, the high simple correlation between the two factors and the results of the multiple regression analysis support the general principle that the greater the hearing impairment, the greater the difficulty in learning language.

Home environment. Running a very close second to hearing impairment, Home Environment is shown as one of the three most significant predictors of language achievement. The rating scale used for assessing the school's subjective rating of the adequacy of the home environment with particular reference to the parents' interest in and ability to provide language stimulation and practice at home is shown in Appendix A-1, Item 9.

The extent to which this rating was influenced by the child's language ability was questionable. That is, it could not be determined whether a teacher might have used poor language achievement itself as evidence of inadequate home conditions. It was decided to explore this factor further in the 1970 Study.

Creativity. This variable is one of the subtests of the Preschool Attainment Record (Doll, 1966). The Preschool Attainment Record is comprised of eight subscales grouped under three main headings of Physical, Social, and Intellectual. The Creativity subscale is grouped with an Information scale and an Ideation scale under the Intellectual category.

The 14 items on this scale are given in six-month intervals ranging from age 0 to 6 months at the lowest end to 78 to 84 months at the upper end. The headings of each of the six-month interval items are: demands, tests, transfers, explores, tears, dramatizes, builds, draws, molds, dramatizes music, paints, invents stories,

solos, and experiments. A general instruction given is to the effect that positive scores on the items should generally show "divergent" behavior, as shown by originality, imagination, and "freshness of gestalt."

Several of the items on the scale are verbal or auditory in nature and therefore inappropriate for rating deaf children. Although the teachers who rated the children on these scales were instructed not to take into account the child's verbal language skills in applying the ratings, this was not an easy task. It was decided to evaluate this aspect more thoroughly in the 1970 Study.

Other significant predictor variables. As may be seen from an examination of Appendix B, Tables 7, 8, and 9, the three variables listed above, namely, Hearing, Home Environment, and Creativity, all have t values significant at levels of .005 and .0005 at the three stages of the stepwise multiple regression shown at Steps 10, 20, and 30.

Variables which achieved significant levels of .01 to .05 are:

Visual Association (ITPA)
Manual Expression (ITPA) (negative t)
Completion of Drawings (Hiskey)
Visual Reception (ITPA)
Sex (maleness) (negative t)
Buttons (M-P) (negative t)
Unstability Rating (negative t)
Visual Reception (ITPA)

All of these variables were re-examined in preparation for the second year of the study designated as the 1970 Study in this report.

Summary of 1969 Study

Sixty-nine hearing impaired children, age 40 months to 64 months, who were born in the critical period following the rubella epidemic of 1963-64, comprised the subjects in the first phase of this study of factors related to language achievement. Language achievement of each subject was rated on a nine-point scale. These ratings constituted the criterion variable in the stepwise

multiple regression analysis. Thirty-nine items from the case history, test performance scores, and behavior ratings, constituted the predictor variables.

Simple correlations were made between the language ratings and 38 variables based on case history data, test scores, and rating scales. These correlations were statistically significant for 23 of the 38 variables, indicating that language problems are characteristically accompanied by other problems and pointing up the need for an index of relative importance among these factors.

Results of the multiple regression analysis indicated the three most important predictors to be Hearing, Home Environment, and Creativity, at significance levels of .005 to .0005. Eight other variables, significant at levels .01 to .05, were: Visual Association (ITPA), Manual Expression (ITPA), Completion of Drawings (Hiskey), Sex, Buttons (Merrill-Palmer), Unstability Rating, and Visual Reception (ITPA).

THE 1970 STUDY

Objectives

The second phase of the study was undertaken during the 1969-70 school year, and culminated in a second program of testing and evaluation in May, 1970.

The major objectives of this phase of the study were the same as for the first phase, namely:

1. To extend and improve the criteria and instruments for evaluating language achievement in a group of hearing impaired children.

2. To continue the search for factors related to language achievement, with the goal of developing a predictive index of such factors.

The major focus of the 1970 Study was on the "deaf" subjects, defined as those whose hearing loss was 66 dB or worse.

Subjects

Of the 69 children included in the first year of the study, 57 remained in the program and constituted the subjects of the 1970 Study.

Ten of the 12 children who transferred out of the program had language ratings of 5 to 8 in the 1969 Study, and were thus in the upper half of the "good" category or in the "very good" category of language achievement. All but one of these children were in the hard of hearing group, with hearing losses of 65 dB or less.

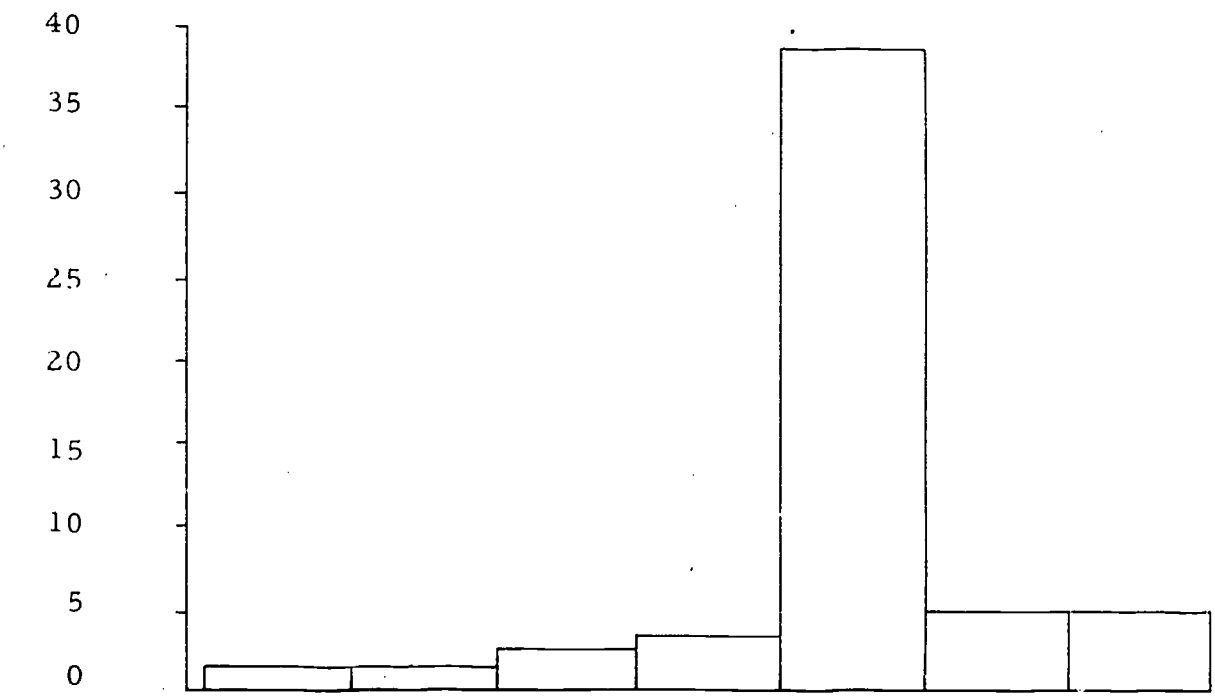
Two children who transferred out of the study were in the 1 and 2, poor to fair, Language Rating groups. One of these was a multiply handicapped child with a 55 dB loss, who moved out of the geographic area. The other child, who had a 109 dB assigned

loss (auditory responses at only one frequency in the 500 - 2000 range), was transferred to another school because of transportation problems.

Age and Sex

Figure 5 shows the age distribution of the 57 subjects. The age range was from 52 to 76 months, with mean age of 66 months. Thirty-eight of the 57 children, 66 percent, were between 5 years-5 months and 5 years-8 months of age.

Forty-eight percent of the total group were boys. Forty-four percent of the "deaf" group, having hearing losses of 66 dB or greater, were boys.



Age Range:	52	53-56	57-61	62-64	65-68	69-72	73-76
N =	1	1	3	4	38	5	5
%	.02	.02	.05	.07	.66	.09	.09

AGE IN MONTHS - (May 1970)

N = 57
Range = 52 - 76 months
Mean = 66 months

Figure 5. Distribution of Subjects by Age, 1970 Study

Hearing

All of the children had repeat audiological evaluations in the soundproof test suites of the Children's Hearing and Speech Center, by the Center's audiologists. As before, the tests included pure tone air and bone conduction threshold testing, and speech awareness or speech reception threshold testing.

Figure 6 shows the distribution of hearing impairment levels. The range for the group was 38 dB to 110 dB, with mean 88.38 dB S.D. 16.35. The mean loss of the "deaf" group (66 dB loss or greater) was 93.62 dB, S.D. 8.015.

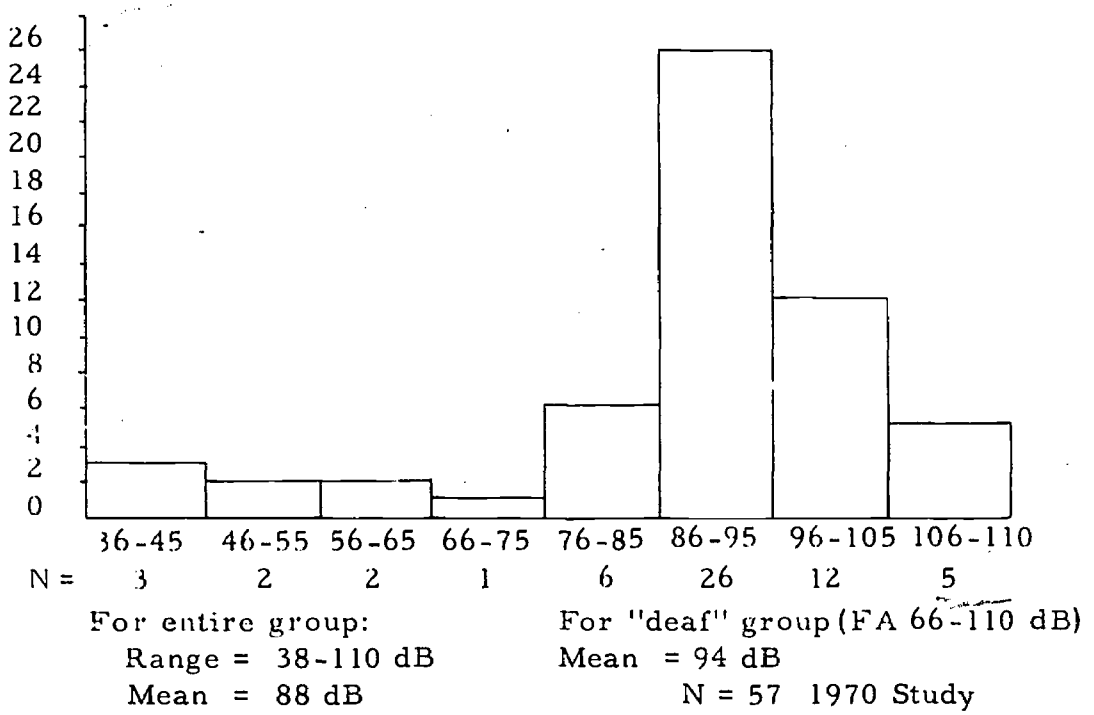


Figure 6: Distribution of Subjects by Hearing Level

A comparison of the hearing test results (Fletcher Average) for 1969 and 1970 indicated that hearing was stable ± 10 dB in 43 children, 75.4 percent. The hearing of 10 children, 17.5 percent, changed ± 10 to 19 dB. One child's hearing was 20 dB worse in 1970. The three children who could not be conditioned in 1969 gave reliable thresholds in 1970.

Presumed Etiology

Appendix B, Tables 9 and 10 show medical history data from which etiology of the hearing impairment might be presumed, for the "deaf" group. These tables show that 39 children (78 percent) had a history of maternal rubella with or without other problems. Eight children (16 percent) had mothers with Rh negative blood, as compared with a rate of 10 percent in the married population in general. Ten children (20 percent) were premature, defined here as birthweight less than 5 pounds, 8 ounces. These categories in Table 9 are overlapping, since in 22 percent of the cases there is possible multiple causation, as shown in Table 10.

Language Achievement Rating -- the Criterion Variable

Educational setting for the rating scale

During the previous school year, all of the children in the program were beginners in the sense that they were in their first daily full-day or half-day educational program. Most of them were between 3 and 4-1/2 years of age.

By the time of the May 1970 tests, another full year of the critical preschool years had passed. Most of the children were now about 5-1/2 years of age, and the range of language achievement in the group was considerably wider, as might be expected.

Because of this wider range in achievement, the Language Rating Scale used in the 1969 Study was no longer considered adequate for proper delineation of the gradations in language achievement along the continuum from very poor to excellent.

