

71-12,724

THRAPP, Robert Wayne, 1925-  
THE IMPROVEMENT OF COGNITIVE FUNCTIONING IN  
THE TRAINABLE MENTALLY RETARDED THROUGH VISUAL-  
MOTOR TUTORING.

University of Arizona, Ed.D., 1971  
Education, special

University Microfilms, A XEROX Company, Ann Arbor, Michigan

© COPYRIGHTED

BY

ROBERT WAYNE THRAPP

1971

THIS DISSERTATION HAS BEEN MICROFILMED EXACTLY AS RECEIVED

THE IMPROVEMENT OF COGNITIVE FUNCTIONING IN THE TRAINABLE  
MENTALLY RETARDED THROUGH VISUAL-MOTOR TUTORING

by

Robert Wayne Thrapp

---

A Dissertation Submitted to the Faculty of the  
DEPARTMENT OF SPECIAL EDUCATION  
In Partial Fulfillment of the Requirements  
For the Degree of  
DOCTOR OF EDUCATION  
In the Graduate College  
THE UNIVERSITY OF ARIZONA

1 9 7 1

THE UNIVERSITY OF ARIZONA

GRADUATE COLLEGE

I hereby recommend that this dissertation prepared under my  
direction by Robert Wayne Thrapp  
entitled THE IMPROVEMENT OF COGNITIVE FUNCTIONING IN THE  
TRAINABLE MENTALLY RETARDED THROUGH VISUAL-MOTOR  
TUTORING  
be accepted as fulfilling the dissertation requirement of the  
degree of DOCTOR OF EDUCATION

Malter Allison  
Dissertation Director

9-1-70  
Date

After inspection of the final copy of the dissertation, the  
following members of the Final Examination Committee concur in  
its approval and recommend its acceptance:\*

<u>Malter Allison</u>	<u>9-1-70</u>
<u>Raye Hamilton</u>	<u>9/1/70</u>
<u>Roger J. Galdrey</u>	<u>9/2/70</u>
<u>J. C. Frost</u>	<u>9/14/70</u>
<u>George Leshin</u>	<u>9/14/70</u>

\*This approval and acceptance is contingent on the candidate's  
adequate performance and defense of this dissertation at the  
final oral examination. The inclusion of this sheet bound into  
the library copy of the dissertation is evidence of satisfactory  
performance at the final examination.

STATEMENT BY AUTHOR

This dissertation has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this dissertation are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the copyright holder.

SIGNED: \_\_\_\_\_

*Robert W. Thrapp*

## ACKNOWLEDGMENTS

The author is indebted to a number of people without whose cooperation and guidance he could not have conducted this research.

To Dr. Elliott Becken, Superintendent and Mr. Trewhitt, Director of Special Education, he expresses his appreciation for permission to work with the students and staff at Rillito West, Amphitheater District, Tucson.

To Dr. Elizabeth Sharp whose special skills and knowledge were essential to the analysis of the Leiter International Performance Scale; and to Miss Leone Carstenson who so ably served as psychometrist for all phases of the study he will always be grateful.

Much appreciation and respect are due Dr. Samuel Kirk for his many valuable suggestions in the planning of this study and in the preparation of this manuscript as well as for his detailed analysis of the Leiter International Performance Scale.

The staff at Rillito West were a constant source of encouragement, laughed with him when things were going well and lifted him when he was very low. To Head Teacher Mrs. Marion Parsons and her staff, Mrs. Dorothy Baum, Mrs. Sally Florence, and Mr. Wayne Burdick, he offers his warmest thanks.

The author is also indebted to Dr. Harold Brasell for serving on his Committee during the early stages of graduate study and to Dr. Howard Morgan for his assistance and encouragement in the planning, execution, and reporting of this research.

Five very human and learned men served on the author's Committee. For their demonstrations of faith and their acts of support he offers Dr. George Leshin, Dr. Paul Danielson, Dr. Roger Daldrup, Dr. Francis Lord, and Dr. Walter Olson his gratitude and the hope that he will not disappoint them in the future. The fifth member assumed the added responsibility of serving as his Committee Chairman and as his Director. To Dr. Olson he offers also his humble thanks.

Finally, there are the sixteen very special children who participated in this study. Each is remembered with and extended his fondest affection and deepest personal regard.

## TABLE OF CONTENTS

	Page
LIST OF TABLES . . . . .	viii
LIST OF ILLUSTRATIONS . . . . .	ix
ABSTRACT . . . . .	x
 CHAPTER	
I. INTRODUCTION . . . . .	1
The Problem . . . . .	3
Hypothesis to be Tested . . . . .	3
Significance of the Problem . . . . .	4
Assumptions . . . . .	4
Subjects . . . . .	5
Definitions . . . . .	5
II. REVIEW OF RELATED LITERATURE . . . . .	6
Early Studies . . . . .	7
Recent Studies . . . . .	9
III. DESCRIPTION OF THE EXPERIMENT . . . . .	15
The Testing Instruments . . . . .	15
The Leiter . . . . .	16
The Hiskey . . . . .	17
The Testing and Sample Selection Program . . . . .	18
The Treatment Programs . . . . .	19
The Experimental Treatment . . . . .	20
The Control Treatment . . . . .	22
Treatment of the Data . . . . .	23
IV. RESULTS OF THE EXPERIMENT . . . . .	25
Statistical Treatment . . . . .	25
A Comparison of Experimental and Control Groups on Pretest Leiter and Hiskey Data . . . . .	26
A Comparison of the Experimental Group on Pretest and Posttest Leiter and Hiskey Data . . . . .	29

TABLE OF CONTENTS--Continued

CHAPTER	Page
A Comparison of the Control Group on Pretest and Posttest Leiter IQ and Hiskey MA . . . . .	32
Testing the Null Hypothesis . . . . .	35
Influence of the Standard Error of Measurement . . . . .	37
Other Factors Influencing Change- Scores . . . . .	38
V. SUMMARY, DISCUSSION, AND RECOMMENDATIONS . . . . .	40
Organization of the Study . . . . .	40
Analysis of the Data . . . . .	41
The Overall Results of the Study . . . . .	41
Theoretical Considerations . . . . .	42
Conclusions . . . . .	43
Recommendations . . . . .	44
APPENDIX A. ANALYSIS OF THE LEITER INTERNATIONAL PERFORMANCE SCALE . . . . .	47
APPENDIX B. VISUAL-MOTOR ACTIVITIES USED WITH EXPERIMENTAL GROUP . . . . .	53
APPENDIX C. TREATMENT SCHEDULES FOR EXPERIMENTAL GROUP . . . . .	58
APPENDIX D. SELECTED TRANSCRIPTS OF TAPE RECORDED LESSONS FOR EXPERIMENTAL GROUP . . . . .	67
APPENDIX E. ACTIVITIES USED WITH THE CONTROL GROUP . . . . .	84
APPENDIX F. TREATMENT SCHEDULES FOR CONTROL GROUP . . . . .	87
APPENDIX G. SELECTED TRANSCRIPTS OF TAPE RECORDED LESSONS FOR CONTROL GROUP . . . . .	96
APPENDIX H. INDIVIDUAL CASE STUDIES FOR EXPERIMENTAL GROUP . . . . .	106
REFERENCES . . . . .	129

## LIST OF TABLES

Table	Page
1. A Comparison of Experimental and Control Subjects on Pretest Leiter Intelligence Quotients . . . . .	27
2. A Comparison of Experimental and Control Subjects on Pretest Hiskey Mental Ages . . . . .	28
3. A Comparison of Pretest and Posttest Leiter Intelligence Quotients for the Experimental Subjects . . . . .	30
4. A Comparison of Pretest and Posttest Hiskey Mental Ages for the Experimental Subjects . . . . .	31
5. A Comparison of Pretest and Posttest Leiter Intelligence Quotient for the Control Subjects . . . . .	33
6. A Comparison of the Pretest and Posttest Hiskey Mental Age for the Control Subjects . . . . .	34
7. A Comparison of Posttest Loss or Gain in Leiter Intelligence Quotient for Experimental and Control Subjects . . . . .	36
8. A Comparison of Posttest Loss or Gain in Hiskey Mental Age for Experimental and Control Subjects . . . . .	37

LIST OF ILLUSTRATIONS

Figure	Page
1. Three-Dimensional Model of the Visual-Motor Process . . . . .	48
2. Modified Three-Dimensional Model of the Visual-Motor Process . . . . .	49
3. Activity I . . . . .	85
4. Activity II . . . . .	85
5. Activity III . . . . .	85
6. Activity IV . . . . .	85
7. Activity V . . . . .	86
8. Activity VI . . . . .	86

## ABSTRACT

This study was designed to investigate the efficacy of a visual-motor training program with trainable mentally retarded children. Experimental and control groups of eight subjects each were used.

The sixteen trainable mentally retarded children who served as the subjects were matched-paired on the basis of chronological age and Leiter International Performance Scale (Leiter) intelligence quotient (IQ). A short form of the Hiskey-Nebraska Test of Learning Aptitude (Hiskey) was also given, prior to the treatment programs, to provide an additional dimension for comparing levels of cognitive functioning.

Eight subjects were randomly assigned to the experimental group and received twenty-seven individual visual-motor tutoring experiences. Each lesson was designed to remediate and/or give practice in the use of various functions of the communications process required to complete successfully the items missed on the pretest Leiter. The eight subjects randomly assigned to the control group received twenty-seven individual experiences in coloring, cutting, and pasting. Following the experimental period, all subjects were retested on the Leiter and the Hiskey.

The Wilcoxin Matched-Pairs Signed-Ranks Test was used for eight statistical comparisons. The experimental and control groups were compared on the basis of their pretest Leiter IQs. This comparison indicated that there was no significant difference between the two groups on their Leiter IQ. A similar comparison of the pretest Hiskey MAs showed no significant difference between the two groups on the basis of their Hiskey MA. The experimental group's pretest Leiter IQs and Hiskey MAs were compared with their posttest measurements on these two instruments. This comparison showed that the group had made significant gains on both posttest measures. A comparison of the corresponding Leiter and Hiskey data for the control group did not show significant gains.

The null hypothesis was tested by comparing the experimental group's posttest Leiter IQs with the control group's posttest Leiter IQs. This comparison indicated that posttest Leiter IQ gains made by the experimental group were significant. The null hypothesis was rejected at the .05 level. A similar comparison of the posttest Hiskey MA data for the two groups, while not significant at the level set for this experiment, showed the experimental group's changes to be in the direction predicted.

Finally, the two groups' posttest Leiter IQs were discussed in terms of the standard error of measurement.

Treatment schedules, the visual-motor and the art and craft activities used, and selected transcripts of tape recorded lessons for the two groups appear in the Appendices. Brief case studies for each of the children in the experimental group appear in Appendix H.

The overall results of this study indicate that increases in Leiter IQs, in trainable mentally retarded children, can be effected by employing the visual-motor activities used in this experiment.

## CHAPTER I

### INTRODUCTION

Education for the trainable mentally retarded has been one of the special educator's greatest challenges. The belief that the trainable retardate learns best by doing, and is more successful in performance rather than verbal learning, has led to the development of curricula oriented toward the teaching of social and self-help skills, and economic usefulness.

Doll's (1941) definition of mental retardation tended to consider the condition irreversible and irremedial. The restriction this viewpoint incorporates may explain the lack of intellectual curiosity and investigation into the learning potential associated with mental retardation, prevalent among many of the earlier professional workers in the field.

Public school educators are assuming more and more responsibility in the education of the trainable mentally retarded. With this increased responsibility has come an increased concern for providing an appropriate educational program. Concomitant with this concern is the search for sound methods of instruction. Of primary concern is the identification and understanding of certain psychological

functions thought to be basic to learning. Once these functions have been identified, their implications to learning can become the focus of attempts to provide the trainable child with developmental learning experiences.