Another factor that necessitated revision of the Language Rating Scale had to do with the language curriculum followed in the program, which is described briefly as follows:

The instructional program for the 3- and 3-1/2-year-olds was one that could best be described as a tutorial program within a nursery school setting. The teacher was attempting to develop the language skills of lipreading, listening and auditory discrimination, and speech, informally in a play-type situation, as well as formally in a tutoring or small group lesson, around a core vocabulary of nouns, verbs, and phrases evolving from experiences provided in school. The teacher was expected to test the child's skills in these areas, and to keep records of progress.

When a child reached the age of 4 to 4-1/2, and had been in the program at least six months, a team staffing conference was held to review his progress and to make decisions about his educational program. Some of the children were rated as having made little or no measurable progress in language comprehension and expression, and were therefore considered as having "special language-learning problems" in addition to the difficulty that might be attributed to hearing impairment alone.

In most cases, the team decided to transfer these children with special language-learning problems from the "regular curriculum" to the "structured curriculum." The latter in its initial stages is a modification and expansion of the McGinnis Association Method (McGinnis, 1963). It is an analytical approach involving the use of the written form as a medium for teaching language. It begins by teaching the graphemes and phonemes, then words, then sentences.

These transfers to the structured curriculum were begun in the spring of 1969.

The revised language rating scale

The June 1970 revision of the Language Rating Scale is shown in Appendix C-2. The 1970 scale was written in two parts, the first for children on the "Regular Curriculum," the second for those on the "Structured Curriculum." A new scale for the Structured Curriculum was needed, since by spring 1970 many of

the children had passed the phoneme-grapheme stage represented by the ratings of 0 or 1 used on the 1969 scale. However, the next higher ratings of 2 and above on the 1969 scale, written to describe progress on the Regular Curriculum, were not applicable. It was decided that a separate scale was needed since it was not reasonable to continue including these children on the bottom levels of the rating scale and consequently minimizing the differences in progress in this group of children.

At the same time the Language Rating Scale for the Regular Curriculum was rewritten to include only the children receiving instruction in the Regular Curriculum. This revised scale was an attempt to assess the actual linguistic performance of the child along the following parameters: (a) the size and content of his vocabularly, (b) his ability to comprehend, and (c) to use linguistic forms increasing in complexity from simple labeling, to prepositions, plurals, pronouns, questions, and verb tense. These items on the rating scale are labeled as to the specific sequence and level in the curriculum in which these forms were taught. The scale is a reflection of the language curriculum used in these classes.

The procedure for rating all of the children was again an empirical one. Each child was rated by the teacher according to his achievements and his instructional level in the curriculum. Each child's name was listed under a tentatively assigned rating by the teacher, along with a notation as to the actual number of nouns, verbs, adjectives, pronouns, etc. he had mastered in both receptive and expressive language performance. Then the teacher, supervisor, and project personnel who were intimately acquainted with the child's classroom and playground language performance, reviewed these lists and in some cases assigned a different rating. The relative position of any child's name on the language rating continuum reflected the concensus of the project and teaching staffs. Final ratings were assigned on the basis of this readjustment.

Table 11, Appendix B, shows the distribution of the 1970 Language Ratings as well as the 1969 ratings for comparative purposes. It should be noted that according to the criteria adopted by the project staff, about 40 percent of the children in the program were making only fair to poor progress in language achievement. If the 12 children who left the program in 1969 were included in their

respective categories at the time of leaving (two in the fair to poor classification, and ten in the good and very good classifications) the proportion of children in the fair to poor group would be 36 percent. This figure is remarkably similar to the percentage of approximately one-third of the children in the "special" or "aphasic" categories in programs for the deaf, as reported in the literature.

Figure 7 shows the distribution of Language Ratings for the deaf group (66^{+} dB hearing level), and indicates in the shaded area, the children being instructed in the Structured Curriculum.

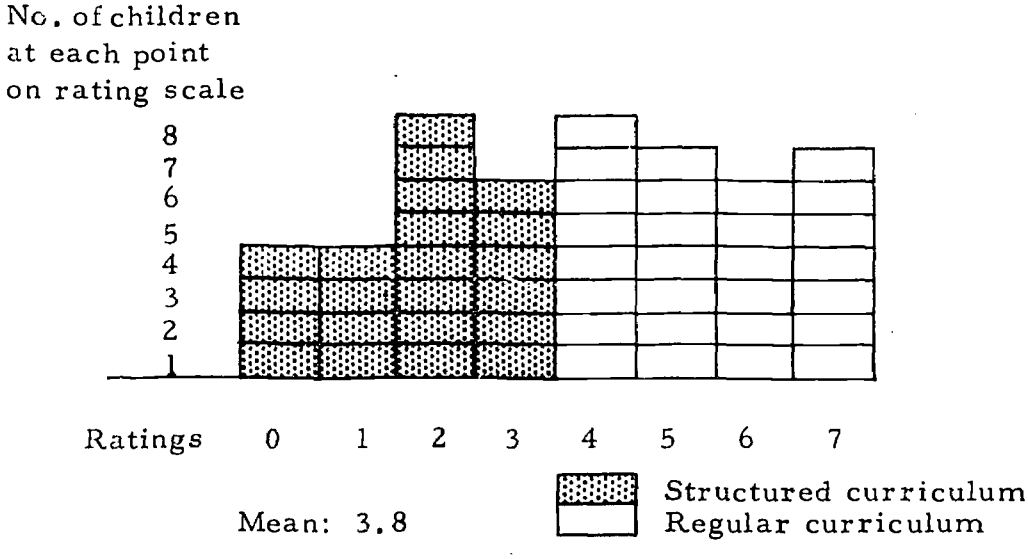


Figure 7. Distribution of Language Ratings, 1970 Study
N = 50 (deaf)

Selection of the Predictor Variables

In preparation for the 1970 Study, the project staff met on numerous occasions to review and discuss the 1969 Study and findings. The 1970 Study was intended to be a continuation and improvement of the research, and the staff undertook to remedy some of the shortcomings of the earlier effort. To this end, several additional analyses of data were made, including (a) separate computer printouts on subjects with and without IQ scores; (b) printouts on the hard of hearing and deaf subjects; and (c) a printout analysis of test scores only, with the factors of sex, race, and age controlled by forcing these into the equation ahead of the other variables.

As a result of these analyses and discussions, 18 predictor variables were selected for the 1970 Study. Following is a discussion of the predictor variables selected:

Age. Although age was not shown as significantly correlated with Language Ratings in the 1969 Study, it was decided to include this factor again in 1970 because of the possibility that another year's maturation and education might yield different results. Moreover, in the 1970 regression analysis it was decided to control for age by forcing this variable into the equation as a control variable ahead of the other variables.

Sex. The 1969 Study showed at various points in the analysis a slight difference in language achievement in favor of the girls. Accordingly, the sex variable was included in 1970.

Hearing. The 1970 hearing test scores were included, as discussed above, and it was decided to make separate analyses for the hard of hearing and the deaf subjects.

Home environment. The home environment was shown to be one of the three most important predictors of language achievement in the 1969 Study. The project staff re-examined the old rating scale, and decided to use it again without revision in 1970. See Appendix A-3 for the rating scales used.

The staff was oriented as to the use of the scale, and cautioned against allowing the child's language performance itself to influence the evaluation of the home situation. Raters were asked to be

prepared to give specific bases for each rating. Separate ratings were given by teachers and by supervisors. The correlation between the two ratings was 0.76, which indicates good interrater reliability.

Where there was a difference in the rating assigned by the teacher and the supervisor, these were either reconciled as a result of subsequent discussion between them, or an intermediate rating was assigned.

Behavior rating scales A, B, and C. These rating scales were presented to the teachers as they are shown in Appendices A-3 and A-4, that is, without a verbal designation of the particular behavior being sampled by the scale. The designations of A-Cooperativeness, B-Stability, and C-Creativity were known only by the project staff (not by the persons making the ratings), until all of the ratings and rater reliability correlations had been completed. The individual scales are discussed below:

A-Cooperativeness. This variable did not achieve significance in the 1969 Study, except in one of the printouts that separated the deaf and hard of hearing groups. However, several teachers had remarked about what they considered lack of cooperation among the children who were having language learning problems. For these reasons, this variable was included in the 1970 Study.

Teacher-supervisor reliability was good, as evidenced by a correlation of 0.75 between the two ratings.

B-Stability. This rating scale had shown predictive significance in several of the 1969 analyses, and was thus included again in the 1970 Study. Teacher-supervisor reliability was evidenced by a correlation of 0.84 between the two ratings.

C-Creativity. This factor was one of the most significant predictors of language achievement in the 1969 Study. In that study, the rating scale used for the variable designated as Creativity was one of the subscales under the heading of "Intellectual" in the Preschool Attainment Record (Doll, 1963). The staff had some misgivings about this scale because several of the items seemed to be unduly loaded with verbal performance, and thus not an appropriate test to use in a search for non-verbal correlates of language performance.

For this reason, it was decided to develop a new scale for rating a factor that would be comparable to Doll's creativity scale, but that would be devoid of verbal language content. The new scale, which was developed by the consulting psychologist on the project staff, Dr. Robert M. Dowling, is shown in Appendix A-4. Dowling's scale also provided for a 0-4 score on each item to indicate degrees of the type of behavior being rated, since on the 1969 Study the teachers had difficulty with the "all or none" ratings on the Doll scale.

As indicated above, this scale was presented to teachers and supervisors without a verbal designation of the characteristics being rated, simply as Behavior Rating C.

The teacher-supervisor rater reliability correlation on this variable was 0.42. Subsequent discussion with the staff indicated that supervisors did not feel competent to make judgments on a number of the items that required more detailed knowledge of the child's behavior and characteristics. In assigning the final rating on this scale, teacher and supervisor met to reconcile any different ratings, and the teacher's rating was usually given the greater credence for the reason stated.

The correlation between the PAR Creativity rating used in 1969, and the new Creativity rating used in 1970, was 0.42. This is significant at the .01 level, and indicates that the two scales seem to be assessing a similar characteristic.

Performance tests

The following subtests were again selected for the 1970 Study because they had yielded significant correlations and predictive value at one or more points in the 1969 regression analysis: (See Appendix D for sources of tests.)

From the Illinois Test of Psycholinguistic Abilities: Visual Reception, Visual Association, and Manual Expression.

From the Hiskey-Nebraska: Completion of Drawings.

The Knox Cubes test (SON) was included again also, even though it reached significance only for brief intervals in the 1969 analysis. The staff recognized that research has shown a strong relationship between problems of temporal sequence processing and language disorders. However, the instrumentation used in these studies consisted of sophisticated electronic devices capable of varying the time intervals between stimuli in terms of milliseconds. Non-verbal tests of temporal sequence processing suitable for use with young children are not available. Since the Knox Cubes test is one of the few nonverbal sequencing tasks available, it was decided to use it, even though it is not purely temporal sequencing nor can it be controlled electronically and precisely.

Visual-motor pattern imitation

Three new tests were selected for inclusion in the 1970 Study because they also had a temporal sequencing aspect. The three visual-motor tests selected from Mills' series of 13 were Hands and Legs, Hands, and Lips and Tongue (Appendix D).

Presumed etiology of hearing impairment. Two variables from the 1969 Study relating to medical history and the presumed history of hearing impairment were included, namely maternal rubella during this pregnancy and Rh negative blood reported for the mother. Prematurity, defined as birthweight of 5 pounds-8 ounces or less, was introduced in the 1970 Study as a separate variable.

The Testing Program

One person (a doctoral student, who had also been involved in the 1969 testing), conducted all the performance tests. One of the shortcomings of the 1969 testing program had been the insufficient number of demonstration items for several of the tests, with the result that the examiners felt that a child did not always understand what was expected of him in performing the task. To remedy this, the consulting psychologist and the examiner made up a number of additional demonstration items. The examiner worked with the child on these demonstration items until she felt certain that he understood the task. All instructions and demonstrations were presented to the child nonverbally, with only natural gestures and facial expressions. In all other respects, administration of the tasks adhered to the instructions provided in the test manuals.

As indicated, the rating scales were scored by the classroom teachers, as well as independently by the supervisory staff. An orientation period was conducted so that the teachers and supervisors understood the rating scales and to ensure uniformity of interpretation of the scaled items.

Results and Discussion

Correlations between language rating and the other variables

Appendix B, Tables 12 and 13, presents the lists of variables, showing variable name, units, means, standard deviations, simple correlations with language rating, and significance levels, for the entire group of 57 subjects, and separately for the 50 deaf subjects in the 1970 Study.

Only five of the 18 variables did not reach significance levels of .05 or better in the correlations for the entire group (N = 57). These were Age, Visual-Motor Lips and Tongue, Manual Expression, Rubella, and Rh Negative Blood.

With the deletion of the seven hard of hearing subjects, the correlations of the deaf group as compared with those of the entire group showed minor but interesting changes. All but six of the variables remained at the same or lower levels of significance, except Visual-Motor Lips and Tongue, which increased from Not Significant to .05.

Several other changes may be noted: Hearing decreased from .01 to .05, Visual Reception from .001 to .01, and Prematurity from .01 to .02.

The variables having correlations at the highest level of significance, $P < .001$ in both tables, are Home Environment, Creativity, Completion of Drawings, and Visual Association.

At the .01 level in both tables are: Sex (in favor of the girls), Cooperativeness, and Stability.

As in the 1969 Study, the large number of variables that are significantly correlated with language achievement points to the need for an index of relative importance of the variables as predictors of achievement.

Stepwise multiple regression analysis - Deaf Group (N = 50)

Table 14, Appendix B, shows the results of the multiple regression analysis through Step 16, when the program was terminated because the remaining two variables did not have sufficient F for entering the equation.

In order to control for age, the Age variable was forced to enter the equation as Step 1. At this step, its t value was .15, and it accounted for only 2.34 percent of the variance. Age achieved a significance level of .05 at Step 9, but at all other stages remained at .10 or .15. The t remained negative throughout, indicating an inverse relationship between language achievement and age.

Creativity entered at Step 2, with a highly significant $P<.0005$, and together with Age accounted for 48.57 percent of the variance. This variable remained at .005 or better through Step 6, then its significance level decreased to .05 at Step 7, and thereafter to .10 and .15 through the completion of the regression analysis.

Hearing entered at Step 2. Its significance level was .0005 also. At this step, 56.65 percent of the variance was accounted for. The significance level of this variable remained at better than .05 until the final three steps, when it decreased to .10. The negative t was expected, and indicates that the degree of hearing impairment adversely affects language development.

At Step 4, Home Environment entered, with $P<.01$, and remained at highly significant levels through Step 8, and remained at $P<.025$ or better throughout. At Step 4, 62.20 percent of the variance was explained.

Visual-Motor Lips and Tongue entered at Step 5, with $P<.10$, raising R-square to 64.08. This variable achieved a significance level of .05 at Steps 6, 7, and 8, and then decreased to the .10 level through Step 14, and finally down to .15 at the last two steps.

At Step 6, Prematurity entered, with $P < .10$. This variable remained at .05 and .10 significance levels throughout the analysis. The negative t indicates an inverse relationship between prematurity, defined as birthweight less than 5 pounds-8 ounces, and language achievement.

Completion of Drawings, a subtest of the Hiskey-Nebraska test, entered at Step 7, with $P < .05$. This variable remained with significance levels of .05 or .10 until the final step, when it decreased to only .15. At Step 7, the R-square indicated that about 68 percent of the variance had been accounted for.

At Step 8, Sex entered with a negative t, with $P < .15$, indicating a mild trend toward better language achievement on the part of the girls.

After Step 8, the following variables entered with non-significant t ($P < .20$): Cooperativeness, Stability, Visual Association, Knox Cubes, Visual-Motor Hands and Legs, Visual-Motor Hands, Rubella, and Rh Blood.

Variables not entering the equation because of insufficient F were Visual Reception and Manual Expression, both subtests of the ITPA.

Table 15, Appendix B, shows the entire multiple regression analysis printout at Step 7. For purposes of prediction, this step seemed best suited for analysis, since all of the variables entering the equation after this step had relatively low significance levels. R-square at this step is 0.67993, and increased only slightly to 0.7042 by Step 16. The variables are listed below in the order of importance as predictors, as indicated by their Beta Weights.

Rank	Variable Number and Name	t	P	Beta Weight
1	5-Home Environment	2.868	.005	.312
2	8-Creativity	1.744	.05	.256
3	4-Hearing	-2.343	.025	-.220
4	9-Completion of Drawings	1.685	.05	.210
5	14-Visual-Motor Lips and Tongue	1.935	.05	.184
6	19-Prematurity	-1.820	.05	.172

Discussion of significant predictor variables

Home environment. The interest and ability of the family to provide language stimulation and practice in the home was the basis of the ratings on this variable. In the 1970 Study, as in the 1969 Study, the importance of the home in the language achievement of deaf children was again confirmed. The home rates first as a predictor of language. This factor is discussed further in the Conclusions section of the report.

Creativity. The strength of this factor in both the 1969 and 1970 studies is noteworthy. As indicated, the 1970 Creativity scale was a revision of the Preschool Attainment Record Creativity scale (Doll, 1963). The revision included: (a) the deletion of all items directly involving audition and verbalization, and (b) the substitution of the scoring procedures to allow for gradations in response in the place of an absence-presence rating. The scale used in the 1970 Study is shown in Appendix A-4.

In the Preschool Attainment Record, this subscale is included under the heading of "Intellectual," and is in line with current thinking about the interrelationship between creativity and intelligence. Briefly stated, current thinking suggests that although creativity is not synonymous with intelligence, a certain level of intelligence (sometimes placed at about 115 IQ level) is a prerequisite to creativity.

Inspection of the correlation matrix shows that the Creativity variable is significantly correlated ($P < .05$) with 12 of the 18 other variables, listed below in rank order by size of correlation:

	r	P
Language	.6864	.001
Completion of Drawings (Hiskey)	.6527	.001
Visual Association (ITPA)	.6399	.001
Home Environment	.5793	.001
Visual Reception (ITPA)	.5569	.001
Cooperativeness	.4820	.001
Stability	.4802	.001
Knox Cubes (SON)	.3957	.01
Visual-Motor Hands	.3419	.02
Visual-Motor Lips and Tongue	.3248	.02
Sex	-.3093	.05
Visual-Motor Hands and Legs	.2770	.05

The Creativity variable was not significantly correlated with Age, Hearing, Manual Expression (ITPA), Rubella, Blood, and Prematurity.

Hearing. This variable continued as one of the three highly significant predictors of language achievement, even within the deaf group, defined here as hearing impairment of 66 dB or greater in the better ear.

Figure 8 is a scattergram showing the relationship between hearing level and Language Rating for the entire group of 57 subjects. The seven hard of hearing subjects, with hearing level of 65 dB or better, are clearly shown on this diagram with the highest ratings, with the exception of one child. The diagram also clarifies the correlation within the deaf group. Also evident, however, is the spread which makes hearing level by itself a doubtful predictor of language achievement. That is, the range in hearing among the two highest Language Rating levels is from 75 dB to 109 dB (assigned to audiograms showing hearing responses at only one of the three frequencies included in the Fletcher Average). Similarly, looking at subjects having hearing losses in the 95 to 105 range, a similar wide range of language achievement can be seen, with about one-third of the subjects having Language Ratings above the mean of 3.8 for the deaf group as a whole.

Completion of Drawings. This variable, a subtest of the Hiskey-Nebraska (Appendix D) is the only one of the standardized performance test items administered that achieved an acceptable level ($P < .05$) as a predictor of language achievement.

In this test, a series of incomplete drawings is presented, such as a girl with one leg missing, a wheel with spokes missing, and the like. The child is to draw in the missing part. It thus requires the child to examine detail as well as to see the gestalt and to execute the motor response.

The standardization data for the test provide separate norms for deaf and hearing subjects. In this study, raw scores were used, rather than published norms, for this and other variables using standardized test subtests.

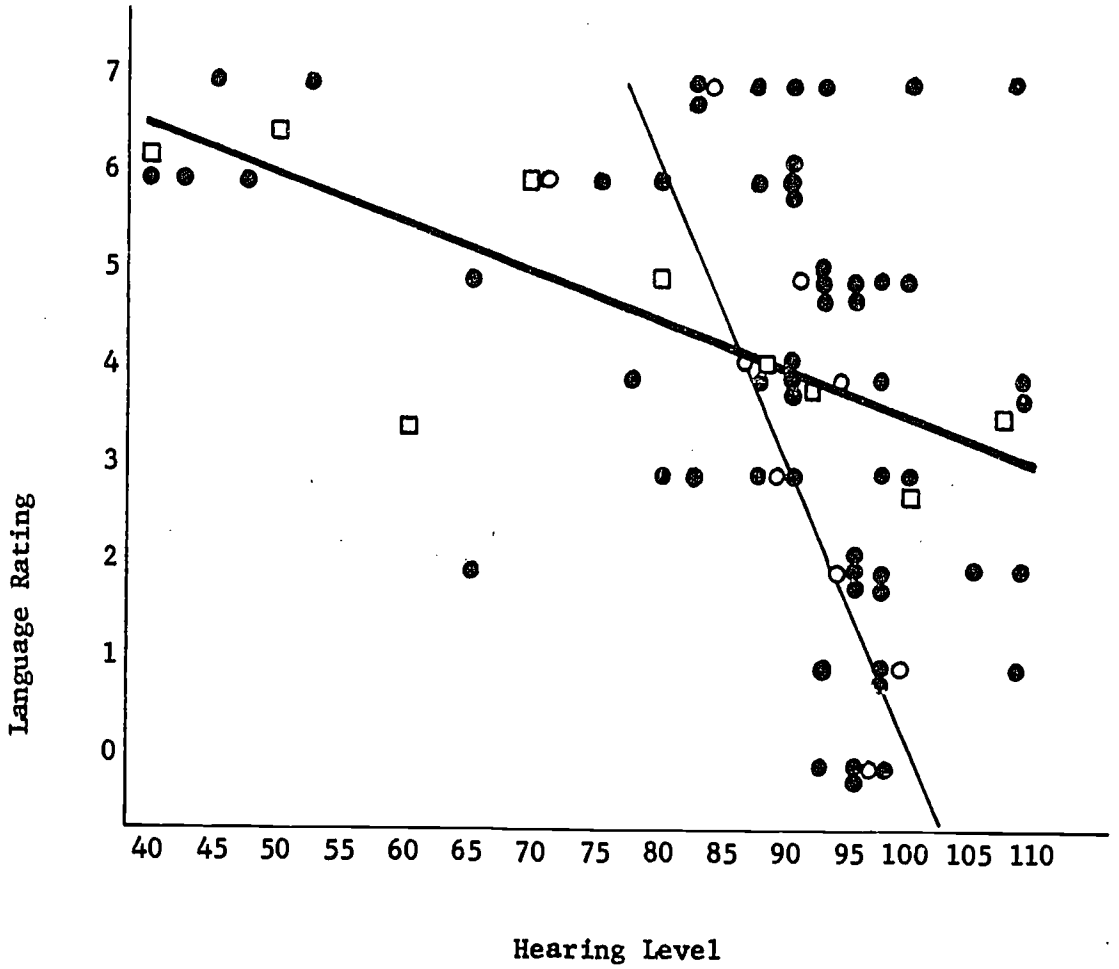


Figure 8. Scattergram showing Correlation Between Hearing Impairment and Language Rating (1970) N = 57

In the administration of this test in the 1969 Study, a large number of subjects could not score, and it was the opinion of the examiners that the children did not understand what they were expected to do, and that more demonstration items would make this a more valid test of the ability under study. For this reason, additional demonstration items were provided in the 1970 testing program. Examination of the data indicates that there was no child who failed to score on the 1970 test.

Examination of the correlation matrix for the deaf group (N = 50) shows correlations that were higher than .2306 ($P < .10$) between Completion of Drawings and the following variables:

	r	P
Language Rating	0.5739	.001
Creativity	0.6527	.001
Home Environment	0.4104	.01
Visual Reception (ITPA)	0.4641	.001
Visual Association (ITPA)	0.6217	.001
Visual-Motor Hands and Legs	0.4173	.01
Visual-Motor Hands	0.3632	.01
Knox Cubes (SCN)	0.3274	.02

The trait measured seems to have a strong congnitive (representational) component, along with visual-perceptual-motor, and to a lesser degree, visual sequencing.

Visual-Motor Lips and Tongue. This significant predictor variable was one of the three tasks selected from Mills' Series of 13 tasks which he used to assess sequencing skills in a study of normal children (Appendix D).

In this task, the child was asked to imitate the examiner's tongue placement and a patterned series of movements as to lateral protrusion upper lip midline, and lower lip midline. The patterns increased in length from a single tongue movement to one of three points demonstrated, to a series of three placement-movements. A response was scored correct only if the stimulus item was present in the response and if the sequence of items in the stimulus and the response were identical. Raw scores indicating the number of correct responses were used in this study.

Although this was described by Mills as a test of visual-motor sequencing, it involves the ability to imitate, to program, and to coordinate tongue movements, which is an essential component of motor speech expression. The significance of this test as a predictor of languge achievement may thus lie in its value as an indicator of verbal apraxia, which is often associated with aphasia and other lesser manifestations of language disability.

It should be mentioned here that in this study, an attempt was made to conduct an examination of the oral speech mechanism for each child. Because of the time and expense involved, however, it was not possible to assign the qualified speech pathologists on the Center's staff to this project. The findings of the staff selected to make the examinations were subsequently considered as not of sufficient validity and reliability to be included.