Many children show discrepancies among their abilities (Kirk, McCarthy, and Kirk, 1968). Although some of these discrepancies are readily identifiable and responsive to remedial methods, there is a need for a body of systematic and sequential activities capable of facilitating various phases of cognitive development (Dunn, 1968). One of these is the visual-motor phase.

It was the purpose of this study to investigate certain aspects of visual-motor learning in trainable mentally retarded children.

Piaget (1958) has discussed the importance of early sensori-motor learnings as a basis for more complex perceptual and cognitive development. Children who have difficulty in making the transition from the visual-perceptual phase of learning to that of higher cognitive functions, can often be shown how to make this step by remedial methods which integrate visual-perceptual training with higher thought processes (Hebb, 1949). The practical bases for such a method of visual-motor learning derive from the 1948 revision of the Leiter International Performance Scale (Leiter) and the Illinois Test of Psycholinguistic Abilities (ITPA).

### The Problem

According to Hebb (1949) the basis for primary learning is chiefly sensory. Central to the theory is the idea that the brain must be programmed by proper proverbial experiences if the individual is to function effectively as a problem solver. It is assumed that most of this primary learning is based upon perceptual experiences.

Is it possible to develop a systematic program of visual-motor learning activities that will effectively improve the cognitive functioning (IQ) level of trainable mentally retarded school children? The investigation of this problem should provide answers to the following questions:

1. Can individual visual-motor tutoring with trainable mentally retarded children result in a statistically significant increase in cognitive functioning?
2. Do the data obtained in the investigation of the problem provide sufficient evidence to support the development of a method of visual-motor tutoring for the trainable mentally retarded?

### Hypothesis to be Tested

Stated in the null form, it was hypothesized that the level of cognitive functioning in trainable mentally retarded children, as measured by the Leiter, cannot be significantly increased by individual visual-motor tutoring.

The .05 level of significance was set for rejection of the null hypothesis.

#### Significance of the Problem

The maximum development of an individual should be considered a worthwhile investment regardless of cost. Morally a democracy is dedicated to this precept and to the principle of preventing dependency (Kirk and Johnson, 1951; Weber, 1963).

To some, the loss or gain of 5 points at an intelligence quotient (IQ) of 25 may seem insignificant. However, the difference between IQ 20 and an IQ of 30 may determine whether a child is placed in an institutional or a public school setting. The type of placement made may well determine whether the child is completely dependent for life or capable of a degree of economic usefulness and independence during adulthood.

#### Assumptions

The delineation of the hypothesis to be tested was based on the following assumptions:

1. It was assumed that the Leiter and the Hiskey-Nebraska Test of Learning Aptitude (Hiskey) were valid and reliable instruments for assessing the cognitive performance level of trainable mentally retarded children.

2. It was assumed that, in general, trainable mentally retarded children with an IQ of 55 or less would develop and mature mentally at a rate of one-half or less than the rate of the individual with an IQ of 100 (Kirk, 1962).

#### Subjects

The subjects for this study were sixteen trainable mentally retarded children enrolled in a special public school in a large southwestern city. They ranged from 6 years, 10 months, to 17 years, 1 month in chronological age (CA). Their pretest Leiter IQs ranged from a low of 33 to a high of 56. The pretest Hiskey mental ages (MA) for the group ranged from 3 years, to 6 years, 6 months.

#### Definitions

For the purposes of this study, the following definitions were used.

1. Trainable mentally retarded was defined as referring to individuals with a functional IQ within the 25 to 55 range.
2. Visual-motor learning was defined as learning acquired through the visual channel and requiring expression through the use of a motor response.

## CHAPTER II

### REVIEW OF RELATED LITERATURE

The past two decades have shown considerable interest and some controversy concerning the placement of children with IQs of 50 or less in a public school setting (Weber, 1963). Kirk (1957) has summarized the legislative definitions of trainable mentally retarded children and, using previous studies, estimated the prevalence of such school age children in a community's school population at about two per thousand.

A knowledge of research findings and information seems essential to an understanding of even a single aspect of mental retardation. When one undertakes an exploration of the literature, however, it becomes immediately apparent that there are many major areas of emphasis available. Each of these major areas also provides innumerable opportunities of pursuit.

Although the present study concerned itself with trainable mentally retarded children, reports of studies using educable mentally retarded subjects have been included in this review. Children who are classified as trainable mentally retarded during one period of their life may later be classified as educable mentally retarded. The reverse is

also true. For this reason, it does not seem prudent to assume that studies utilizing educable retardates as subjects have no relevance to the trainable retardate. Then too, the mentally retarded represent a heterogeneous grouping with wide discrepancies in abilities. Children who are classified appropriately as educable for the purposes of a particular study are to be found within the upper limits of the IQ range set for the present investigation.

The primary concern of this chapter, then, is to review the literature pertinent to the modification of intelligence in the mentally retarded. The studies presented here used educational programs in attempts to effect changes in IQ. Each of these investigations dealt specifically with the mentally retarded and the effects of such programs on their intellectual development.

#### Early Studies

The modification of intelligence through education was of major concern to a number of early pioneers in the field.

In 1801 the young French physician, Itard (1962) published his preliminary report on the first recorded attempt to educate a mentally retarded child. Itard's attempts at training Victor are well documented in "The Wild Boy of Aveyron." Although Victor made educational progress, he was still considered feebleminded when he died. In

working with Victor, Itard emphasized sensory-motor training to provide competency in sensory discrimination. His efforts with Victor have contributed to modern concepts of perceptual training as well as a new attitude toward the mentally retarded (Kodman, 1963).

To Decroly and his student, Descoedres (1928), and Montessori (1964), the training of the senses had a direct influence on the central nervous system and, therefore, on the intellectual development of the mentally retarded. Itard's student, Seguin (1907), believed that muscle and sense training would strengthen the receptors of the peripheral nervous system, bombard the central nervous system and stimulate the cortex to greater mental functioning. All of these scientists used especially constructed games and didactic materials designed to enhance the intellectual development of children who were mentally retarded.

Binet (1909) who, with Simon, developed the forerunner of the present Stanford-Binet test of intelligence, used his own method of "mental orthopedics" to improve the intellectual development of Paris school children. Working for one year with a group of children who had entered a class for abnormals with a retardation of three years in their studies, Binet found at the end of the trial period the children showed no more than two years retardation. In analyzing the gains made by the children, Binet felt they had taken two steps instead of one. Had the children

remained in their ordinary classes their retardation would have been aggravated; they would have been more than three years retarded. Had they advanced as the normal children did in their studies, the retarded children would have advanced exactly a year. They would not have made up lost time and their retardation would have remained equal to three years. Binet believed that since the retarded children had actually diminished their retardation by one year, they had benefited more than had the normal children. Unlike many of his contemporaries, Binet did not feel that the retarded's rate of mental development, as measured by his test, remained constant.

Reacting to the testing movement created by Binet, most American educators and psychologists confined their efforts in measuring growth in the mentally retarded to the measurement of progress in school subjects, and to the effects of education on their social and vocational adjustment (Kirk, 1964). "So entrenched was the belief that IQ scores were unmodifiable, that no serious attempt to demonstrate otherwise was made until Kirk conducted his study in the middle 1950's [Guskin and Spicker, 1968, p. 220]."

#### Recent Studies

Hottel (1958) has reported on a one year experiment that attempted to determine whether a special class improves

the development of trainable mentally retarded children more than does parental training received at home.

The subjects were twenty-one pairs of trainable retardates matched for sex, clinical type, chronological age, and mental age. The mean IQ for the experimental group was 41.1, the mean chronological age was 8.7 years, and the mean mental age was 3.5 years. The control group had a mean IQ of 39.9, their mean chronological age was 8.6 years, and the mean mental age for the group was 3.4 years. One member of each pair received special day class training while the other member of the pair remained at home without special class training.

The 1937 Revision of the Stanford-Binet, Form L, and the Vineland Social Maturity Scale were used as indicators of behavioral skills development. A Rating Scale of Child Behavior and a modified version of the Fels Scale of Parent Behavior were also utilized.

The results of the experiment indicated no statistically significant difference between the experimental and control groups in rate of development of mental age, intelligence quotient, social adjustment, or social quotient. However, when the groups were subdivided into high (IQs between 40 and 50) and low (IQs between 30 and 40) groups, the ten pairs in the high-IQ training group were found to have gained significantly in IQ over the corresponding home-group and over the low-IQ training group. A similar

comparison of social age and social quotient did not show similar results.

Kirk (1958) has reported on a longitudinal study of the effects of preschool training on the social and mental development of young retarded children. Eighty-one retarded children between the ages of three and six years of age, with IQs generally between 45 and 80, were divided into four groups. Twenty-eight received training in a specially designed community school preschool experience. Twenty-six children served as a contrast group and were not given the opportunity of preschool education. Fifteen children were given preschool education in an institutional setting while a contrast group remained on the wards during the preschool period. An analysis of the data resulting from this experiment led Kirk to conclude that children from psycho-socially deprived homes tend to retain their rate of development as they grow older. A dramatic change of environment, such as foster home placement and preschool training, tended to produce an increased rate of growth.

Gallagher (1960) studied the effects of tutoring on the development of intellectual functioning, social maturity, and personality development in brain-injured children. The subjects were forty-two institutionalized brain injured children who had been assigned at random to experimental and control groups.

The experimental group received tutoring on tasks designed to facilitate development of intellectual skills for one hour a day for two years. They received no tutoring for the third year. Children assigned to the control group received tutoring during the third year only.

The results of the experiment indicated that some brain injured, mentally retarded children can show improvement in intellectual development through the tutoring methods used. Gallagher (1960) concluded that too much "pessimism has prevented us from giving them the intellectual and educational stimulation we would wish for all our children [p. 198]."

Using one control and two experimental groups of educable mentally retarded, Chansky and Taylor (1964) demonstrated that perceptual training could raise the achievement levels of retarded children. The control group received no perceptual training while one experimental group received individual perceptual training and the additional experimental group received the training in group sessions. Comparing the results of the three groups on their pretest Wechsler Intelligence Scale for Children (WISC), the Benton Visual Retention Test (BVRT) and the California Achievement Test (CAT) scores with their posttest scores, led the investigators to conclude that the improvement noted in the two experimental groups could be linked directly to the nature of the perceptual training.

Both experimental groups improved significantly over the control group in vocabulary, reading comprehension, arithmetic foundations, and spelling on the CAT. On the Full Scale IQ of the WISC, in contrast to the control group, experimental group 1 improved 9.65 points and experimental group 2 improved 6.99 points. In addition, both experimental groups made fewer errors on retests with the BVRT than did the control group.

Corder (1966) used an intensive twenty day program of physical education with three groups of educable mentally retarded boys. The eight boys in the training program and the eight boys in the officials group were removed from their classes five times per week over a period of four weeks and given planned physical education lessons and planned duties respectively. The eight controls remained in their classrooms and received the usual classroom instruction. Comparing the three groups on the Wechsler Intelligence Scale for Children (WISC), the Youth Fitness Test (YFT), and the Cowell Distance Scale (CDS), Corder found the training group made significant gains in their Full Scale WISC mean IQ scores over the control group. There was no difference in Full Scale IQs for the training and the officials group. The training group also made significant gains over the officials and the controls on all seven physical fitness tests but there was no difference among the three groups on the mean gain scores on the CDS.