Examination of the correlation matrix shows the following correlations in the deaf group between the Visual-Motor Lips and Tongue variable and the following other variables that involved visual-motor sequencing:

Variable	r	P
Knox Cubes	.4500	.001
Visual-Motor Hands	.3762	.01
Visual-Motor Hands and Legs	.3399	.02
Manual Expression (ITPA)	.2016	N.S.

Prematurity. Prematurity had been included with "other problems of pregnancy and birth" in the 1969 Study, but was entered as a separate variable in the 1970 Study. It was defined here as birthweight less than 5 pounds-8 ounces, since no records of actual examinations for evidences of prematurity at the time of birth were available.

Eleven of the entire group (N = 57) were premature. Ten of these were in the deaf group (N = 50).

Age, which had been forced into the equation as a control variable, was shown at Step 7 with a low but negative t ($P < .10$), indicating a mild inverse relationship between age and language

achievement. Within the deaf group, the age range was 52 to 76 months. Inspection of the data reveals no ready explanation for the negative relationship, except that three of the five children in the oldest group (73 - 76 months) were on the Structured Curriculum which meant that they had made unsatisfactory progress in the regular curriculum. Thus, although in actuality all of the children progressed in language acquisition during this two-year study, the children with "special language learning problems" did not catch up to the levels achieved by the other children. And as pointed out in the Introduction to this report, these special children constitute a sizable proportion of the total population of hearing impaired children.

Study of residuals -- over-achievers and under-achievers

Table 17, Appendix B, is the printout Table of Residuals, showing Observation (subject) number, Y Value (actual language rating), Y estimate (predicted language rating), and Residual (difference between actual and predicted language rating).

In order to study the residuals for the purpose of gaining insight into the nature of the errors or inadequacies of the predictive index, Table 18, Appendix B, was prepared. This table lists all subjects whose actual Language Rating differed from the estimated (or predicted) rating by $\pm$ 1.5 points on the rating scale. The table shows Actual Language Rating, Estimated (or predicted) Language Rating, Difference (Residual), and shows the score or rating on each of the six significant predictor variables (namely, Home Environment, Creativity, Hearing, Completion of Drawings, Visual-Motor Lips and Tongue, and Prematurity).

From these tables, it can be seen that errors in prediction of $\pm$ 1.5 points on the Language Rating Scale were made in eight cases, 16 percent of the total group. In the case of six subjects, actual language achievement was from 1.6 to 2.9 points better than predicted. This indicates that 6 subjects, or 12 percent of the total sample, were "over-achievers." Stated in other terms, the predictive index underestimated the language achievement by 1.6 to 2.9 points.

In terms of the verbal designations given to the rating scale items, the underestimated cases were as follows:

Estimated	Actual	Number of Subjects	Subject I D Number
Good	Very Good	3	1, 6, 24
Fair	Good	2	4, 5
Poor	Good	1	45

Table 18, Appendix B, also shows that two subjects had actual language ratings worse than predicted. In one case, the difference was 3.29 points and in the other 1.88 points. In terms of the verbal designations, these two "under-achievers" were as follows:

Estimated	Actual	Number of Subjects	Subject I D Number
Good	Poor	1	31
Fair	Poor	1	48

Between-group comparisons - etiology

As further clarification of the factor of etiology of the hearing impairment in relation to language achievement, comparisons were made of the Language Ratings of the three dichotomized etiology groups: rubella - nonrubella; premature - full term; Rh blood in mothers - non-Rh.

Table 16, Appendix B, shows the analysis of variance of Language Ratings in these three etiologic groups. From this analysis, it may be seen that only Prematurity had a significant F in this comparison, ($P < .01$). Just as DeHirsch (1966) concluded as a result of her studies that prematurely born children must be considered as a high-risk group for reading and academic learning, the present study found that lightweight hearing impaired premature children are at risk also for language learning.

Intelligence and language achievement

It was not feasible in either the 1969 or 1970 Study to administer individual standardized intelligence tests to all of the children in the project. By the time of the 1970 Study, however, IQ scores were available for 39 of the 50 children in the deaf group (hearing loss 66+ dB).

All of these 30 subjects had been given either the Merrill-Palmer Scale or the Leiter Scale by the Center's psychologist or his assistant. The Merrill-Palmer was generally administered to the younger children, and the Leiter to the older ones.

Table 19, Appendix B, treats these two tests separately, and shows the relationships between Merrill-Palmer and Leiter Scale Scores and Age, Language, and Creativity Scores for the 39 subjects in the 1970 Study. From this table it may be seen that the mean age at which the subjects were tested with the Merrill-Palmer was 41.1 months, and with the Leiter 65.7 months. The mean IQ of the children tested at the younger age on the Merrill-Palmer was 111.7 and the mean IQ of the children tested at a later age on the Leiter was 100.0.

Table 19, Appendix B, also shows that the mean 1970 Creativity score for the Merrill-Palmer subjects was 28.4, and that of Leiter subjects was 24.0. The correlation between the Merrill-Palmer IQ scores and the 1970 Creativity ratings was .66, which is significant at less than the .01 level. Correlation between the Leiter IQ scores and the 1970 Creativity ratings was only .33, which was not significantly different from zero.

Table 20 shows further that the correlation between Language Ratings and IQ for the Merrill-Palmer group was .61, $\underline{P}$ less than .01, and for the Leiter group .64, $\underline{P}$ less than .01.

Figure 9 shows the relationship between IQ test scores (Merrill-Palmer and Leiter grouped together) and 1970 Language Ratings for the 39 of the 50 deaf subjects for whom IQ scores were available. This table dichotomizes the group into those on the Structured Curriculum (that is, the children with special language-learning problems) and those on the Regular Curriculum (children making good or better progress in a natural language oral approach).

As this table shows, for the average group, having IQ's in the 90 - 109 range, the children are about equally divided into the Structured and Regular curriculums. At the two extremes, however, the relationships between intelligence and language achievement are obvious: all but one of the 14 children having IQ's of 110 and above are in the Regular Curriculum, and all but one of the 8 children with special language learning problems in the Structured Curriculum have IQ's below 90.

IQ Range	Language Rating 0 - 3 (Structured Curriculum)	Language Rating 4 - 7 (Regular Curriculum)	Total
Above average (110 and above)	1	13	14
Average (90 - 109)	9	8	17
Below average (below 90)	7	1	8
Total	17	22	39

Figure 9. Relationships between IQ Scores and 1970 Language Ratings

Summary of the 1970 Study

During this second phase of the study, 57 of the original 69 subjects continued in the project. Of these, 50 had hearing losses of 66 dB or greater, and were studied separately as the "deaf" group. In May 1970, language performance was rated on a revised rating scale. The significant predictors from the 1969 Study were reexamined, and another testing program was conducted. Eighteen variables were used in the multiple regression

analysis. Home Environment, Creativity, and Hearing were again indicated as the most significant predictors of language achievement. Three other variables achieved levels of .05 as significant predictors: Completion of Drawings, Visual-Motor Patterns - Lips and Tongue, and Prematurity. Study of the table of residuals indicated errors of prediction of $\pm$ 1.5 points on the language rating scale in 8 cases, or 16 percent of the total. Between-group comparisons based on etiology indicated significant differences only in the case of the premature subjects. Intelligence was found to correlate with language achievement in the above-average and below-average IQ groups, but not in the average group having IQ's between 90 and 109.

DISCUSSION

The results of this study are discussed below in terms of the two major objectives of the study, namely, (1) the development of an instrument for evaluating language achievement in hearing impaired children, and (2) the discovery of a predictive index of factors related to language-learning ability and achievement in deaf children.

1. Instruments for objective assessment of language achievement in hearing impaired children

In the absence of published instruments for making objective assessments of the level of language development achieved by deaf children, two Language Rating Scales were developed, one in the 1969 Study and the second in the 1970 Study. Both were empirical scales which recorded the actual level of receptive and expressive oral language demonstrated by each child in the group. These scores were then placed in rank order, the continuum was segmented in accordance with specific criteria, and finally a numerical and a verbal designation were assigned for each point on the scale.

The expanded range of language development during the one-year period between the ratings rendered the 1969 scale inadequate for the second year of the study. The 1970 Language Rating Scale directly reflected the curriculum used in the classrooms, as to the sequence in which certain new linguistic forms were introduced (such as plurals, prepositions, etc.)

One of the major drawbacks of the Language Rating Scale is the fact of being tied to a specific curriculum, and the consequent limited applicability for its use in another setting using another curriculum.

A second aspect of these scales that limits possible broader use of them is that they cover oral language reception and expression only. The children in this program had begun to read during

the 1969-70 school year, but this was not included in the language ratings. Their reading was in some respects better than the type of skill measured in the usual standardized reading tests at the beginning first grade level, but not high enough for profitable testing with such standardized tests.

Another aspect of the scales that makes them of limited usefulness in certain school settings is that they include inadequate provision for ratings on the other instructional and communication media. In this instance, the ratings assigned to children on the Structured Curriculum were considered satisfactory for the 1970 Study, but inappropriate one year later when these children had made greater progress in this curriculum. The Regular and Structured curriculums are quite different, just as the children in each group display quite different learning characteristics. To some extent the problem of equalizing the ratings has been solved in the program, but further discussion of this is not germane to the present report.

At the time of the 1970 Study there were no children in the program using simultaneous or manual communication. Had there been, the rating scales used would not have adequately reflected their language achievements.

As indicated earlier in this report, Jenson's Pupil-Teacher Communications Scale (Restaino and Socher, 1969) holds promise as a means of rating communication behavior on a wide continuum of what she terms "progress toward oral linguistic competence." It does not provide a rating or assessment of specific linguistic forms mastered at any level or step in the progression.

A number of language curriculum outlines issued by schools for the deaf refer to "levels" but do not include age-criteria. In the opinion of this writer, there is a great need in the area of education of the deaf, for a uniform scale of linguistic performance and for related tests in the language skill areas prior to age 8 or 9 and prior to the achievement of third grade reading skill, that could be used to differentiate various levels of language achievement and acquisition.

Within the context of the present research, the Language Rating Scales used are believed to be valid instruments that satisfac' rily reflect the continuum of language performance manifested by this group of hearing impaired subjects. To the extent that verbal designations of "very good, good, etc." on the scale can be substantiated in another setting by objective test results or other data, it is believed that this study could be replicated with similar results in a representative population of hearing impaired children.

2. The predictive index

With reference to the variables that make up the index of significant predictors of language performance in the present study, the following future research needs are evident:

Home Environment. There is a need, as pointed out earlier in this report, for a better delineation of the specific aspects of the child's home and family situation that are crucial to language learning prognosis. It is now the opinion of this writer that the critical factor is the mother-child relationship. A valid and reliable scale for rating mother-child relationships in the early training of deaf infants is an urgent area for research at this time.

Creativity. The Creativity Rating Scale developed Robert A. Dowling as a part of this study is an unstandardized revision and adaptation of the Creativity subscale under the heading of "Intellectual" on the Preschool Attainment Record (Doll, 1966). There is a need to standardize this, or a similar non-verbal scale, that would reliably assess this factor. There is a further need to define the characteristic actually assessed by this scale, and to determine whether it is the same as, or only one facet of, the construct of intelligence.

Hearing. Continued progress in the development of reliable means of assessing auditory sensitivity in infants is being made and modern instruments should be used in the reliable early identification of children with impaired hearing. As indicated in this research, however, hearing level alone should not be the basis for predicting an individual child's potential for achieving oral language skills.

Completion of Drawings. The test used in this research is not suitable for use with children younger than about 3-1/2 years of age. (This is the basal age in the norms for normal-hearing children given in the test standardization data.) It may be that this factor is adequately assessed by the other measures of creativity or intelligence. Further study of this variable and of suitable means of assessing it in younger children would seem to be desirable.

Visual-Motor Patterns - Lips and Tongue. As indicated earlier, this test reflected the ability to imitate movements of the tongue in a patterned series. Further exploration of this test and the development of reliable norms seems indicated.

In addition, it seems obvious that the evaluation of a child's ability to learn oral verbal language skills should include a complete examination of the oral speech mechanism by a qualified and experienced speech pathologist. Tests of oral sensation and perception as well as tests of ability to imitate patterned sequences of tongue movement should be included as a part of this examination.

CONCLUSIONS

This exploratory study of the factors related to language learning in hearing impaired children seems to substantiate the judgment of experienced teachers and clinicians that certain organic factors have predictive implications. Among these factors are the following:

Degree of hearing impairment. Children with profound hearing losses in this study exhibited a wide range of language performance from poor to excellent. Nevertheless, the degree of hearing loss was found to be directly and adversely related to language achievement.

Prematurity. Light birthweight hearing impaired children as a group have a poorer prognosis for language achievement than do children born at term and of heavier than 5 pounds-8 ounces weight.

Coordination of the oral speech mechanism. One aspect of such coordination was assessed by tests of the child's ability to imitate and program a sequence of patterns of tongue movements, and was shown to have predictive significance.

Certain factors that reflect both innate ability and experience also seem to be related to language-learning potential in hearing impaired children. Among these are intelligence as assessed by standardized IQ tests, and a factor designated as creativity which also seems to be a measure of manifested intelligence. The Completion of Drawings subtest probably reflects both this type of intelligence and a measure of visual-motor coordination.

Of primary importance is the home environment, particularly the parent-child relationship. Every child, and the handicapped child in particular, needs a warm, loving, uninterrupted, secure relationship with his parents. Early diagnosis of hearing impairment and early intervention can help parents cope with problems that adversely affect these basic interpersonal needs. Herein would seem to lie the hope for good language achievement for those hearing impaired children who have the innate capacity for language.

BIBLIOGRAPHY

Bangs, Tina E. Language and Learning Disorders of the Pre-Academic Child. New York: Appleton-Century-Crofts, 1968.

Carrow, Sister Mary Arthur, et al. A Theoretical Approach to the Diagnosis and Treatment of Language Disorders in Children. San Antonio, Texas: Harry Jersig Speech and Hearing Center, Our Lady of the Lake College, 1969.

De Hirsch, Katrina, Jeannette J. Jansky, and William S. Langford. Predicting Reading Failure. New York: Harper & Row, 1966.

Efron, Robert. Comments on Hirsh's paper in Millikan and Darley, Brain Mechanisms Underlying Speech and Language. New York: Grune & Stratton, 1967.

Efron, Robert. "Temporal Perception, Aphasia, and Deja Vu," Brain, 86, Sept. 1963, 403-24.

Ewing, A.W.G. Educational Guidance and the Deaf Child. Washington, D.C.: The Volta Bureau, 1957.

Fiedler, Miriam F. Developmental Studies of Deaf Children. ASHA Monographics No. 13. Washington, D.C.: American Speech and Hearing Association, Oct. 1969.

Kirk, Samuel A. The Diagnosis and Remediation of Psycholinguistic Disabilities. University of Illinois: Institute for Research on Exceptional Children, 1966.

Kirk, Samual A., and James J. McCarthy. "The Illinois Test of Psycholinguistic Abilities--An Approach to Differential Diagnosis," American Journal of Mental Deficiency, 66, 3, Nov. 1961.

Lowe, Audrey D., and Richard A. Campbell. "Temporal Discrimination in Aphasoid and Normal Children," Journal of Speech and Hearing Research, 8, 3, Sept. 1965.

McGinnis, Mildred A. Aphasic Children. Washington, D.C.: Alexander Graham Bell Association for the Deaf, 1963.

Monsees, Edna K. "Aphasia in Children--Diagnosis and Education," Volta Review, 59, 7, November 1957.

Monsees, Edna K. "Experiences with Children Who Failed to Learn to Talk," Volta Review, 60, 5, September 1958.

Monsees, Edna K. "Aphasia and Deafness in Children," Exceptional Children, 25, 9, May 1959.

Monsees, Edna K. "Aphasia in Children," Journal of Speech and Hearing Disorders, 26, 1, February 1961.

Mulholland, Ann M. "The Impact of Individual Differences on Language Learning," Exceptional Children, 30, 8, April 1964.

Osgood, Charles E. Contemporary Approaches to Cognition, A Behavioristic Analysis. Cambridge: Harvard University Press, 1957.

Restaino, Lillian, and Benny Socher. "Psycho-Educational Assessment of Young Deaf Children," Project CREED 3, New York State Department of Education, 1969.

Rosenstein, Joseph, Sheila Lowenbraun, and Judith A. Jonas. "A Survey of Educational Program for Deaf Children with Special Problems in Communication in New York State," Project CREED, New York State Department of Education, 1967.

Vernon, McCay. "Characteristics Associated with Post-Rubella Deaf Children," Volta Review, 69, 3, March 1967.

Wepman, J.M., L.V. Jones, R.D. Beck, and Doris Van Pelt. "Studies in Aphasia: Background and Theoretical Formulations," Journal of Speech and Hearing Disorders, 25, 4, November 1960.

APPENDICES

APPENDIX A. CHECKLISTS AND RATING SCALES

APPENDIX A - 1

May 1969

Demographic and Other - Coding Checklist 1

Child's Name: _____ Bd. _____ M-F W-N ID No. _____

List checked and coded by: _____ Date _____

(1) Age in months at time of testing: _____ months.

(2) Hearing. Date of most recent test _____

Thresholds (ISO) for better ear at:

500 Hz 1000 Hz 2000 Hz

F.A. = _____ dB

(3) Auditory behavior

Able to discriminate between drum and bell	Yes (0) No (1)	_____
Able to discriminate between 3 or more known words	Yes (0) No (1)	_____
Responds to environmental sounds when wearing hearing aid	Yes (0) No (1)	_____
Total No (1)		_____

(4) Ability to imitate speech - Rate as
(1) Good, (2) Fair, (3) Poor, (4) No Ability

Isolated phonemes	Rating _____
Single words (CVC)	Rating _____
3-word phrases	Rating _____
Longer sentences	Rating _____

(5) Height-weight-head circumference

Height: _____ inches Percantile: _____

Weight: _____ inches Percantile: _____

Head circumference: _____ inches Percantile: _____

(6) Gross motor coordination

P.A.R. Ambulation - Attainment quotient: _____

P.A.R. Manipulation - Attainment quotient: _____

(7) Hand preference established at age 4 or over: Yes (0); No (1)_____
(If child is not yet 4 years of age, code (9).

(8) Intellectual IQ on two most recent tests:

Date of test	Name of test	by whom	IQ
_____	_____	_____	_____
_____	_____	_____	_____

Code higher IQ _____

P. A. R. Intellectual

Ideation Attainment Quotient _____

Creativity Attainment Quotient _____

(9) Home environmental factors

Parents separated or divorced, or only one parent in the home: Yes No _____

Child cared for, outside of school, by non-English speaking adult (parent or other): Yes No _____

Child cared for outside of school, by "inadequate" adult other than parents: Yes No _____

Parent(s) do not require the child to use the language he knows; accept and use gestures for communication most of the time: Yes No _____

Parent(s) do not work with the child on child's school work at home: Yes No _____

Parent(s) exhibit significantly negative emotional attitudes toward the child: Yes No _____

Other poor environmental factors: Yes No _____
Specify: _____

School's subjective rating of the adequacy of the home environment with particular reference to the parents' interest in and ability to provide language stimulation and practice at home, taking into account the factors circled "Yes" above:

Poor ( ); Fair to poor ( ); Fair to good ( );
Good ( ); Very good ( ) _____

(10) Present behavior characteristics: (Circle one rating on each of the scales.)

	1	2	3	4	5
a.	Withdrawn, autistic-like	Inclined to be shy or withdrawn	Normally outgoing	Inclined to be aggressive toward others	Seriously aggressive
b.	Passive	Somewhat too quiet and passive	Normally active	Mildly or occasionally hyperactive	Usually hyperactive (except when on medication, if used)
c.	Often uncooperative, stubborn	More like 1 than 3	Needs to be coaxed or humored, but then usually cooperates	More like 5 than 4	Normally cooperative
d.	Very rigid and ritualistic	More like 1 than 3	Gets upset occasionally when schedules, etc. changed, but not very serious problem	Has some problem of adjusting to change	Normally flexible and adaptable
e.	Generally unpredictable Has good and bad period during a single day, cause generally unknown	Good and bad days, cause usually unknown	Easily upset, cause often unknown	Somewhat easily upset (less than 3) cause usually is known, child generally relaxed	Emotionally stable and predictable; seldom upset except for cause and in proportion to the cause

APPENDIX A - 2

May 1969

Case History - Coding Checklist II

Child's Name _____ Bd. _____ M-F W-N ID No. _____

List checked and coded by: _____ Date _____

(1) Family history

Circle yes if at least one parent, sibling, aunt, or uncle has/had the following:

Congenital hearing impairment (hereditary, or other etiology)	Yes No _____
Late (4 years of age or older) in talking	Yes No _____
Problem in learning to read beyond age 7	Yes No _____
Severe speech problem (stuttering, severe articulation problem, cleft palate, or other)	Yes No _____
Epilepsy, mental retardation, cerebral palsy, or autism	Yes No _____
Other (specify)_____	
	Sum: _____

(2) Pregnancy and birth history

Rubella during pregnancy confirmed by tests ( ) or suspected ( )	Yes No _____
Code 9 if no rubella. If yes for rubella, circle yes for first trimester, or no for second or third trimester	Yes No _____
Mother was seriously ill during pregnancy Specify: _____	Yes No _____
Any drugs other than vitamins taken by mother during this pregnancy. Specify _ _____	Yes No _____
Mother smoked or drank heavily during pregnancy	Yes No _____
Blood incompatibility: Mother is Rh negative ( ); or ABO combination ( )	Yes No _____
Number of miscarriages mother has had: _____	
Threatened miscarriage during this pregnancy Specify how serious: _____	Yes No _____
Length of this pregnancy: _____ weeks	
Birth weight of infant: _____ lbs.	
Circle yes for prematurity based on these factors	Yes No _____

False labor ( ); prolonged labor _____ hours ( )
or precipitous delivery ( ) Yes No _____
Anesthetic used during delivery Yes No _____
Specify type: _____
Complications during delivery Yes No _____
Breech ( ); Caesarian ( ); placenta previa ( );
Other - Specify: _____
Infant was cyanotic (blue) Yes No _____
Infant was jaundiced Yes No _____
Blood transfusion or exchange administered Yes No _____
Oxygen administered to infant Yes No _____
Infant had trouble breating ( ) or sucking ( ) Yes No _____
Other complications of delivery or birth
Specify: _____

Rating scale of severity of problems of pregnancy and delivery based upon above factors: Circle: (1) No problems; (2) Mild; (3) Moderately severe (4) Severe; (5) Very severe Code: _____

(3) Medical history

Meningitis ( ) or encephalitis ( ) Yes No _____
If yes, was illness before the onset of speech Yes No _____
Specify age: _____
Other illnesses accompanied by high fever 105°+ Yes No _____
Specify: measles ( ); mumps ( ); flu ( );
Other: _____ _____
Other diseases not accompanied by high fever; Yes No _____
Specify: _____
Drug intake by child during illness: Yes No _____
Specify: _____
Severe injury or trauma accompanied by loss of consciousness or other sequalae Yes No _____
Severe injury or trauma (car accident, fall, blow on head, etc.) not accompanied by loss of consciousness or balance.
Specify: _____ Yes No _____
One or more episodes of fainting ( ), convulsions ( ), or breath-holding ( ) Yes No _____
Abnormal EEG reported Yes No _____
Problem of balance reported. Specify: _____ Yes No _____
_____

Physical problems other than hearing have been diagnosed. Specify: vision ( ); heart ( ); other: _____ Yes No _____

Congenital deformities. Specify: _____ Yes No _____

_____

Other severe medical problems. Specify: _____ Yes No _____

_____

(4) Developmental history, including language

Late in walking unsupported (average = 12-18 mos.) Yes No _____

Toilet training was difficult and child was unable to care for self at toilet until 3-1/2 years or older Yes No _____

Had problems of chewing and swallowing Yes No _____
If yes, is problem still present? _____

Child started to talk (said at least 5 words clearly) and then stopped without obvious cause Yes No _____

Child had normal language development that stopped following known illness Yes No _____
Specify: _____

Child used jargon beyond age of 3 years Yes No _____
(Definition: Speech that is fluent and has some normal-sounding intonation patterns, but includes only occasional or no intelligible words.)

Rating of child's developmental history other than language development: Circle one:
(1) Very slow or severely deviant; (2) Moderately slow or deviant; (3) Essentially normal. _____

(5) Therapy and educational background

Age in months when child's hearing impairment was first diagnosed by physician ( ) or audiologist ( ) _____

_____ _____

Age in months when child received his first hearing aid _____

Age in months when child was first enrolled in a parent-training or nursery program for hearing impaired children

Specify type of program: _____ _____

Approximate number of individual therapy sessions or days of attendance in special nursery for hearing impaired prior to the age of 3 years, 0 months _____

Approximate number of individual therapy sessions only or attendance in special nursery for hearing impaired (with or without individual tutoring) as a part of the program _____

Cued speech has been used by teachers and parents on a fairly regular and consistent basis _____

APPENDIX A - 3

Title VI Special Study - 1970
Rating Scales

Child's Name _____ Bd. _____ M-F 1970 ID No. _____

Rated by: _____ Date _____

1. Environmental factors

Parents separated or divorced, or only one parent in the home: Yes No _____

Child cared for outside of school by non-English speaking adult (parent or other): Yes No _____

Child cared for outside of school by "inadequate" adult other than parents: Yes No _____

Parent(s) do not require the child to use the language he knows; accept and use gestures for communication most of the time: Yes No _____

Parent(s) do not work with child on child's school-work at home: Yes No _____

Parent(s) exhibit significantly negative emotional attitudes toward the child: Yes No _____

Other poor environmental factors - Specify: _____ Yes No _____

School's subjective rating of the adequacy of the home environment with particular reference to the parents' interest in and ability to provide language stimulation and practice at home, taking into account the factors circled "yes" above: Circle one of the following:

1	2	3	4	5
Poor	Fair to poor	Fair to good	Good	Very good

2. Behavior Rating A - Circle one:

1	2	3	4	5
Often uncooperative, stubborn	More like 1 than 3	Needs to be coaxed or humored, but then usually cooperates	More like 5 than 3	Normally cooperative

3. Behavior Rating B - Circle one:

1	2	3	4	5
Generally unpredictable. Has good and bad periods during a single day, cause generally unknown.	Good and bad days, cause unknown.	Easily upset, cause often unknown.	Somewhat easily upset (less than 3); cause usually is known. Child generally relaxed.	Emotionally stable and predictable. Seldom upset except for cause and in proportion to the cause.