Edgar et al. (1969) studied organically impaired mentally retarded children to determine the effects of sensory-motor training on their adaptive behavior. Eleven retardates with a mean MA of 15 months were given individual sensory-motor training while a similar group of children received individual attention. Gesell Developmental Schedules were administered before and after eight months training. The results of Gesell Full Scale scores on each sub-scale indicated that the children who received intensive sensory-motor training gained significantly more than the control children on the sub-scales for Motor, Language, and Personal-Social Behavior.

The studies presented in this section indicate that the level of cognitive functioning in the mentally retarded is modifiable. Charney (1963) has noted the serious need to study various aspects of the learning process in trainable mentally retarded children in community day schools while Guskin and Spicker (1968) have concluded that the present style of research has contributed pitifully little that is of value to the educational practitioner. Hopefully, future research will contribute data and information that will be applicable to planning new approaches in curriculum development, as well as providing new methods for teaching the trainable mentally retarded.

## CHAPTER III

### DESCRIPTION OF THE EXPERIMENT

In this chapter, the following subject-areas are considered: discussion of the testing instruments, the testing and sample selection program, the experimental and control groups' treatment programs, and statistical treatment of the data.

#### The Testing Instruments

The instruments used for the pretest and posttest phases of this study were the Leiter International Performance Scale and the Hiskey-Nebraska Test of Learning Aptitude.

Standardization statistics and technical information for the Leiter and the Hiskey are available in the test manuals (Leiter, n.d.; Hiskey, 1966). Both instruments are in current use by qualified psychologists and psychometrists. For these reasons, and because the examiner employed in this study closely followed the testing and scoring procedures outlined in the manuals, a technical discussion of the standardization procedures for the two tests will not be presented here.

## The Leiter

The Leiter was constructed on the assumption that the child's ability to cope with new situations is an index of general intelligence. According to the test's author (Leiter, n.d.) standardization of the instrument has involved studies utilizing over four thousand children. Quoting from Tate (1950, 1952), Leiter gives a reliability coefficient of .75 and correlations with the Revised Stanford-Binet, Form L, of .77 on MA and .81 on IQ. He interprets these data as indications of the validity and reliability of the instrument. Allen and Jones (1967) discuss the need for more reliability and validity evidence on the Leiter but conclude that the instrument has a definite place in the psychologist's test battery since many children, who previously were considered untestable, may be realistically assessed with this instrument.

The 1948 Revision of the Leiter was analyzed to identify the various functions of the communications process required to complete the sub-tests used throughout the instrument. The results of this analysis, based on the three-dimensional model of the ITPA (Kirk et al., 1968), appear in Appendix A. Once the level of organization and the process had been identified, three-dimensional visual-motor activities were designed to correspond to various sub-tests on the Leiter. Each visual-motor activity required the use of the same level of organization and the same

process as did the corresponding Leiter item. The visual-motor activities appear in Appendix B.

### The Hiskey

In order to provide an additional dimension for comparing posttreatment cognitive functioning, a short form of the Hiskey was used. The procedures outlined by Hiskey (1966, p. 22) were followed in abbreviating the test. The short form used consisted of the sub-tests for: (1) memory for color, (2) picture identification, (3) picture association, (4) block patterns, and (5) completion of drawings.

The test manual (Hiskey, 1966) cites the coefficients of reliability for hearing subjects in the three to ten year group at .933, and at .904 for hearing subjects in the eleven to seventeen group. Correlations with the Stanford-Binet, Form L-M, and the Wechsler Intelligence Scale for Children are given as evidence of validity. These correlations range from a low of .78 to a high of .86.

Tables for arriving at an IQ from the Hiskey mental ages do not go below IQ 30. Since a number of the subjects used in this experiment obtained Hiskey MAs for which the tables do not provide an IQ, it was the opinion of the investigator that the MA would provide a more accurate means of utilizing the Hiskey data. For this reason the Hiskey data are expressed in terms of MA rather than IQ.

The Testing and Sample Selection Program

Twenty-five of the students enrolled in the special school where this investigation was made were given the Hiskey and the Leiter. Of the remaining three students, for a total enrollment of twenty-eight, two were not testable and one was absent during the entire pretesting period.

Of the twenty-five students tested, sixteen were matched as closely as possible on the basis of chronological age and Leiter IQ. From the resulting eight pairs, within-pairs assignment of subjects to either the experimental or control group was accomplished by using the Table of Random Numbers (Edwards, 1967). The group assignments were made by the same psychometrist who administered all phases of the testing program.

After being assigned to the experimental group, each of the eight subjects was numbered from 1 to 8, according to their chronological age. Thus subject number 1 was the youngest in the experimental group and subject number 8 the oldest. Their partners in the control group were assigned the numbers 9 to 16. Thus subject number 1 in the experimental group was the originally matched pair of subject number 9 in the control group. This procedure was continued until subject number 8's partner in the control group had been given the number 16. It is by these numbers that they are referred to throughout the remainder of this report.

It was the intention of the psychometrist to pretest all of the students on the Hiskey prior to pretesting them on the Leiter. Due to an error in scheduling, however, subject 8 was actually tested on the Leiter prior to being tested on the Hiskey. This error did not seem of sufficient importance to exclude the subject from the experiment.

The apparent discrepancies in chronological age for subjects 6, 7, 9, and 16 were a function of the accepted practice of using fifteen days of chronological age as the determinant in calculating the months of CA.

In the process of selecting children for the study, one exception was made to the selection criteria. Subject number 3 and her partner, subject 11, both had initial Leiter IQs 1 point above the limit set for this study. Because both were so well matched with an IQ of 56 and but five months apart in chronological age, they were included in the study sample. This seemed justifiable since both had obtained IQs within the limits of this study on previous measures of intelligence.

#### The Treatment Programs

The treatment program for the subjects in the experimental group consisted of the visual-motor tutoring activities while the treatment for the control subjects was simple art and craft activities. Both programs were initiated immediately following the pretesting. Posttesting

of all subjects on the Leiter and the Hiskey immediately followed cessation of the treatments. The posttest was given as a basis for assessing the efficacy of the visual-motor tutoring.

#### The Experimental Treatment

Each of the specially designed visual-motor activities became the basis for individual tutoring with the subjects in the experimental group.

The Leiter protocols for each of the subjects were examined to identify sub-tests missed on the pretest. The appropriate visual-motor activities were then incorporated into the tutoring program. These activities required use of the same level of organization and the same process as did the corresponding sub-test on the Leiter. For example, Leiter sub-test V-1 had been identified as being at the representation level with visual decoding as the process. The test requires matching by genus; a man to a woman, a horse to a cow, a rooster to a hen, a pear to an apple, and one flower to two flowers. The visual-motor activity designed to correspond to this item required the subject to match a pear to an apple, a red car to a yellow truck, a red flower to a yellow flower, a green ball to a red ball, and a tiger to a camel. The Leiter items consist of pictures on a one inch cube while the visual-motor activities were three-dimensional.

Presentation of the visual-motor activities followed the procedure outlined for administering the Leiter at Year II and Year III (Leiter, 1966, pp. 73-78). At these levels, all items may be demonstrated as many times as necessary to determine whether the child understands the task. Each of the subjects received twenty-seven individual tutoring experiences. In general, each session consisted of three of the visual-motor activities and lasted from ten to fifteen minutes. When a subject was able to perform an activity correctly, a new activity was added to the tutoring program. This allowed each subject to progress at his own rate. Individual tutoring programs for each of the subjects appear in Appendix C.

The uniqueness of the learning difficulties exhibited by each of the subjects permitted no pre-determined design or content of the verbal communications used during the tutoring sessions. Each tutoring experience was a singular one for both the subject and the experimenter. In general, however, verbal communications were limited to that which appeared to be essential to the maintenance of rapport and attention and to facilitate the desired learning. There was a conscious effort on the part of the investigator to provide each tutoring session with an atmosphere of pleasant rapport, quiet surroundings, and unhurried calm. Representative transcripts of a typical

tutoring session for three of the subjects are presented in Appendix D.

While it is undoubtedly impossible to be certain through observation only that a subject is attending, or to determine to what intensity attention is focused, the cumulative attention span during the first ten minutes of the eighth, sixteenth, and twenty-sixth lesson was obtained on each of the subjects. This was accomplished by using a stop watch and observing the subject during the lesson period. The timer was allowed to run during any interval in which the subject appeared to be attending the task to be performed or to the verbal communications of the experimenter. The results of these samplings of attention are presented in the individual case studies in Appendix H. It was hoped that the attention span of subjects showing a sizeable increment in Leiter IQ at the end of the treatment period might provide one possible explanation for any gains made.

#### The Control Treatment

Each of the subjects in the control group also received twenty-seven individual tutoring experiences. Lessons for the group were not intended to be instructive in terms of facilitating cognitive development. They were, rather, intended to make use of skills the subjects already possessed. For this reason, verbal communications between

the subjects and the experimenter were minimal. Subjects were not discouraged from talking, but neither were they encouraged to do so.

Individual lessons for the group consisted of coloring designs provided for them, free-hand drawing, cutting, and pasting. The activities used are presented in Appendix E.

Typically, the lessons for the group ranged from ten to fifteen minutes duration. Again, there was a deliberate effort on the part of the experimenter to provide an atmosphere of pleasant rapport, quiet surroundings, and unhurried calm.

Individual lesson schedules for each subject appear in Appendix F. A sample transcript of one tape recorded lesson for four of the subjects is shown in Appendix G.

#### Treatment of the Data

The data obtained in this investigation showed direction as well as magnitude of change. Because it accommodates both of these dimensions of change; and because of its applicability to small, matched groups; the Wilcoxin Matched-Pairs Signed-Ranks Test (Downie and Heath, 1965) was used for all statistical comparisons. The procedure outlined by Lord (1959) was used to calculate the standard error of measurement (SEM) for the Leiter.

In evaluating a training program, a single adverse condition could have the effect of lowering the scores of some subjects. Group comparisons may suffer as a result. Since the primary purpose of this study was to investigate the effects of a visual-motor training program on individual IQs, it was the writer's opinion that a statistical analysis of group data would leave some questions unanswered. Consequently, brief case studies for each of the subjects in the experimental group are presented in Appendix H. The results of statistical analysis of the pretest and posttest data as well as a discussion of the posttest Leiter IQ scores in terms of the SEM appear in the following chapter.

## CHAPTER IV

### RESULTS OF THE EXPERIMENT

The purpose of this chapter is to present and interpret the findings from the pretest and posttest Leiter IQ and Hiskey MA data for both the experimental and control groups.

The experimental group was made up of the eight children who had been randomly selected to receive the visual-motor treatments described in Chapter III and presented in Appendix B of this study. The control group consisted of the eight children who had been randomly assigned to receive the art and craft activities described in Chapter III and presented in Appendix E.

#### Statistical Treatment

The Wilcoxin Matched-Pairs Signed-Ranks Test (Wilcoxin) as described by Downie and Heath (1965) and Tate and Clelland (1957) was used for eight statistical comparisons. The .05 level of significance was set for rejection of the null hypothesis.

The experimental group was compared with the control group on the basis of obtained IQs on the pretest Leiter to determine if there was a significant difference between the two groups on initial IQ. A similar comparison was made of

the Hiskey MA data. Secondly, the experimental group's pretest Leiter IQs and Hiskey MAs were compared with their posttest scores on these two measures to determine direction and magnitude of change. A similar comparison was made of the corresponding data for the control group. Thirdly, the experimental and control groups were compared on the basis of posttest Leiter IQ and Hiskey MA gains and/or losses. This comparison was the basis for testing the null hypothesis. Finally, the two group mean ( $\bar{X}$ ) pretest and posttest Leiter IQs were discussed in terms of the influence of the SEM on the results.