APPENDIX A - 4

Creativity Rating Scale - 1970 Study
(Revised by Dr. Robert Dowling,
Staff Psychologist)

Behavior Rating C

Use the following numerical scale to rate each item. The basic task is to rate the extent to which the child actually displays the type of behavior discussed:

0 - not at all
1 - rarely (or slightly)
2 - occasionally (or mildly)
3 - frequently (or definitely)
4 - very frequently (or to a great extent)

1. "Tests"

Tries things out as if searching, e.g., takes thing apart, piles things together or otherwise explores as if "to see what will happen if . . ." Rating _____

2. "Questions"

Shows an inquisitive interest in his surroundings by gesture or action, e.g., pulls open draws, looks into bags, "asks" why. Rating _____

3. "Transfers"

Moves things about, rearranges objects, carries objects in containers purposefully and with some constructiveness and originality (i.e., not merely as a way of being negative or destructive). Rating _____

4. "Explores"

Investigates his surroundings, i.e., goes about school or playground in what might be called an adventuresome way (for example, trying out a new toy on the playground without much teacher encouragement). Rating _____

5. "Tears"

Cuts with scissors, unwraps packages, pulls things apart, etc., in purposive ways of learning, experiencing and practicing. Rating _____

6. "Builds"

Engages in behaviors that show imagination in the use of construction toys such as blocks, building bricks, etc. Rating _____

7. "Paints"

Uses pencil or crayon for making visual representations of people, things, animals, designs, diagrams, etc., that are recognizable but not necessarily "artistic" or precise. Rating _____

8. "Individualizes"

Shows some degree of personal "style" in his "artistic" productions regardless of the medium or degree of sophistication. Rating _____

9. "Solos"

Demonstrates self-reliance in his various activities such as "singing," dancing, performing, etc. (that is, does these things with enjoyment, on his own and with little or no support from teachers or peers). Rating _____

10. "Experiments"

Tries new or unusual ways of doing things, i.e., creates his own methods or techniques in his play or other activities. (These should not be compulsive habits but rather constructive and imaginative ways of doing things that show some freedom from the conventional.) Rating _____

APPENDIX B - TABLES

APPENDIX B - TABLES (Continued)

APPENDIX B - 1

Table B-1. Presumed etiology of hearing impairment 1969 Study

Etiology		N	Percent
Rubella only		11	15.9
Blood incompatibility only		2	2.9
Other problems only		9	13.0
Multiple problems			
Rubella, blood incompatibility and other	8		
Rubella and blood incompatibility only	2		
Rubella and other	30		
Blood incompatibility and other	4		
Total cases of multiple problems		44	63.8
Etiology unknown (none of the above three factors)		3	4.4
Total	N =	69	100.00

APPENDIX B - 2

Table B-2. Presumed etiology of hearing impairment 1969 Study

Etiology	N	Percent
a. Rubella alone or in combination	51	73.9
b. Blood incompatibility alone or in combination	16	23.1
c. Other problems with neither rubella nor blood incompatibility	9	13.0
d. Unknown	3	4.3

(Note: There is overlapping in categories a and b.)

APPENDIX B - 3

Table B-3. Global ratings on presumed etiology of hearing impairment 1969 Study

Score	Rubella	Blood Incompatibility	Other Problems of Pregnancy and Birth	N
5	Yes	Yes	Yes	8
4	Yes	Yes	No	2
3	Yes	No	Yes	30
2	No	Yes	Yes	4
1	Yes on any one item			22
0	No on all three items			3
			N =	69

Mean Global Rating = 2.46 S.D. = 1.38

APPENDIX B - 4

Table B-4. Distribution of ratings on Language Rating Scale, May 1969

Rating	No. Subjects	%	Cumulative %
Poor			
0	2	2.9	2.9
1	10	14.5	17.4
Fair			
2	8	11.6	29.0
3	8	11.6	40.6
Good			
4	9	13.0	53.6
5	13	18.8	72.4
Very Good			
6	5	7.2	79.6
7	10	14.5	94.1
Excellent			
8	4	5.7	99.8
	N = 69	99.8	

Mean = 4.10 S.D. 2.26

APPENDIX B - 5

Table B-5. List of variables showing variable name, units, means, standard deviations, simple correlation with criterion (variable number 3, Language Rating) and significance levels, May 1969.

Variable Name	Units	Mean	S.D.	r	P
1. Sex (maleness)	0 - 1	.51	.504	-.278	.02
2. Race (Non-white = 1)	0 - 1	.26	.442	-.262	.05
3. Language Rating	0 - 8	4.10	2.26	-	-
4. Chronological age	months	54.06	4.38	-.027	NS
5. Auditory Sequential Memory (ITPA)	PLA	15.49	16.83	.559	.001*
6. Repetition of words and Sentences (MP or WPPSI)	MA	7.83	10.95	.669	.001*
7. Picture Memory (SON)	MA	57.81	17.66	.341	.01
8. Sequential Memory (Knox Cubes-SON)	Scaled Score	20.84	7.13	.513	.001
9. Visual Sequential Memory (ITPA)	PLA	50.83	17.33	.398	.001
10. Farm Board (Sequin-MP)	MA	58.22	10.01	.353	.01
11. Geometric Designs (MP or WPPSI)	MA	52.43	11.23	.395	.001
12. Block Designs (WPPSI)	MA	52.87	18.56	.294	.02
13. Completion of Drawings (Hiskey)	MA	50.14	32.51	.328	.01
14. Visual Closure (ITPA)	PLA	46.65	20.56	.384	.001
15. Holding a pencil	0 - 2	1.80	.40	.087	NS

APPENDIX B - 5 (Continued)

Variable Name	Units	Mean	S. D.	r	P
16. Buttons (MP)	MA	47.00	14.36	.216	NS
17. Manual Expression (ITPA)	PLA	54.97	19.99	.099	NS
18. Visual Reception (ITPA)	PLA	45.19	15.58	.487	.001
19. Visual Association (ITPA)	PLA	41.78	17.35	.438	.001
20. Analogies (SON)	MA	42.00	29.46	.427	.001
21. Sorting (SON)	MA	58.11	12.59	.330	.01
22. Rapport (PAR)	AQ	113.22	23.88	.529	.001
23. Responsibility (PAR)	AQ	127.68	34.77	.297	.02
24. Hearing - F. A.	dB	87.94	18.77	-.489	.001
25. Auditory discrimination impairment rating	0 - 4	1.03	1.43	-.454	.001
26. Ambulation (PAR)	AQ	124.22	23.08	.254	.05
27. Manipulation (PAR)	AQ	119.06	27.22	.097	NS
28. IQ [1]	IQ	108.94	17.87	.588	.001
29. Ideation (PAR)	AQ	83.30	28.80	.718	.001*
30. Creativity (PAR)	AQ	81.78	24.46	.554	.001
31. Unfavorable environment rating	1 - 5	2.49	1.06	-.594	.001
32. Behavior - withdrawn/ aggressive	0 - 2	.39	.52	-.171	NS
33. Behavior - passive/ hyperactive	0 - 2	.30	.55	-.273	.05
34. Behavior - cooperativeness	1 - 5	4.04	1.14	.214	NS
35. Behavior - rigid/flexible	1 - 5	4.49	.93	.192	NS

APPENDIX B - 5 (Continued)

Variable Name	Units	Mean	S. D.	r	P
36. Behavior - stability	1 - 5	4.30	1.07	.132	NS
37. Family history of hearing impairment	0 - 1	.14	.35	.366	*
38. Family history of speech and language problems	0 - 1	.19	.39	.143	NS
39. Rubella	0 - 1	.74	.44	-.164	NS
40. Blood incompatability	0 - 1	.23	.42	.113	NS
41. Other problems of pregnancy and birth	0 - 1	.74	.44	-.135	NS
42. Global rating of 39, 40 and 41	0 - 5	2.46	1.38	-.119	NS
43. Age when rehabilitative training started	months	30.58	10.12	.168	NS

[1] - N = 37 on this item only. N = 69 on all other variables.

* - deleted. See discussion.

APPENDIX B - 6, 7, 8

Table 6. Significant Predictor Variables at Step 10 1969 Study

Variable Number and Name	Coefficient	t	P*	Beta Weight
31 Environment	-.0885	-5.845	.0005	-.416
3 Hearing	-.0450	-5.981	.0005	-.373
5 Creativity	.0255	3.664	.0005	.270
19 Visual Association	.0287	2.704	.01	.223
7 Manual Expression	-.0227	-2.776	.01	-.203
13 Completion of Drawings	.0113	2.108	.025	.158
18 Visual Reception	.0188	11.701	.05	.131

*df = 58 one tail
Language Constant Cooefficient = 7.7510
R^2 = 0.79506 N = 69

Table 7. Significant Predictor Variables at Step 20 1969 Study

Variable Numbe. and Name	Coefficient	t	P*
24 Hearing	-.0472	-4.3569	.0005
31 Environment	-.7417	-4.4989	.0005
30 Creativity	.0257	3.4445	.005
1 Sex (maleness)	-.8440	-2.3184	.025
18 Visual Reception	.0274	2.1987	.025
16 Buttons	-.0259	-1.7441	.05
36 Unstability	-.0263	-1.7889	.05

*df = 48 one tail
Language Constant Coefficient = 7.1155
R^2 = 0.83281 N = 69

Table 8. Significant Predictor Variables at Stepl 30 1969 Study

Variable Number and Name	Coefficient	t	P*	Beta Weight
24 Hearing	-.0479	-4.970	.0005	-.397
31 Environment	-.6724	-3.471	.005	-.316
30 Creativity	.0280	3.356	.005	.303
1 Sex (maleness)	-.8652	-2.089	.025	-.208
13 Completion of Drawings	.0134	2.046	.025	.187
36 Unstability	-.3398	-2.019	.025	-.148
18 Visual Reception	.0265	1.871	.05	.179

*df = 40 one tail
Language Constant Cooefficient = 6.221
R^2 = 0.84697 N = 69

APPENDIX B - 9, 10

Table 9. Presumed Etiology of Hearing Impairment in Deaf Group
N = 50 1970 Study

	* N	%
Rubella alone or in combination with blood incompatibility and/or prematurity	39	78
Blood incompatibility alone or in combination	8	16
Prematurity alone or in combination	10	20
None of these problems	6	12