A Comparison of Experimental and Control Groups  
on Pretest Leiter and Hiskey Data

The data for making a comparison between the experimental and control group on their pretest Leiter IQs appear in Table 1. The mean T ( $\bar{T}$ ) was calculated at  $\bar{T} = 7.5$  while the value of the Wilcoxin T statistic was  $T = 6$ . The value of  $T = 6$  indicates that there was no significant difference between the two groups on the basis of their pretest Leiter IQs.

The experimental and control groups were also compared on their obtained pretest Hiskey MAs. The data for this comparison appear in Table 2.

The  $\bar{T}$  for the data in Table 2 was calculated at  $\bar{T} = 7.5$  while the obtained Wilcoxin T statistic was 7. The value of  $T = 7$  was not significant, indicating that there

Table 1. A Comparison of Experimental and Control Subjects  
on Pretest Leiter Intelligence Quotients

S	CA	IQ	Differ- ence	Absolute Rank	R(+)	R(-)	IQ	CA	S	
1	6-10	48	-6	4.5		4.5	54	7-7	9	
2	8-7	37	-6	4.5		4.5	43	8-5	10	
3	8-9	56	0				56	9-2	11	
4	11-6	48	3	1	1		45	12-4	12	
5	11-7	37	4	2	2		33	11-3	13	
6	12-8	48	5	3	3		43	12-4	14	
7	16-5	51	0				51	16-2	15	
8	17-1	43	0				43	17-0	16	
					R (+) 6* (-) 9					

\*Not significant.

Table 2. A Comparison of Experimental and Control Subjects on Pretest Hiskey Mental Ages

S	CA	MA	Difference (in months)	Abso- lute Rank	R(+)	R(-)	MA	CA	S	
1	6-9	3-0	-18	4		4	4-6	7-7	9	
2	8-6	3-6	0				3-6	8-4	10	
3	8-8	4-0	-6	2		2	4-6	9-1	11	
4	11-5	6-6	0				6-6	12-3	12	
5	11-6	5-0	24	5	5		3-0	11-2	13	
6	12-8	5-0	6	2	2		4-6	12-3	14	
7	16-5	5-0	-6	2		2	5-6	16-1	15	
8	17-2	4-6	0				4-6	17-0	16	
					R (+) 7* (-) 8					

\*Not significant.

was no difference between the experimental and control group on the basis of their pretest Hiskey MAs. These results were in agreement with the comparison made on the corresponding Leiter IQ data for the two groups.

A Comparison of the Experimental Group  
on Pretest and Posttest Leiter  
and Hiskey Data

One of the questions this study was designed to answer was: Do the data obtained in the investigation of the problem provide sufficient evidence to support the development of a method of visual-motor tutoring for the trainable mentally retarded? An affirmative answer required that the experimental group make gains on their posttest Leiter IQ and Hiskey MA measurements. A similar comparison of the corresponding data for the control group should not show similar gains.

The data for comparing the experimental group on the basis of their pretest and posttest Leiter IQs appear in Table 3 while the data for the Hiskey MA comparison appear in Table 4.

The  $\bar{T}$  for the data in Table 3 was calculated at  $\bar{T} = 18$  with the obtained Wilcoxin T statistic of  $T = 0$ . These results indicated that the experimental group had made significant gains on their posttest Leiter IQs when compared to their pretest Leiter scores.

Table 3. A Comparison of Pretest and Posttest Leiter Intelligence Quotients for the Experimental Subjects

S	IQ		Difference	Absolute Rank	R(+)	R(-)
	Pretest	Posttest				
1	48	65	17	7	7	
2	37	53	16	6	6	
3	56	66	10	3	3	
4	48	62	14	5	5	
5	37	45	8	2	2	
6	48	61	13	4	4	
7	51	53	2	1	1	
8	43	62	19	8	8	
					R (+) 36 (-) 0*	

\*Significant.

Table 4. A Comparison of Pretest and Posttest Hiskey Mental Ages for the Experimental Subjects

S	MA		Difference (in months)	Absolute Rank	R(+)	R(-)
	Pretest	Posttest				
1	3-0	3-6	6	1.5	1.5	
2	3-6	4-0	6	1.5	1.5	
3	4-0	5-6	18	5	5	
4	6-6	8-0	18	5	5	
5	5-0	5-0	0			
6	5-0	8-6	42	7	7	
7	5-0	6-6	18	5	5	
8	4-6	5-6	12	3	3	
					R (+) 28 (-) 0*	

\*Significant.

The  $\bar{T}$  for the data in Table 4 was calculated at  $\bar{T} = 14$  and a Wilcoxin T statistic of  $T = 0$  was obtained. The value of  $T = 0$  was significant.

The results of the experimental group data presented in Table 3 and Table 4 were in agreement. This led the investigator to conclude that it is possible to significantly raise the level of cognitive functioning in trainable mentally retarded children by individual tutoring with the visual-motor activities used in the experimental treatment program.

A Comparison of the Control Group on Pretest  
and Posttest Leiter IQ and Hiskey MA

In an attempt to assess the efficacy of the visual-motor tutoring program, the control group was denied the experimental treatment and given the alternate treatment described in Chapter III of this study. It was the belief of the investigator that this group would not show significant gains in Leiter IQ or Hiskey MA at the close of the experiment. The data for these comparisons appear in Table 5 and Table 6.

The  $\bar{T}$  for the group was calculated at  $\bar{T} = 14$ . The obtained value of Wilcoxin's T statistic was also 14, which is not significant. This indicated that the control group did not make significant gains in Leiter IQ during the experimental period.

Table 5. A Comparison of Pretest and Posttest Leiter Intelligence Quotient for the Control Subjects

S	IQ		Difference	Absolute Rank	R(+)	R(-)
	Pretest	Posttest				
9	54	49	-5	4		4
10	43	54	11	7	7	
11	56	56	0			
12	45	41	-4	2.5		2.5
13	33	42	9	6	6	
14	43	46	3	1	1	
15	51	45	-6	5		5
16	43	39	-4	2.5		2.5
				R (+) 14* (-) 14*		

\*Not significant.

Table 6. A Comparison of the Pretest and Posttest Hiskey  
Mental Age for the Control Subjects

S	MA		Difference (in months)	Absolute Rank	R(+)	R(-)
	Pretest	Posttest				
9	4-6	4-6	0	2	2	
10	3-6	4-0	6	2	2	
11	4-6	4-6	0			
12	6-6	5-6	-12	5		5
13	3-0	3-6	6	2	2	
14	4-6	5-6	12	5	5	
15	5-6	6-6	12	5	5	
16	4-6	5-0	6	2	2	
					R (+) 16 (-) 5*	

\*Not significant.

An analysis of the group's pretest and posttest Hiskey MA data substantiated the results of the data presented in Table 5. The data for the Hiskey MA comparison appear in Table 6.

The  $\bar{T}$  for the group pretest and posttest Hiskey MA data was calculated at  $\bar{T} = 10.5$  while the value of the Wilcoxin T statistic was  $T = 5$ . This value is not significant, indicating that the control group did not make significant gains on their posttest Hiskey MA.

#### Testing the Null Hypothesis

The rejection of the null hypothesis for this experiment required that the experimental group make significant gains, over possible gains made by the control group, on their posttest Leiter IQ. The data for this comparison appear in Table 7.

The  $\bar{T}$  for the data in Table 7 was calculated at a value of  $\bar{T} = 18$  while the value of the Wilcoxin T statistic was  $T = 1$ . The value of  $T = 1$  was significant at the .02 level. Since the level of significance for this experiment had been set at .05, the null hypothesis was rejected.

An additional comparison of posttreatment cognitive functioning for the experimental and control group was made on the basis of their posttest Hiskey MA data. While this comparison was not required for rejection of the null hypothesis, it was interpreted as additional supportive

Table 7. A Comparison of Posttest Loss or Gain in Leiter Intelligence Quotient for Experimental and Control Subjects

S	Posttest IQ Loss or Gain	Differ- ence	Abso- lute Rank	R(+)	R(-)	Posttest IQ Loss or Gain	S
1	17	22	7	7		-5	9
2	16	5	2	2		11	10
3	10	10	4.5	4.5		0	11
4	14	18	6	6		-4	12
5	8	-1	1		1	9	13
6	13	10	4.5	4.5		3	14
7	2	8	3	3		-6	15
8	19	23	8	8		-4	16
				R (+) 35 (-) 1*			

\*Significant.

evidence of the Leiter IQ data presented in Table 7. The data for the Hiskey MA comparison appear in Table 8.

The data in Table 8 compared the experimental and control group on the basis of posttest Hiskey MA loss or gain. The  $\bar{T}$  was calculated at  $\bar{T} = 14$  while the obtained value of the Wilcoxin T statistic was  $T = 2.5$ . Although this value was not significant at the level set for rejecting the null hypothesis, change for the experimental

Table 8. A Comparison of Posttest Loss or Gain in Hiskey Mental Age for Experimental and Control Subjects

S	Posttest MA Loss or Gain (in months)	Differ- ence	Abso- lute Rank	R(+)	R(-)	Posttest MA Loss or Gain (in months)	S
1	6	6	2.5	2.5		0	9
2	6	0				6	10
3	18	18	5	5		0	11
4	18	30	6.5	6.5		-12	12
5	0	-6	2.5		2.5	6	13
6	42	30	6.5	6.5		12	14
7	18	6	2.5	2.5		12	15
8	12	6	2.5	2.5		6	16
				R (+) 25.5 (-) 2.5*			

\*Not significant.

group was in the predicted direction. These results were interpreted as lending support to the Leiter data which permitted rejection of the hypothesis.

#### Influence of the Standard Error of Measurement

The standard error of measurement (SEM) for the Leiter was calculated at  $\pm 3.56$  (Lord, 1959). Using the data in Table 1 (p. 27) a group mean ( $\bar{X}$ ) IQ on the pretest Leiter was calculated at  $\bar{X} = 46$  for both the experimental and the

control group. The posttest Leiter  $\bar{X}$ , from the data in Table 3 (p. 30) was calculated at  $\bar{X} = 58.3$  for the experimental group. The data in Table 5 (p. 33) resulted in a  $\bar{X}$  of 46.4 for the control group. The experimental group's gain of 12.3 IQ points represented a gain of more than +3 SEM deviations. The control group's gain of but .4 IQ points on their posttest  $\bar{X}$  IQ was well within the range of +1 SEM. These results were interpreted as lending strong support to the conclusion that posttest Leiter IQ gains made by the experimental group subjects were due to the experimental treatment program, the visual-motor tutoring, and not a function of the SEM.

#### Other Factors Influencing Change-Scores

There are factors other than the SEM which may contribute to a change in scores on a test-retest application of a given instrument. Among these are errors in testing and test-retest correlations. Clarke (1965) has discussed the problem of errors in testing and concluded that such errors almost always result in an underestimation of the IQ while test-retest correlations tend to show some subjects increasing in IQ, some decreasing, and some remaining constant.

Four of the control subjects, numbers 9, 12, 15, and 16, indicated decreases in their posttest Leiter IQs. Subject 12 also showed a decrease in posttest Hiskey MA.

The loss of twelve months MA by subject 12 can be traced to the loss of 1 point on the sub-test for memory for color and the loss of 2 points on the sub-test for picture identification. The Hiskey protocol provides no clues as to why these points were lost.

The Leiter IQ losses for the four subjects ranged from 4 to 6 points. These losses were due to subject 9 completing on the posttest, one item less than on the pretest; and to subjects 12, 15, and 16 each completing two items less on the posttest. Although some of the items missed on the posttest had been completed correctly on the pretest, the Leiter test protocols provide no clues as to why they were missed.