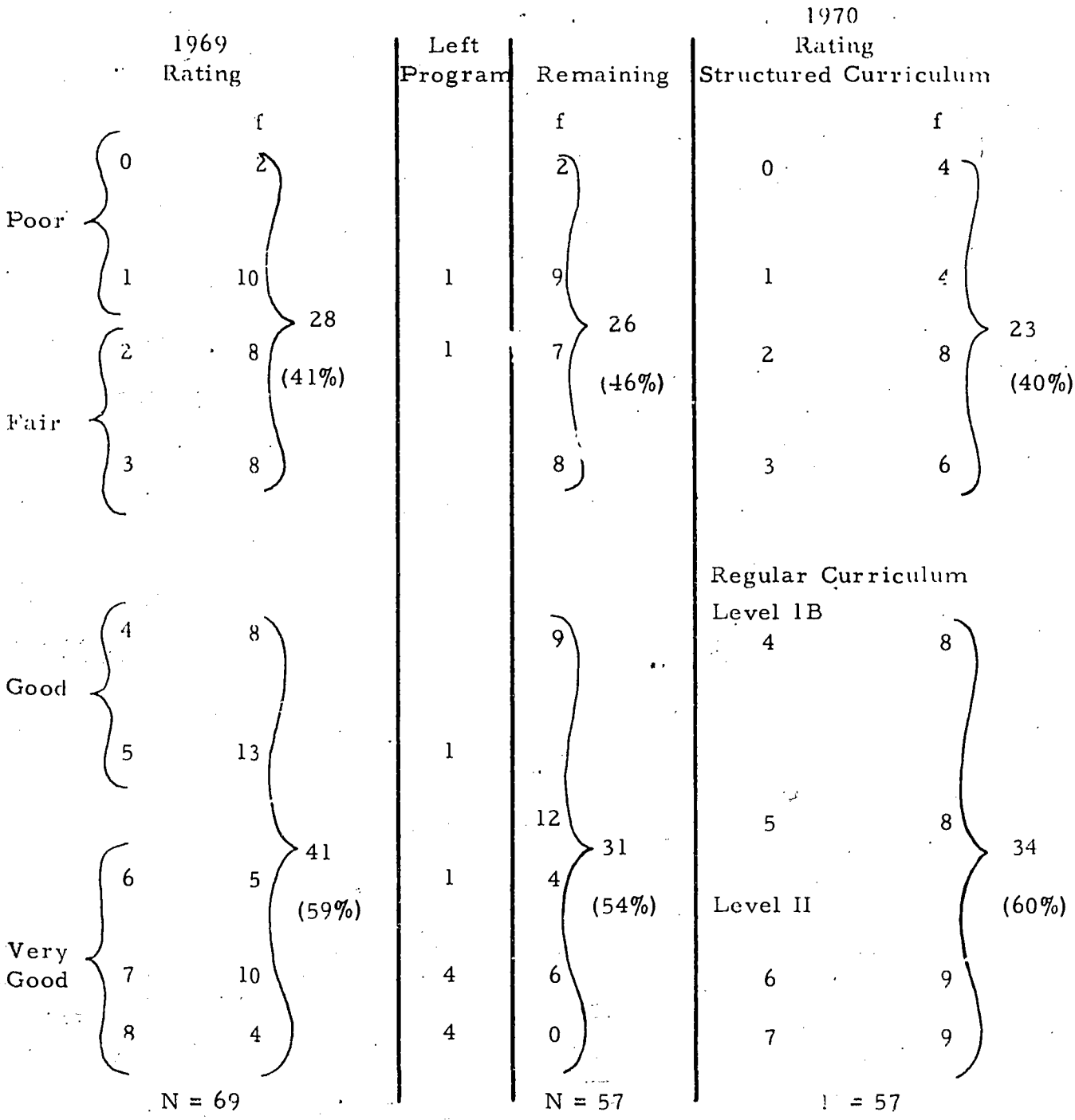
*There is overlap among the categories. Therefore total exceeds N of study.

Table 10. Presumed Etiology of Hearing Impairment in Deaf Group
N = 50 1970 Study

		N	%
Rubella only		29	58
Blood incompatibility only		2	04
Prematurity only		2	04
Multiple problems			
Rubella with blood incompatibility	3		
Rubella with prematurity	5		
Rubella with blood incompatibility and prematurity	2		
Non-rubella; blood incompatibility with prematurity	1		
Total multiple problems		11	22
None of these problems		6	12
	N =	50	100

APPENDIX B - 11

Distribution of Language Ratings



APPENDIX B - 12

Table 12. List of variables showing variable number and name, units, means standard deviations, simple correlations with language rating (variable No. 1) and significance levels - 1970 Study. N = 57

Number	Name of Variable	Units	Mean	S.D.	r	P*
1	Language	rating	4.01	2.18	-	-
2	Age	months	66.35	4.26	-.216	NS
3	Sex (maleness)	0 - 1	.53	.50	-.366	.01
4	Hearing	dB	88.38	16.35	-.399	.01
5	Home Environment	rating	3.73	1.25	.575	.001
6	Cooperativeness	rating	3.79	1.22	.385	.01
7	Stability	rating	4.07	1.26	.385	.01
8	Creativity	rating	26.38	8.56	.684	.001
9	Completion of Drawings	score	8.59	2.91	.568	.001
10	Visual Reception	score	12.61	5.05	.418	.001
11	Visual Association	score	13.29	5.36	.451	.001
12	Knox Cubes	score	6.95	2.32	.352	.01
13	V-M Hands and Legs	score	7.28	1.95	.296	.05
14	V-M Lips and Tongue	score	6.23	2.03	.184	NS
15	V-M Hands	score	5.91	1.49	.291	.05
16	Manual Expression	score	22.33	4.33	.026	NS
17	Rubella	0 - 1	.75	.43	-.014	NS
18	Blood Incompatibility	0 - 1	.19	.40	.181	NS
19	Prematurity	0 - 1	.19	.40	-.374	.01

*Reference: Yamane, Taro. Statistics, An Introductory Analysis, New York: Harper & Row. Table 8A.

APPENDIX B - 13

Table 13. List of variables showing variable number and name, units, means, standard deviations simple correlations with Language Rating, and significance levels, 1970 Study, for deaf group N = 50

Number	Name of Variable	Units	Mean	S.D.	r	P*
1	Language	rating	3.80	2.17	-	-
2	Age	months	66.96	4.03	-.153	NS
3	Sex (maleness)	0 - 1	.56	.50	-.364	.01
4	Hearing	dB	93.62	8.01	-.305	.05
5	Home Environment	rating	3.658	1.308	.580	.001
6	Cooperativeness	rating	3.738	1.322	.364	.01
7	Stability	rating	3.998	1.322	.359	.01
8	Creativity	rating	26.18	8.82	.686	.00
9	Completion of Drawings	score	8.54	2.98	.574	.001
10	Visual Reception	score	12.20	4.45	.389	.01
11	Visual Association	score	13.30	5.48	.463	.001
12	Knox Cubes	score	6.84	2.39	.332	.02
13	V-M Hands and Legs	score	7.12	1.80	.210	NS
14	V-M Lips and Tongue	score	6.36	1.89	.307	.05
15	V-M Hands	score	5.90	1.54	.305	.05
16	Manual Expression	score	22.28	4.28	.046	NS
17	Rubella	0 - 1	.78	.418	.108	NS
18	Blood Incompatibility	0 - 1	.16	.370	.117	NS
19	Prematurity	0 - 1	.20	.404	-.327	.02

*Reference: Yamane, Taro. Statistics, An Introductory Analysis, New York: Harper & Row. Table 8A.

Appendix B - Table 14. Multiple Regression Analysis, Steps 1-16, showing Predictor Variables with t, significance levels (P), and R^2 at each step. 1970 Study - Deaf group, N=50

STEP NO.		2 AGE	3 SEX	4 HEARING	5 ENVIRN.	6 COOPT.	7 STABL.	8 CREATV.	9 CODRAW	10 VISREC	11 VISASN	12 KNOXCU	13 VMBL	14 VMLT	15 VMMND	16 MANEXD	17 RUBLLA	18 BLOOD	19 PREMY	R^2
1	t	-1.0716																		.0234
	p	.15																		
2	t	-1.1550						6.5001												.4857
	p	.15						.0005												
3	t	-1.0498		-2.9286				6.9536												.5665
	p	.15		.005				.0005												
4	t	-1.1268		-3.1944	2.5712			4.5118												.6220
	p	.15		.005	.01			.0005												
5	t	-1.1881		-3.2653	2.8270			3.7270						1.5153						.6408
	p	.15		.005	.005			.0005						.10						
6	t	-1.2779		-2.9377	2.8873			3.3404						1.7127					-1.4840	.6583
	p	.15		.005	.005			.005						.05					.10	
7	t	-1.6468		-2.3428	2.8683			1.7440	1.6852					1.9349					-1.8199	.6799
	p	.10		.025	.005			.05	.05					.05					.05	
8	t	-1.6178	-1.1068	-2.1965	2.6918			1.5202	1.8499					1.6897					-1.8893	.6892
	p	.10	.15	.025	.005			.10	.05					.05					.05	
9	t	-1.7291	-1.1757	-1.9372	2.5421			1.4758	1.8755					1.6128				.7583	-1.8955	.6936
	p	.05	.05	.05	.01			.10	.05					.10				.25	.05	
10	t	-1.5921	-1.1498	-1.9337	2.4556			1.4550	1.8877				-.4044	1.6420				.7270	-1.8955	.6949
	p	.10	.15	.05	.01			.10	.05				NS	.10				.25	.05	
11	t	-1.5625	-1.2326	-1.9122	2.4871			1.2613	1.9118			.6068	-.6657	1.3840				.6159	-1.6908	.6978
	p	.10	.15	.05	.01			.15	.05			NS	NS	.10				NS	.05	
12	t	-1.2128	-1.2823	-1.8187	2.4973			1.1832	1.8298			.6477	-.6892	1.3665			.4601	.6478	-1.6178	.6996
	p	.15	.15	.05	.01			.15	.05			NS	.25	.10			NS	NS	.10	
13	t	-1.2518	-1.1634	-1.7951	2.2237	-.4428		1.2467	1.5589			.5917	-.7628	1.3840			.4964	.7639	-1.5304	.7012
	p	.15	.15	.05	.025	NS		.15	.10			NS	.25	.10			NS	.25	.10	
14	t	-1.2649	-.0593	-1.6682	2.3065	-.5616		1.2730	1.4099			.3289	-.8585	1.3326	.5589		.6066	.9013	-1.6117	.7038
	p	.15	NS	.10	.025	NS		.15	.10			NS	.20	.10	NS		NS	.20	.10	
15	t	-1.2441	.0491	-1.6519	2.2666	-.4493	.1716	1.2579	1.4007			.3524	-.8356	1.2496	.5319		.5706	.8901	-1.5153	.7041
	p	.15	NS	.10	.025	NS	NS	.15	.10	Did		NS	.25	.15	NS	Did	NS	.20	.10	
16	t	-1.2249	.0965	-1.6305	2.1023	-.4350	.1489	1.1389	1.2327	Not	.1030	.3525	-.8241	1.2352	.4945	Not	.5681	.8432	-1.4688	.7042
	p	.15	NS	.10	.025	NS	NS	.15	.15	Enter	.20	NS	.25	.15	NS	Enter	NS	.20	.10	

NS = P .20 1970 Study - Deaf group. N = 50

APPENDIX B - 15

Table 15. Multiple Regression Analysis Printout at Step 7

Step Number 7
Variable Entering 9
Multiple R 0.82458
Std Error of Y.X 1.32392
R Square 0.67993

Multiple Regression Equation

Variable		Coefficient	Std. Error	T Value	Partial Cor.	Beta
Language =						
Constant		8.7037+000	3.8392+000	2.2671+000		
Age	X- 2	-7.9663-002	4.8373-002	-1.6468+000	-2.4629-001	-1.4819-001
Hear	X- 4	-5.9484-002	2.5390-002	-2.3428+000	-3.3997-001	-2.2006-001
Envirn	X- 5	5.1714-002	1.8030-002	2.8683+000	4.0472-001	3.1227-001
Creatv	X- 8	6.2827-002	3.6024-002	1.7440+000	2.5987-001	2.5582-001
CoDraw	X- 9	1.5309-001	9.0843-002	1.6852+000	2.5166-001	2.1039-001
VMlt	X-14	2.1071-001	1.0890-001	1.9349+000	2.8608-001	1.8407-001
Premy	X-19	-9.2247-001	5.0688-001	-1.8199+000	-2.7036.001	-1.7204-001

Analysis of variance for reduction in SS due to variable entering

Source	DF	SS	MS	F
Due regression	7	1.56384+002	2.23406+001	1.27460+001
Dev. from reg.	42	7.36156+001	1.75275+000	
Total	49	2.30000+002	4.69388+000	

Partial Cor. for Var. Not in Equation

Variable		Coefficient	F for Selection
Sex	X- 3	-1.7033-001	1.2250+000
Coopt	X- 6	-3.6044-002	5.3337-002
Stabl	X- 7	-5.6095-002	1.2942-001
VisRec	X-10	6.4570-003	1.7095-003
VisAsn	X-11	6.1968-002	1.5805-001
KnoxCu	X-12	2.6082-002	2.7911-002
VMHL	X-13	-7.4029-002	2.2593-001
VMHnd	X-15	5.4097-002	1.2034-001
ManExp	X-16	-9.7761-003	3.9188-003
Rubella	X-17	2.2489-002	2.0746-002
Blood	X-18	9.8438-002	4.0118-001

APPENDIX B - 16

Table 16. Analysis of variance of Language Ratings in three etiology groups -- rubella, prematurity, and Rh negative mothers. 1970 Study N = 57

	Mean	S.D.	N	F	P
Rubella	4.0	2.0	43	.01	NS
No rubella	4.1	2.8	14		
Premature*	2.4	2.2	11	8.9	.01
Full term	4.4	2.0	46		
Blood	4.8	1.8	11	1.9	NS
Non-blood	3.8	2.2	46		

*Birthweight less than 5 pounds-8 ounces.