Gunzburg (1965) has discussed the problems inherent in the assessment of the mentally retarded and concluded that great caution must be taken when interpreting a person's test score. The data obtained in this investigation do not seem to be discrete enough to explain, with certainty, why the four subjects in the control group showed posttest losses. It was tentatively conjectured that the reasons were probably a combination of factors, possibly including those discussed on page 38.

## CHAPTER V

### SUMMARY, DISCUSSION, AND RECOMMENDATIONS

Can individual visual-motor tutoring raise the level of cognitive functioning in the trainable mentally retarded? This was the general question to be answered by this investigation.

Programs for the trainable retarded in the public schools are usually concerned with the development of those skills, habits, and social adjustments that these children can acquire within the limits imposed by their intellectual ability. Such programs do not generally have as their primary purpose the increasing of level of cognitive functioning, although this may occur.

The purpose of this investigation was to provide data to confirm or negate the writer's belief that it is possible to assist trainable mentally retarded children to increase their level of cognitive functioning.

#### Organization of the Study

In this study, sixteen trainable mentally retarded children were matched and paired on the basis of chronological age and Leiter IQ. Eight of these children were randomly assigned to the experimental group and eight were randomly assigned to the control group. The subjects in the

experimental group received twenty-seven individual visual-motor tutoring experiences. The eight subjects in the control group received twenty-seven lessons in coloring, drawing, cutting, and pasting.

#### Analysis of the Data

Data for this experiment were of such a nature that analysis by statistical method only would not make the fullest use of all information available. For this reason individual case studies for each of the subjects in the experimental group were presented. Statistical comparisons of the experimental and control group were also made.

The case studies of the children in the experimental group included information gained through observation and psychometric examinations made during this experiment as well as information from the subject's school records. Statistical comparisons were made on results of the objective tests given prior to and immediately following the two treatment programs.

#### The Overall Results of the Study

Various statistical comparisons of the objective data obtained in this experiment indicate that it is possible to raise the level of cognitive functioning, as measured by the instruments used, in the trainable mentally retarded. Each of the eight children in the experimental group made gains in their posttest Leiter IQ. Submitting

the data to a statistical analysis showed that the IQ gains made by this group, when compared to the corresponding data for the control group, were significant beyond the .05 level. While a similar comparison of the corresponding Hiskey MA data was not significant at the level set for this experiment, movement by the experimental group subjects was in the predicted direction.

#### Theoretical Considerations

Of concern to the investigator is the query: Does remediation and training increase the level of cognitive functioning or a score on a particular instrument? The question may be circular and analogous to the physician prescribing glasses to correct a visual defect. Although the visual defect remains, the individual with corrected vision may function more efficiently, visually.

Posttest Leiter IQs for the children in the experimental group show them to have functioned at a higher cognitive level than they had on the pretest Leiter. While these data show the group to have increased their IQs on a particular instrument, the Leiter, such an increase would not have occurred had they functioned at their previous level, the pretest level. In other words, a substantial gain in IQ, with factors such as the standard error of measurement and errors in testing held constant, requires an increase in the level of cognitive functioning.

Conversely, an increase in the level of cognitive functioning may result in IQ gain.

Secondly, it is questioned: What do the IQ gains made by the subjects in the experimental group mean?

Bortner and Birch (1970) have presented convincing arguments that a distinction must be made between cognitive capacity and cognitive performance if we are to be most effective in developing approaches for educating mentally retarded children. Significant though they were, the present writer does not hold the view that the experimental group's gains in cognitive performance, as measured by the Leiter IQ, are the most important findings of the present study. Rather, it is the evidence that trainable mentally retarded children possess the potential for improving their cognitive functioning, and the facilitative nature of the visual-motor tutoring activities to exploit this potential, that is of importance.

### Conclusions

Results such as those obtained in this study allow us to be optimistic when searching for appropriate methods to assist the trainable retardate in becoming more nearly what we would wish for all children. One of the questions this study was designed to answer is: Can visual-motor tutoring with trainable mentally retarded children result in a significant increase in cognitive functioning? An

affirmative answer to this question would require, and lend support to, an affirmative answer to the next query: Do the data obtained in the investigation of the problem provide sufficient evidence to support the development of a method of visual-motor learning for the trainable mentally retarded? Statistical analyses of the objective data obtained in this experiment led the writer to the following conclusions:

1. Significant increments in cognitive functioning, as measured by the Leiter, can be obtained in trainable mentally retarded children.
2. The Leiter IQ gains made by the subjects in the experimental group can be attributed to the visual-motor tutoring used in this study.
3. The data obtained in the investigation support the development of a method of visual-motor tutoring for trainable mentally retarded children.

#### Recommendations

The positive results obtained in this experiment have several implications for education in general, the education of the trainable mentally retarded child in particular. Based on the objective data gathered during this investigation, the following recommendations seem to be in the best interest of both areas of education.

1. It is recommended that classes for the trainable mentally retarded incorporate into their curriculum, provisions for teaching the visual-motor activities used in this study.
2. It is recommended that the Leiter International Performance Scale be used in conjunction with the visual-motor activities when possible. Periodic Leiter evaluations of children receiving the visual-motor activities may reveal valuable diagnostic information that can be directly applied to planning subsequent visual-motor activities as needed.
3. It is recommended that this study be replicated with subjects other than trainable mentally retarded children. Of particular interest to the writer would be investigations using educable mentally retarded subjects and preschool children of all intellectual levels.
4. It is recommended that similar future studies include a follow-up study to determine if gains made by children receiving the experimental treatment are maintained over a period of time.
5. It is recommended that replications of the present study investigate the effects of massed practice for short periods of time and short practice sessions over long periods of time.

6. It is recommended that replications of the present study be extended to investigate the effects of improvement in cognitive functioning on non-intellectual behavior.
7. It is recommended that future studies of the nature of the present investigation employ as tutors individuals other than the principal investigator to administer the training programs. The appropriateness of an experimenter acting as the tutor in a study such as the present one may be questionable.

## APPENDIX A

### ANALYSIS OF THE LEITER INTERNATIONAL PERFORMANCE SCALE

The ability to problem-solve new material has been given heavy weighting on the Leiter International Performance Scale (Leiter). Many of the sub-tests present unusual or unfamiliar arrangements of familiar visual stimuli for the subject to respond to. In addition to this characteristic, the various sub-tests rely on certain functions of the communications process for completion.

The three-dimensional model of the Illinois Test of Psycholinguistic Abilities (Kirk et al., 1968) was used to analyze the Leiter from Year II through Year XII. This analysis identified the level of organization and the process required in responding to the Leiter items. Figure 1 presents the model of the Illinois Test of Psycholinguistic Abilities (ITPA) used in making this analysis.

Completing items on the Leiter requires the subject to manipulate blocks, either manually or through gestural and/or verbal directions to the examiner. All of the subjects used in this study were able to manipulate the blocks for themselves. The expressive process used then, was manual expression and visual discrimination could be assumed if the subject responded correctly. Further, since

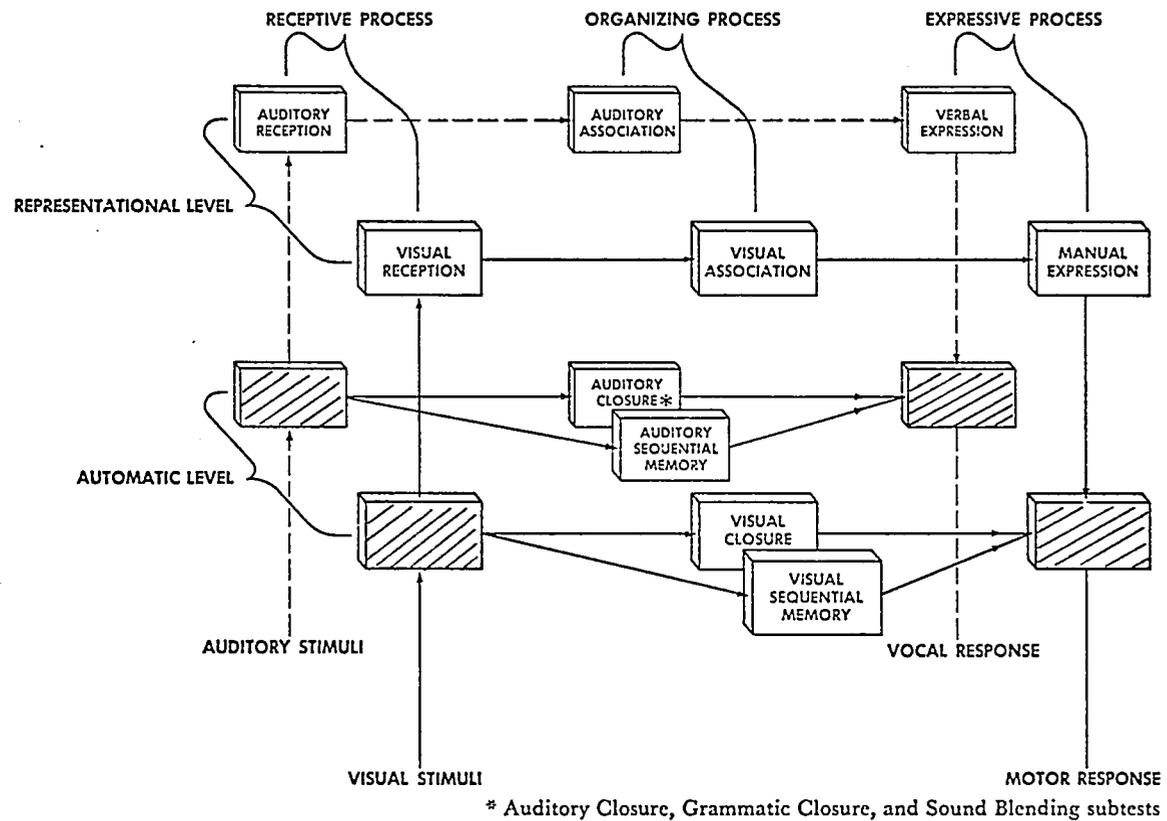


Figure 1. Three-Dimensional Model of the Visual-Motor Process -- Source: Kirk et al., 1968.

the test may be administered completely without verbal communications, visual reception was the only sensory input channel required in responding to the various sub-test items. A modified model of the ITPA, as it applied to the administration of the Leiter in this study, is presented in Figure 2.