APPENDIX B - 17

Table 17. Table of Residuals 1970 Study, deaf group N = 50

Observation	Y Value	Y Estimate	Residual
1	7.000000	5.246599	1.753401
2	4.000000	3.384621	0.615379
3	3.000000	3.838040	-0.838040
4	5.000000	3.356912	1.643088
5	5.000000	3.371910	1.628090
6	7.000000	4.478569	2.521431
7	4.000000	4.050915	-0.050915
8	5.000000	5.444780	-0.444780
9	1.000000	2.229977	-1.229977
10	6.000000	4.897662	1.102338
11	3.000000	3.134263	-0.134263
12	3.000000	4.326234	-1.326234
13	6.000000	6.071765	-0.071765
14	5.000000	4.432544	0.567456
15	2.000000	2.758779	-0.758779
16	4.000000	3.195388	0.804612
17	0.000000	0.314966	-0.314966
18	7.000000	5.973058	1.026942
19	4.000000	4.034337	-0.034337
20	5.000000	4.403989	0.596011
21	6.000000	6.540677	-0.540677
22	6.000000	6.400842	-0.400842
23	7.000000	6.123050	0.876950
24	7.000000	4.571498	2.428502
25	3.000000	3.866079	-0.866079
26	2.000000	1.672343	0.327657
27	6.000000	7.001634	-1.001634
28	4.000000	5.493903	-1.493903
29	2.000000	2.864560	-0.864560
30	2.000000	0.650363	1.349637
31	1.000000	4.285701	-3.285701
32	7.000000	6.975495	0.024505
33	4.000000	4.177765	-0.177765
34	2.000000	1.546733	0.453267
35	2.000000	2.224243	-0.224243
36	2.000000	2.383350	-0.383350

APPENDIX B - 17 (Continued)

Observation	Y Value	Y Estimate	Residual
37	1.000000	1.122058	-0.122058
38	7.000000	6.046377	0.953623
39	3.000000	3.898575	-0.898575
40	5.000000	4.972571	0.027429
41	0.000000	0.994362	-0.994362
42	2.000000	2.489886	-0.489886
43	6.000000	6.839401	-0.839401
44	4.000000	2.927874	1.072126
45	4.000000	1.141257	2.858743
46	0.000000	1.411063	-1.411063
47	5.000000	5.306744	-0.306744
48	1.000000	2.879225	-1.879225
49	3.000000	3.528650	-0.528650
50	0.000000	0.718414	-0.718414

Von Neumann Ratio 1.99119 Durbin-Watson Test 1.95137

Autocorrelation Function of Residuals

1) -0.0021 2) 0.0328 3) -0.1190 4) 0.0890

Table 18. Over-Achievers and Under-Achievers in Terms of Actual Language Rating (Y) ± 1.5 Rating Scale Points from Predicted Rating (Y Estimate) 1970 Study N = 50 (deaf)

Subject ID#	Actual Language Rating (Y Value)	Estimated Language Rating (Y Est.)	Difference ± 1.5 Points (Residual)	#5 Home Environment Mean = 3.66 SD = 1.31 Beta .312	#8 Creativity Mean = 26.18 SD = 8.82 Beta .256	#4 Hearing Mean = 93.62 SD = 8.01 Beta -.220	#9 Completion of Drawing Mean = 8.54 SD = 2.98 Beta .210	#14 V-M Lips and Tongue Mean = 6.360 SD = 1.893 Beta .184	#19 Pre-maturity Yes/No Beta .17
1 S A	7 Very Good	5.25 Good	+ 1.73	5.0	40.0	100	11	9	yes
4 A B	5 Good	3.36 Fair	+ 1.64	4.0	30.0	93	10	6	yes
5 C B	5 Good	3.37 Fair	+ 1.63	3.5	32.0	93	9	7	no
6 M B	7 Very Good	4.48 Good	+ 2.52	3.5	25.0	93	12	7	no
24 A L	7 Very Good	4.57 Good	+ 2.43	5.0	40.0	109	8	6	no
45 G S	4 Good	1.14 Poor	+ 2.86	2.5	8.0	90	7	0	no
31 W M	1 Poor	4.29 Good	- 3.29	5.0	30.0	93	12	2	no
48 H V	1 Poor	2.88 Fair	- 1.88	4.5	26.0	109	10	6	yes

Language Rating Mean = 3.80; S.D. 2.17

APPENDIX B - 19

Table 19. Relationship between Merrill-Palmer scale and Leiter scale IQ scores, Age when test administered, 1970 Language Ratings, and 1970 Creativity Ratings

Scale	n	Age*		IQ		Language**				Creativity		
		Mean	SD	Mean	SD	Mean	SD	F	P	Mean	SD	F
Merrill-Palmer	21	41.1	6.5	111.7	25.4	4.6	2.0	4.8	.05	28.4	9.5	2.4 n.s.
Leiter	18	65.7	16.6	100.0	13.3	3.0	2.3			24.0	9.0	

*Age in months when test was administered
**1970 ratings

APPENDIX B - 20

Table 20. Correlations between IQ and Age, Language and Creativity on Merrill-Palmer and Leiter Scales

Scale	IQ/Age*		IQ/Language		IQ/Creativity	
	r	P	r	P	r	P
Merrill-Palmer	-.36	n.s.	.61	.01	.66	.001
Leiter	-.30	n.s.	.64	.01	.33	n.s.

*Age in months when test was administered

APPENDIX C. LANGUAGE RATING SCALES

APPENDIX C - 1

Children's Hearing and Speech Center
Washington, D.C. 20001

Language Rating Scale for Hearing Impaired Children
Age 3 to 5

ID No.: _____

Child's Name: _____ Bd: _____ School: _____

Rated by: _____ Date: _____ _____

Instructions: A rating of 0 through 8 is to be given to each child who has had more than 6 months of training at this Center or elsewhere. A rating of 9 should be given to a child who has had less than 6 months of training at this Center or elsewhere, or whose attendance over a longer period has been so poor that it is virtually impossible to evaluate either progress or potential.

This scale attempts to combine receptive and expressive language achievement into a single scale. It uses numbers of words and percentages of recall in an effort to obtain ratings as objective as possible. The scale is meant to represent a continuum from very poor to excellent achievement as of this date. Rate each child at the number which most nearly describes his achievement even though the description given may not fit precisely.

Underline the phrases which describe the child's language achievement. Draw a line through any phrases within the rating that do not apply. Write in any corrections or comments which might more accurately describe the child's actual language behavior.

Rating	Description
Poor	
(0)	Failed to learn to speechread and recall 3 or more whole words, after 6 months or more of training. On Association Method and learning very slowly (less than 2 sounds per week).

(1) Failed to learn to speechread and recall 3 or more whole words after 6 months or more of training. On Association Method and learning at rate of about 2+ sounds per week. No whole words.

Fair

(2) Started on Association Method because of poor progress with whole words. Subsequently started to learn some whole words with both speechreading and recall but has learned fewer than 25 words.

(3) Learning by whole words. Speechreads (with Cued Speech if used) 25 to 50 words. Requires much repetition and review to remember. Uses little or no spontaneous speech.

Good

(4) Speechreads 50+ words (with Cues if used). Recalls 75% or more of known vocabulary (i.e., words that he can speechread). Little or no use of spontaneous speech. Uses single words taught upon demand.

(5) Speechreads 50 to 100 words, and some 2-word phrases (e.g., color, number or size adjective plus noun) and simple sentences in context (formal lesson or with situational clues). Recalls 75% or more of known language (i.e., words and phrases that he can speechread). Uses speech spontaneously outside of formal teaching situation, but it consists mainly of single words.

Very Good

(6) Speechreads 100+ words, 2- and 3-word phrases, and sentences having two key words. (Examples of 2- and 3-word phrases: two cars; one blue flower, etc.) Examples of sentences with 2 key words: Put the car on the box. Put the ball on the floor.) Recalls almost everything that he can speechread. Uses speech for communication. Is "oral language oriented." Expressive language includes some phrases but often consists of single words only.

(7) Speechreads more than 200 words, phrases and sentences having at least two key words. Recalls almost everything that he can speechread. Frequently uses speech for communication using many phrases and sentences. Has spontaneous use of language. Expression through speech is usually an adequate means of communication. Expects to be understood and usually is.

Excellent

(8) Understands freely the conversation of familiar people and strangers without situational or contextual clues. Converses readily; asks questions, describes experiences, expects to be understood. Wide-range vocabulary, now uncountable. Ready for partial or total integration with normal-hearing children with some supportive help.

---

(9) Has received training for less than 6 months at this Center or elsewhere, or attendance over a longer period has been so poor that it is not possible to make a judgment about his language achievement or potential.

APPENDIX C - 2

Children's Hearing and Speech Center
Children's Hospital of D.C.
Washington, D.C. 20001

Language Rating Scale
for Hearing Impaired Children
Age 2-1/2 to 7-1/2 years
(For End-of-Year Rating, June 1970 and 1971)

Revised
June 1970

Child's Name_____ Bd:_____ School:_____

Rated by_____ Date_____

Instructions: This scale attempts to combine receptive and expressive language achievement in a single scale. It uses instructional level in the curriculum adopted in this program as the main index of language achievement, and it differentiates those who are at various stages within a level.

Rate each child under either (but not both) Regular Curriculum or Structured Curriculum:

Regular Curriculum ratings are to be used for children age 2-1/2 years and older who began formal language instruction in the school setting during the current school year, as well as for children who are achieving at various levels of language instruction through Level III. (A separate rating scale is to be used in the Infant Program up to age 2-1/2.)

Structured Curriculum ratings are to be used for children who made unsatisfactory progress under the regular curriculum and who are therefore now receiving instruction in the Structured Curriculum.

Rate each child at the number that most nearly describes his achievement, even though the description may not fit precisely. Draw a line through any phrases within the rating description that do not apply. Write in any corrections or comments that might more accurately describe the child's actual language behavior and level of achievement.

Rating	Description
1	Level I A. Beginner. Working on first 10-15 words. Very slow progress.
2	Level I A. Working on first 25 words and phrases. Good progress for the length of time child has been in the program.
	OR
	Has been in program since September or before. Fair progress.
3	Level I B, beginning third. Nouns and verbs primarily, some adjectives and colors. A few expressions. Recall vocabularly of nearly 50 words.
4	Level I B, middle. Has learned (lipreads and recalls) about 150 nouns, verbs, adjectives, and colors. Some expressions. Beginning work with prepositions and questions in isolation. Beginning reading by matching word to picture or action. Uses single words spontaneously.
5	Level I B, top third. In addition to nouns and verbs, learning more adjectives and colors. Has begun to read by matching words and sentences to picture or action, and in experience stories. Beginning to write independently (i.e., not tracing). Speech expression on practiced material is understandable. Is using some spontaneous speech, single words and phrases and short sentences. Lipreads several questions in isolation.
6	Level II - first half. In addition to the above, is beginning to lipread the basic question forms (Wh questions, and how many, and what color) with fewer contextual clues. Beginning to learn plurals, pronouns, and calendar words. Making progress in reading in experience stories. Categorizes and knows several category names.
7	Level II - top half. Has almost completed material included in the curriculum guide and as detailed above.
8	Level III - making good progress on possessives, subject and object pronouns, past and future verb tense, advanced questions, compound and complex sentences.

Structured Curriculum

0 Has been in program more than one year and is still at phoneme-grapheme stage or has less than 10 words.

1 Is working at phoneme-grapheme stage, OR has learned fewer than 10 words in entire school year.

2 Has learned about 20 phoneme-graphemes and 10 to 20 words since beginning of school year.

3 Has learned phoneme-graphemes and 20-25 words since beginning of school year OR has learned 10-20 words in half of school year.

4 Has learned phoneme-graphemes and 20-25 words since January of this year. Has started on sentence patterns.

5 Has progressed to advanced sentence work - binary and unary transformations.

Comments:

APPENDIX D

Sources of Tests Used

DeHirsch, Katrina, Jeannette Jansky, and William S. Langford. Predicting Ready Failure - A Preliminary Study. New York: Harper & Row, 1966.

Doll, Edgar. Preschool Attainment Record (Research Edition). Circle Pines, Minnesota: American Guidance Service, Inc., 1966.

Hiskey, Marshall S. Nebraska Test of Learning Aptitude. Lincoln, Nebraska: University of Nebraska, 1955.

Kirk, Samuel A., James J. McCarthy, and Winifred D. Kirk. Illinois Test of Psycholinguistic Abilities, Revised Edition. Urbana, Illinois: University of Illinois Press, 1968.

Mills, Jack R. Study of Some Sequencing Skills in Young Children, unpublished dissertation. Baltimore, Maryland: Johns Hopkins University, 1969.

Snijders - Oomen. Nonverbal Scale (S. O. N.) Groninger, Holland: J.B. Walter's, 1959.

Stutsman, Rachel. "Guide for Administering the Merrill-Palmer Scale of Mental Tests" (originally published in Terman, Lewis M. (Ed.), Mental Measurements and Adjustment Series, Part III, 139-262.) Beverly Hills, California: Western Psychological Services.

WPPSI - Wechsler Preschool and Primary Scale of Intelligence, New York: The Psychological Corporation, 1949 (1967).