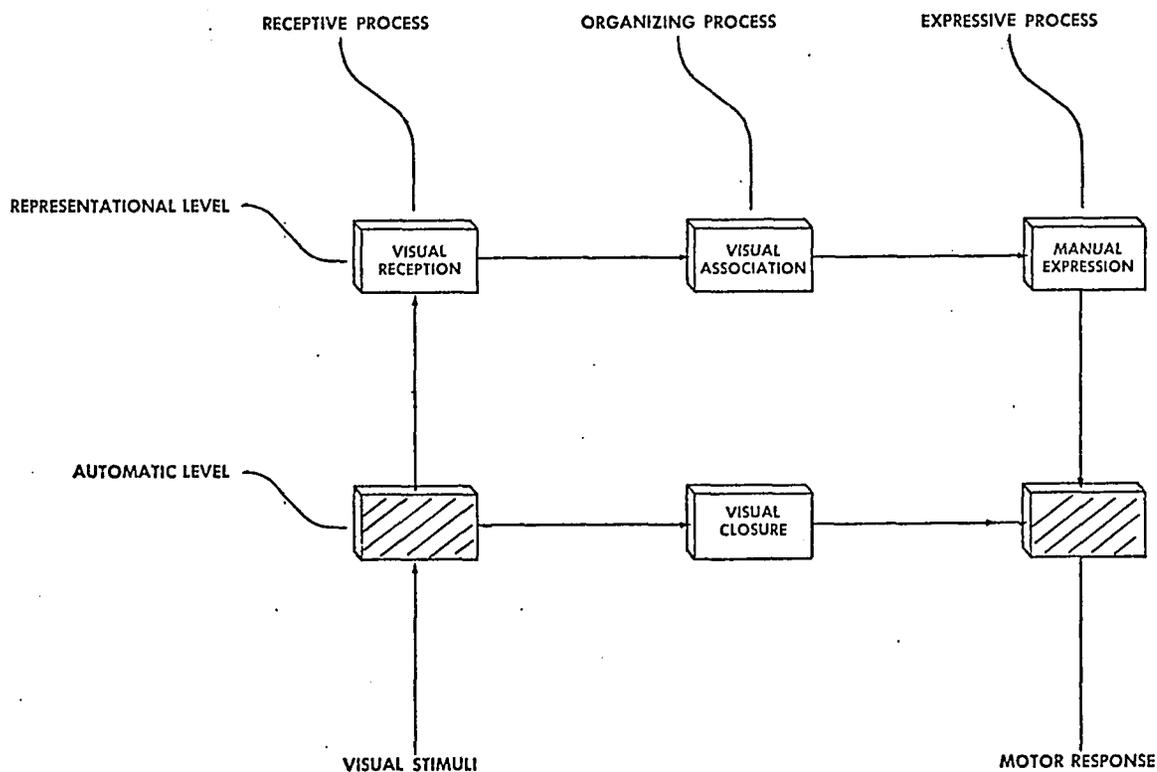


Figure 2. Modified Three-Dimensional Model of the Visual-Motor Process

The results of analyzing the Leiter appear on the following pages. Each sub-test on the Leiter is identified by a Roman number which designates the year level and an Arabic number that designates the sub-test for that year. The system of numbering the Leiter items here is identical to that used by Leiter (1966) in the test manual and on the test protocol.

Results of the Analysis of the Leiter

<u>Leiter Item</u>	<u>Level of Organization</u>	<u>Process</u>	<u>Remarks</u>
II-1	A	VD	
II-2	A	VD	
II-3	A	VD	
II-4	A	VD	
III-1	A	VD	
III-2	A	VD	Orientation added.
III-3	A	VC	
III-4	A	VD	
IV-1	A	VD	2 fVD--form and color.
IV-2	A	VD	
IV-3	R	VA	
IV-4	A	VD	3 fVD--form, color, and number.

<u>Leiter Item</u>	<u>Level of Organization</u>	<u>Process</u>	<u>Remarks</u>
V-1	R	VDc	
V-2	A	VD	fVD--4 colors.
V-3	R	VA	
V-4	A	VD	3 fVD--form, color, and sequence.
VI-1	R	VA	
VI-2	A	VA	
VI-3	R	VA	
VI-4	A	VD	3 fVD--orientation, color, and sequence.
VII-1	A	VC	Change in sequence.
VII-2	R	VA	Assume concept of 1 to 8; in order.
VII-3	R	VA	Sequencing involved.
VII-4	R	VA	
VIII-1	A	VD	Fine color discrimination.
VIII-2	A	VD	Fine symbol discrimination.
VIII-3	A	VD	
VIII-4	R	VA	

<u>Leiter Item</u>	<u>Level of Organization</u>	<u>Process</u>	<u>Remarks</u>
IX-1	R	VA	Sequencing.
IX-2	R	VDC	Very fine form discrimination.
IX-3	A	VD	Form, color, orientation, and sequencing.
IX-4	A	VC	
X-1	A	VD	Very fine visual discrimination.
X-2	A	VC/VD	4 fVD--time, form, color, and orientation.
X-3	R	VA	
X-4	A	VC/VD	3 fVD--form, color, and sequence.
XII-1	A	VC/VD	4 fVD--time, form, color, and orientation.
XII-2	R	VA	
XII-3	R	VA	
XII-4	R	VA	

---

VA--visual association	A--association level
VC--visual closure	R--representational level
VD--visual discrimination	fVD--factors in visual discrimination
VDC--visual decoding	

---

## APPENDIX B

### VISUAL-MOTOR ACTIVITIES USED WITH EXPERIMENTAL GROUP

The visual-motor activities used with the experimental group were designed to remediate specific weaknesses identified on the subject's pretest Leiter. Each activity is an attempt to provide practice and training in the functions of the communications process involved in executing the tasks required by the Leiter sub-test, rather than practice on the test item itself.

In general, the materials used in the visual-motor activities were selected on the basis that they were visually attractive, three-dimensional, and dissimilar to items appearing on the Leiter blocks. In presenting them here, V-M is used to indicate visual-motor activity. The Arabic numerals used to identify each V-M corresponds to the Leiter sub-test item the activity was designed to remediate; i.e., V-M 31 corresponds to Leiter Year III-1. Finally, V-M 84 refers to Leiter Year VIII-4.

#### V-M ACTIVITIES

<u>V-M</u>	<u>Materials</u>	<u>Task to be Performed</u>
31	Large, yellow pop-out beads. Two each of four different shapes.	Match one bead of each shape, placed before <u>S</u> in random order, to one of each shape presented as a unit.

<u>V-M</u>	<u>Materials</u>	<u>Task to be Performed</u>
32	Marble form board and sixteen marbles.	Eight marbles are placed in the form board; yellow, blue, red, yellow, blue, red, green, and red. <u>S</u> is given eight marbles of the same colors and duplicates the pattern.
33	Plastic carrot, beet, eggplant, and squash; cut in half.	Half of each item is placed in a row before <u>S</u> . The matching halves are laid before <u>S</u> in random order. <u>S</u> matches.
34	Plastic lemons, pears, and oranges.	Lemons are placed before <u>S</u> in order: 1, 2, 1, 2. Two single pears and two bunches of two pears are randomly placed before <u>S</u> . <u>S</u> matches by quantity. Oranges are then matched to the pears and for the third match, lemons are matched to the oranges.
41	Yellow and blue plastic pop-out beads. Three yellow of different shapes and three blue of different shapes.	Six beads, three of each color and each a different shape, are placed in a row before <u>S</u> . The remaining six beads are randomly placed before <u>S</u> at one time. <u>S</u> matches.
42	Seven pairs of plastic shapes.	One shape of each pair is placed before <u>S</u> , in a row. Remaining seven shapes are presented to <u>S</u> at one time, randomly. <u>S</u> matches.
43	Same as 34 but with bunches of 1, 2, 3, and 4.	Same as 34 but with elements 3 and 4 added.
44	Orange and green plastic pop-out beads; two different shapes; 1 or 2 dots on pairs.	Three of each color and with 1 or 2 dots are placed before <u>S</u> , in a row. The remaining six matching beads are presented to <u>S</u> at one time, randomly. <u>S</u> matches.

<u>V-M</u>	<u>Materials</u>	<u>Task to be Performed</u>
51	Plastic pear, apple, red car, yellow truck, red flower, yellow flower, green ball, red ball, tiger, and camel.	Apple, red flower, car, red ball, camel are placed before <u>S</u> in a row. Remaining items are presented together and in random order. <u>S</u> matches by genus.
52	Twenty plastic pop-out beads.	Ten beads are connected in pairs: blue and orange, blue and green, purple and green, purple and orange, and green and orange. These are placed before <u>S</u> at one time, in random order. <u>S</u> duplicates the patterns and places his pair by the model.
61	Plastic tomato, onion, plum, garlic bulb, orange, and lemon; from large to small in this order Plastic cups from large to small.	Fruits and vegetables are placed before <u>S</u> in order, from large to small. Six plastic cups of different sizes are placed before <u>S</u> in random order. <u>S</u> matches cups to model on the basis of size.
62	Green and white plastic balls; hollow and cut in half.	Five half balls are laid before <u>S</u> in order: white, green, white, green, and white. <u>S</u> is given four white and three green halves. <u>S</u> matches model and continues pattern with the extra white, green, and white halves.
63	Plastic cup, saucer, toy car, and motorcycle. Glass jar and lid, table knife and fork, and a pencil and pad of paper.	One item from each pair is placed before <u>S</u> in a row. The remaining items are presented at one time, randomly placed. <u>S</u> matches on the basis of use.
64	Marble form board with three patterns of four marbles each. Two colors in each pattern.  R Y R B B Y Y R B R Y B	Form board with patterns glued in and twelve marbles: four red, four blue, four yellow are placed before <u>S</u> . <u>S</u> duplicates the patterns exactly. Reversals are considered incorrect.

<u>V-M</u>	<u>Materials</u>	<u>Task to be Performed</u>
71	Two each: plastic lemons, pineapples, cucumbers, oranges, ears of corn, garlic bulbs, apples, and tomatoes. Toy blocks with numbers 1 to 8. Large oak tag card with numbers 1 to 8.	The oak tag card is laid before <u>S</u> . By each number one of the plastic fruits or vegetables is placed. The remaining pieces, one of each kind, are randomly placed before <u>S</u> . <u>S</u> matches by picking up a numbered block, finding its corresponding fruit or vegetable on the model and then places the block by the correct piece of randomly placed stimuli before him.
72	Assorted plastic nuts, lemons, pears, and oranges.	One piece is laid to the <u>S</u> 's left and a bunch of six is placed to his right, approximately eight inches apart. The remaining items, in bunches of 2, 3, 4, and 5, are randomly placed before <u>S</u> . <u>S</u> places the bunches in numerical sequence between those placed by the experimenter.
73	One whole plastic banana and six pieces of banana, each of different size.	The whole banana is placed to the <u>S</u> 's right. The smallest piece is placed approximately eight inches to the left. The remaining five pieces are placed before <u>S</u> in random order. <u>S</u> places the five pieces between the whole banana and the small piece placed by the experimenter, in order by size.
83	Six plastic squares and six plastic circles, all yellow and of different sizes.	Six circles are placed in a row before <u>S</u> , not in order by size. Six square pieces are presented randomly and at the same time. <u>S</u> matches on the basis of mass.

<u>V-M</u>	<u>Materials</u>	<u>Task to be Performed</u>
84	Eight dominoes with 1, 2, 3, 4, 5, 6, 7, and 8 dots.	The domino with one dot is placed to the <u>S</u> 's left and the domino with 8 dots is placed approximately six inches to the right. The remaining dominoes are presented randomly and at one time. <u>S</u> places the dominoes in appropriate numerical order between the two placed by the experimenter.

## APPENDIX C

### TREATMENT SCHEDULES FOR EXPERIMENTAL GROUP

The individual treatments for the experimental group were intended to require from ten to fifteen minutes for completion. Occasionally a subject would indicate that he (or she) had finished before ten minutes had elapsed. In such cases the subject was encouraged, but not required, to continue. If the subject did not, he was given an additional activity at the next session. Three activities usually required the time allowed for each lesson.

Schedules of the individual treatment programs appear on the following pages. Each lesson (L) is designated by the Arabic numeral representing its place in the sequence 1 to 27. Activities are identified by Arabic numerals 31 through 84. These numbers correspond to the various sub-tests on the Leiter; i.e., V-M 31 represents the visual-motor (V-M) activity designed to remediate a failure on Leiter sub-test III-1. Subjects are identified by the letter S and the number used to match-pair them with their control group partner; i.e., S-1 represents the experimental subject who had been paired with control subject number S-9 at the beginning of the experiment.

Treatment Schedule for S-1

<u>L</u>	<u>Date</u>	<u>V-M</u>	<u>L</u>	<u>Date</u>	<u>V-M</u>
1	4-8-69	34,41,44	15	5-14-69	43,44,52
2	9	34,41,44	16	16	43,44,52
3	10	34,41,44	17	19	43,44,52
4	11	34,41,44	18	20	43,44,52
5	15	34,41,44	19	21	43,44,52
6	21	34,41,44	20	22	43,44,51,52
7	22	34,41,44	21	23	43,51,52
8	24	34,41,44	22	26	43,44,51,52
9	28	34,41,51	23	27	43,51,52
10	30	34,41,51	24	28	44,51,52
11	5-2-69	34,51,52	25	29	44,51,52
12	6	43,44,52	26	6-2-69	43,44,51
13	8	43,44,52	27	3	43,44,52
14	12	43,44,52			

Treatment Schedule for S-2

<u>L</u>	<u>Date</u>	<u>V-M</u>	<u>L</u>	<u>Date</u>	<u>V-M</u>
1	4-8-69	32,34,42	15	5-13-69	42,43,44
2	9	32,34,42	16	15	42,43,44
3	10	32,34,42	17	19	42,43,44
4	11	32,34,42	18	20	43,44,52
5	15	32,34,44	19	21	43,44,52
6	21	34,42,44	20	22	43,44,52
7	22	42,43,44	21	23	43,44,52
8	23	42,43,44	22	26	42,43,51
9	25	42,43,44	23	27	42,43,51
10	29	42,43,44	24	28	42,43,44
11	5-1-69	42,43,44	25	29	42,43,44
12	5	42,43,44	26	6-2-69	43,44,51
13	7	42,43,44	27	3	42,43,51
14	9	42,43,44			

Treatment Schedule for S-3

<u>L</u>	<u>Date</u>	<u>V-M</u>	<u>L</u>	<u>Date</u>	<u>V-M</u>
1	4-8-69	32,43,61	15	5-13-69	43,62,63
2	9	32,43,61	16	15	62,63,64
3	10	32,43,61	17	16	62,63,64
4	11	32,43,61	18	19	62,63,64
5	15	32,43,61	19	20	62,63,64
6	21	43,61,62	20	21	62,64,72,73
7	22	43,61,62	21	22	62,64,73
8	23	43,61,62	22	23	71,73,84
9	25	43,61,62	23	26	71,73,84
10	29	43,61,62	24	27	71,73,84
11	5-1-69	43,61,62	25	28	71,73,84
12	5	43,61,62	26	29	71,73,84
13	7	32,43,61,64	27	6-2-69	71,73,84
14	9	43,62,63			

Treatment Schedule for S-4

<u>L</u>	<u>Date</u>	<u>V-M</u>	<u>L</u>	<u>Date</u>	<u>V-M</u>
1	4-8-69	43, 51, 61	15	5-14-69	71, 73
2	9	43, 51, 61	16	16	71, 73, 83
3	10	43, 51, 61	17	19	71, 73, 83
4	11	43, 51, 61	18	20	71, 73, 83
5	15	43, 51, 61	19	21	71, 73, 83
6	21	61, 64, 71	20	22	71, 73, 83, 84
7	22	61, 64, 71	21	23	71, 73, 83, 84
8	24	61, 64, 71	22	26	71, 73, 83, 84
9	28	61, 64, 71	23	27	71, 73, 83, 84
10	30	61, 64, 71	24	28	71, 73, 83
11	5-2-69	61, 64, 71	25	29	71, 84
12	6	71, 73	26	6-2-69	71, 84
13	8	71, 73	27	3	71, 84
14	12	71, 73			

Treatment Schedule for S-5

<u>L</u>	<u>Date</u>	<u>V-M</u>	<u>L</u>	<u>Date</u>	<u>V-M</u>
1	4-7-69	33,34,43	15	5-9-69	43,44,52
2	9	33,34,43	16	13	43,44,52
3	10	33,34,43	17	15	43,44,52
4	11	33,34,43	18	16	43,44,52
5	14	33,34,43	19	19	43,44,64,73
6	21	33,34,43	20	20	43,44,64,73
7	22	33,34,43	21	21	43,44,52,73
8	23	33,34,43	22	22	43,64,73
9	24	43,44	23	23	43,64,71,73
10	25	43,44	24	26	43,71
11	29	43,44,52	25	27	43,64,71
12	5-1-69	43,44,52	26	29	43,64,71
13	5	43,44,52	27	6-2-69	43,64,71
14	7	43,44,52			

Treatment Schedule for S-6

<u>L</u>	<u>Date</u>	<u>V-M</u>	<u>L</u>	<u>Date</u>	<u>V-M</u>
1	4-7-69	61,64,73	15	5-12-69	61,64,71,72,73
2	9	61,64,73	16	14	72,83,84
3	10	61,64,73	17	16	72,83,84
4	11	61,64,73	18	19	52,61,71,72,83
5	14	61,64,73	19	20	72,83,84
6	21	71,72,83	20	21	52,61,72,73,84
7	22	71,72,83	21	22	72,83,84
8	23	71,72,83	22	23	72,83,84
9	24	71,72,83	23	26	73,83,84
10	28	71,72,83	24	27	73,83,84
11	30	71,72,83	25	28	73,83,84
12	5-2-69	71,72,83	26	29	71,73,84
13	6	71,72,83	27	6-2-69	71,73,83
14	8	71,72,83			

Treatment Schedule for S-7

<u>L</u>	<u>Date</u>	<u>V-M</u>	<u>L</u>	<u>Date</u>	<u>V-M</u>
1	4-7-69	62,64,73	15	5-12-69	62,64,73
2	9	62,64,73	16	14	62,64,73
3	10	62,64,73	17	16	62,64,73
4	11	62,64,73	18	19	62,64,73
5	14	62,64,73	19	20	62,64,73
6	21	62,64,73	20	21	62,64,72,73
7	22	62,64,73	21	22	62,64,72
8	23	62,64,73	22	23	62,64,72
9	24	62,64,73	23	26	71,72,83
10	28	62,64,73	24	27	71,72,83
11	30	62,64,73	25	28	71,72,83
12	5-2-69	62,64,73	26	29	64,71,72
13	6	62,64,73	27	6-2-69	64,71,72
14	8	62,64,73			

Treatment Schedule for S-8

<u>L</u>	<u>Date</u>	<u>V-M</u>	<u>L</u>	<u>Date</u>	<u>V-M</u>
1	4-8-69	61,62,63	15	5-13-69	61,62,64
2	9	61,62,63	16	15	61,62,64
3	10	61,62,63	17	16	61,62,64
4	11	61,62,63	18	19	61,62,64
5	14	61,62,63	19	20	61,62,64
6	21	61,62,63	20	21	62,64,73
7	22	61,62,64	21	22	64,71,73
8	23	61,62,64	22	23	64,71,73
9	24	61,62,64	23	26	64,71,73
10	25	61,62,64	24	27	64,71,73
11	5-1-69	61,62,64	25	28	64,71,73
12	5	61,62,64	26	29	64,71,73
13	7	61,62,64	27	6-2-69	64,71,73
14	9	61,62,64			

## APPENDIX D

### SELECTED TRANSCRIPTS OF TAPE RECORDED LESSONS FOR EXPERIMENTAL GROUP

The tutoring of children on an individual basis does not seem to lend itself to predetermined or routine dialogue. In an attempt to provide the reader with an accurate idea of how the visual-motor lessons were presented and conducted, sample lessons for each of the experimental group children were tape recorded. Three of these transcribed tape recorded lessons are presented on the following pages. The lessons selected for presentation here were chosen on the basis of the visual-motor activities presented and the general representative nature of their content. The dialogue is identified by E for the experimenter and S for the experimental subject. All responses that were unintelligible on playback are designated U.

S-3 Lesson 20 Time: 9' 45"  
V-M 64, 62, 73, 72

E: How are you this morning, Ida?

S: Fine.

E: Fine. Do you know what I have here on the floor? Look here. I have a tape recorder. And it's going. So everything you say goes on the tape. And maybe someday you can hear it play. Would you like that? You have to talk then, don't you.

S: Yes.

E: 'Cause if you don't talk, nothing goes on. Okay? You want to start with this one?

S: Yes.

E: Do you remember what you have to do there?

S: U.

E: Um hmm.

S: U. And this one here. And here.

E: That's right. That's very good, Ida.

S: U.

E: Very good. You got those two right.

S: U.

E: Do you know something, Ida? This is the first time you got them all right. Without changing any.

S: U.

E: They're glued in.

S: These aren't.

E: No. But do you know this is the first time you got them all right without any help? That's very good, isn't it? You learned how to do that. Do you want to put your marbles back?

S: U.

E: No, those don't come out. That's very good, Ida. You've learned that. You've worked hard, haven't you? Do you want to do this one next?

S: Yes. U.

E: Now this one is hard too, remember? Maybe you can get this one the first time. Wouldn't that be nice if you got it the first time?

S: U.

E: What's that, Ida? Are they bubbles?

S: Yeah.

E: Um hmm.

S: U.

E: Why Ida! That's very good. You got it right the first time. That is very good. Now. Do you think you can do as well on this one?

S: Yes.

E: I hope so. Those are mine.

S: U.

E: Those are mine and these are yours. Do you want to put them where they go? Oh, Ida! That's very good. You've done them right the first time. You're getting good at this aren't you.

S: U.

E: You're getting good at this aren't you. I'm going to have to give you a new one today. That one--this one you don't have to do--you know it so well. You don't have to do that one anymore. So I'm going to have to give you something new to do. Would you like that?

S: U.

E: I know. I'm going to give you the one with the bananas.

S: U.

E: Banana. See, this is a whole banana. Okay? I'm going to lay it right there. And this is just a little piece of banana, isn't it. Now, in the box are a lot of pieces of banana. Would you put them here where they go? Very good. They don't go together. Now. Look at them, Ida. Is one of them in the wrong place? No. No.

S: U.

E: Well, where does it go?

S: Right here.

E: No, not quite. See, this one goes over there. So this one goes--

S: Right here.

E: Would you want to put it there? Yes. Now you see what you had to do there Ida? You see what happened? This is a big banana and each piece gets a little smaller, doesn't it. And pretty soon you don't have any banana at all, hardly. Just a little end.

S: U.

E: Now, let's put these back in the box and see if you can do it alone now. Let's see if you can put them back now.

S: U.

E: That's very good, Ida. You did them all right.

S: U.

E: You learned that real fast. I'm going to give you that one again next time you come in. See if you can do it again. Okay? Next time you come. We'll do it again. Okay? That's a pretty sweater you have on today.

S: Green.

E: Green. And what else?

S: Blue.

E: Right. Green and blue. No, that one you know. You don't have to do that one. Do you remember this? You remember this? See? You remember that. You got it right every time. You don't have to do that any more.

S: U.

E: We can do this one. I'll show you what happens here, Ida. Can you count those nuts for me? How many nuts are there?

S: Three.

E: No. A little bit more than three. I'll help you. I'll point to the nut and you say it.

S: One, two, three, four, five, six.

E: Very good. And how many is here?

S: One.

E: That's just one nut. Now, can you put these things where they go--in between?

S: Yes.

E: What goes next to one?

S: Two.

E: All right. Do you want to put the pear and the nut there? Now what goes next to two?

S: U.

E: One, two.

S: Two, three.

E: Three goes next to two, doesn't it? And there you have two nuts and a lemon and that's three. Now, how many are there?

S: Four.

E: That's right. That goes next. And how many are there?

S: Five.

E: That's right. We'll do that next time too, Ida, and I think you'll get it right alone. Without any help. You want to put those in there? That's very good Ida.

S: U. Outside.

E: You want to go outside? Okay, Ida. Thank you.

S: Thank you.

E: You did a real good job.

S-6 Lesson 18 Time: 9' 2"  
V-M 84, 73, 72, 52, 61

- E: Would you like to be recorded today--on the tape recorder?
- S: Yes.
- E: I turned it on--it's down there on the floor--and the wheels are going around.
- S: U.
- E: So now you're being recorded.
- S: I like that.
- E: You like that?
- S: Yeah.
- E: Okay. Would you like to start with the dominoes? You remember what you have to do?
- S: Yeah.
- E: I have to see them to see if I've got the right ones out there. Don't want that one. Now, they're right. Would you like to put those where they go for me?
- S: Yes. One, two, three, four, five. One, two, three. One, two. One, two, three, four.
- E: You go ahead, Patty. You're doing fine.
- S: One, two, three, four, five. Five, six, seven.
- E: That's right. U. Very good. Can't fool you can I, huh? Okay. You remember these?
- S: Yeah.
- E: Do you know what you have to do?
- S: Yeah.
- E: Here you are. Now, you want to put them where they have to go. Very good, Patty. Would you like to put them back in this thing for me?
- S: Yeah.

E: You remember this one. What is that?

S: Banana.

E: Banana. What color is the banana?

S: Yellow.

E: And what other colors do you see on it?

S: Green.

E: Green.

S: Black.

E: Black. That's where it's getting ripe. It's getting ripe isn't it. And they turn brown. Now, can you put the pieces where they go? That's very good Patty. You can put those back in the box if you want to. Do you remember this one?

S: Yeah.

E: What do you have to do with this one?

S: Count.

E: You have to count, don't you.

S: Yeah.

E: What is that? It's a walnut.

S: Huh?

E: Walnut. Can you say walnut? Can you say nut?

S: Nut.

E: Nut. It's a nut.

S: One, two, U, one, two, three, four. One, two, three. And one, two, three, four. One, one, two, four, five, U.

E: How many? Now, you count that again.

S: Five.

E: Are you sure? How many are there?

S: Five.

E: Right. You wouldn't let me fool you would you. That's very good, Patty. How many are there?

S: Six.

E: Six. Very good. I can't fool you, can I?

S: No.

E: Oh, let's put it up here, Patty. We have so many of them, don't we. Now here's one I know is too easy for you, Patty. But I think it will be kind of fun. Do you want to try it?

S: Oh!

E: I don't mean that one. You've done that one. This--now let me see, what number is it? Here. I know this is too easy for you.

S: (Laughs.)

E: But I think it might be kind of fun. Because you've never done it before.

S: I know.

E: U. You see. I lay those out like that. And then you take these in the box and put them together the way these are. No, no. These.

S: U.

E: See, you make one like this--make one like this.

S: Okay. U.

E: Right. Now lay it right there by it. Now you have it.

S: U.

E: Green and orange.

S: U.

E: That's right.

S: Green and purple.

E: That's right.

S: Right there. There's a blue one.

E: That's very good, Patty. Now I'll put mine back in the box and you pull yours apart and put them in the box. Okay?

S: That was easy.

E: That was easy wasn't it?

S: Yeah.

E: They're all easy for you.

S: Yeah.

E: You've done very well at this--you know?

S: Yes.

E: We have a little time left. Let me see if I can find something else. U.

S: What's that?

E: See. Most of these are too easy for you. Here's a good one, Patty. I think you did this a long time ago.

S: Yes.

E: Do you remember? You haven't done it for a long time have you. And maybe it might be good to see if you still know how to do it. What is that?

S: Huh?

E: What is that? It's a plum. Plum.

S: Tomato.

E: Tomato.

S: U.

E: Onion.

S: Onion. Garlic.

E: Garlic.

S: Orange.

E: Orange.

S: Lemon.

E: Lemon. Very good.

S: U.

E: Ah! You got caught didn't you.

S: Yeah.

E: You fooled yourself. That's very good. You know when you made the mistake, didn't you.

S: There.

E: That's very good, Patty. Did you enjoy it?

S: Yes.

E: Did you? I'll see you tomorrow? Or maybe the next day. Either tomorrow or Monday. Maybe I won't get to you tomorrow. But if I don't get to you tomorrow I'll see you Monday. All right? Okay. Thank you.

S-8 Lesson 21 Time: 13' 54"  
V-M 64, 73, 71

E: You know the tape recorder wasn't working the other day. So would you like to have it taped again today? Hmm? Would you like that? I have it going now. Do you want to do these?

S: U.

E: Remember that?

S: U.

E: That's very good, Paul. Very good.

S: U.

E: Now, what is this one? That's red. Red. Right. Now these two. Right. Very good.

S: U.

E: Now the last one.

S: U.

E: That's right.

S: U.

E: That's very good, Paul. You want to put your marbles away?

S: U.

E: Thank you.

S: U.

E: Yes. You want to try the banana? We'll put the big banana here and the little pieces here. And you put those pieces where they go.

S: U.

E: Right.

S: U.

E: Right.

S: U.

E: That's very good, Paul. That's very good. Now, I have a real hard one, Paul. But you can do it. You can learn.

S: U.

E: Yes! There are a lot of things in there. And you can learn to do this one. Do you know what that number is?

S: U.

E: One.

S: U.

E: Two.

S: U.

E: Three.

S: U.

E: Can you say three?

S: U.

E: Four.

S: U.

E: Five.

S: U.

E: Five.

S: U.

E: Six.

S: U.

E: Seven.

S: U.

E: Eight.

S: U.

E: Cucumber.

S: U.

E: Corn, pineapple.

S: U.

E: Yes, pineapple. Tomato.

S: U.

E: Garlic, lemon, orange.

S: U.

E: And an apple.

S: U.

E: Now, these I put down here are yours.

S: U.

E: And you get these blocks.

S: U.

E: Yes. Blocks.

S: U.

E: Now Paul, pick up one block. All right. Now find that number up here--and that's the pineapple. Wait a minute. So put your block by your pineapple. Put it by yours. Yours is over here. Put it over here. No, Paul. Here. Take the block. Take the block. See? That is like this, isn't it? And that is like this. Now pick up another block. No, no. That's two isn't it. Hold the block. Two. Where's two here? By the orange. So put it by your orange. Put it by your orange. Right. Now. Pick up another block.

S: U.

E: Right. Put it by yours. Where is yours like this? Where is your garlic? Put it by the garlic. Your garlic. Not mine. Put it by your garlic. That's good, Paul. Now, what is the next number?

S: U.

E: No, here. Hold this in your hand. That's the cucumber. Put it by your cucumber. Right.

S: U.

E: Now pick up another block. Six. That's the tomato isn't it. Where is your tomato? Very good. Now another block. One.

S: U.

E: Yes. By your apple. Right. Now another block. Eight. That's the lemon. Put it by your lemon. By your lemon.

S: U.

E: Right. Now three. Corn. Very good.

S: U.

E: Yes. That's very good. Shall we try that again without help? You think you can do it alone now? You try it alone. I think you can do it.

S: U.

E: Right. Very good.

S: U.

E: Very good, Paul. Very good. There.

S: U.

E: U.

S: U.

E: Very good.

S: U.

E: Are those the same?

S: U.

E: There you have it.

S: U.

E: Right.

S: U.

E: Very good.

S: U.

E: Very good, Paul.

S: U.

E: Now, Paul, I helped you just a little bit, didn't I. Do you think you could do it this time without any help?

S: U.

E: See, I pointed to some of them for you. Maybe this time I won't have to point. Let's see if you can do it without any help at all. Okay?

S: U.

E: That's right.

S: U.

E: And that one is right.

S: U.

E: Very good.

S: U.

E: Very good. That one is all right. You leave that one there.

S: U.

E: These you had wrong, Paul. No. That one is all right. Just these were wrong. Let me see you do something with those.

S: U.

E: All right. Put it there then. That's right.

S: U.

E: Right. Right. And that one has to go there, doesn't it.

S: U.

E: Right.

S: U.

E: Now, Paul. When I put these things away we'll say them.  
All right?

S: U.

E: Can you say apple? Apple. Tomato. Tomato. Pineapple.  
Pineapple. You like pineapple?

S: U.

E: Corn. Yes. You eat that off the cob. Corn.

S: U.

E: Pickle. Cucumber. Yes.

S: U.

E: Orange. Orange.

S: U.

E: Garlic.

S: U.

E: Lemon.

S: U.

E: Do you want to put the blocks in the box for me? That's  
very good, Paul.

S: U.

E: That's a lot of boxes.

S: U.

E: Are you finished?

S: U.

E: Okay, Paul. Thank you.

## APPENDIX E

### ACTIVITIES USED WITH THE CONTROL GROUP

The activities used with the control group are presented on the following pages. All except activities I through VI, Figures 3 through 8, are self-explanatory. Each of these activities were presented on a single sheet of plain, white paper measuring 8-1/2" by 11". Subjects were asked to color them in any manner and with any color they chose.

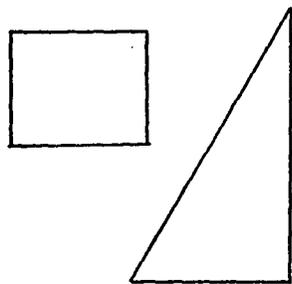


Figure 3. Activity I

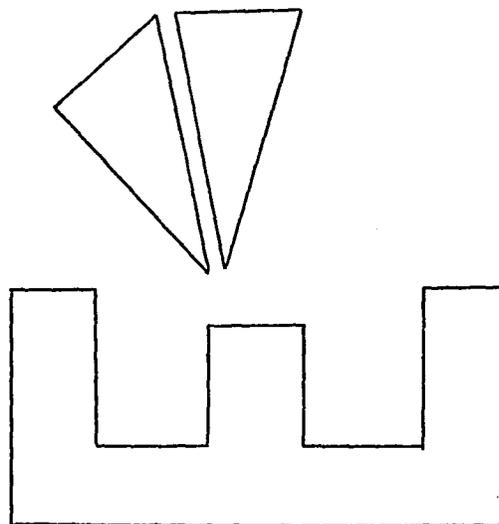


Figure 4. Activity II

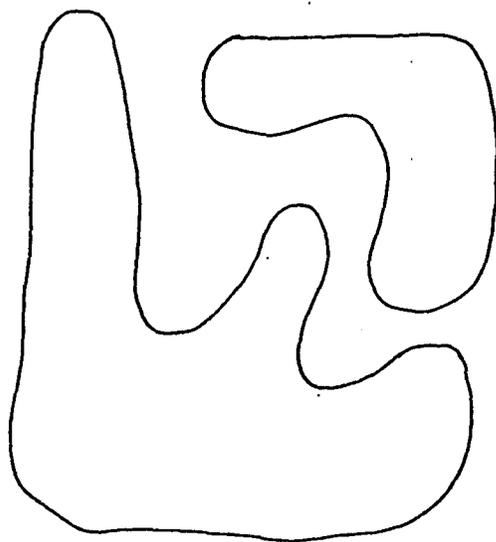


Figure 5. Activity III

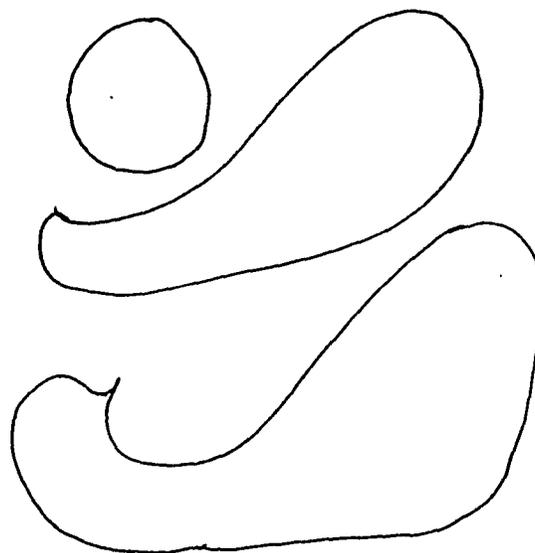


Figure 6. Activity IV

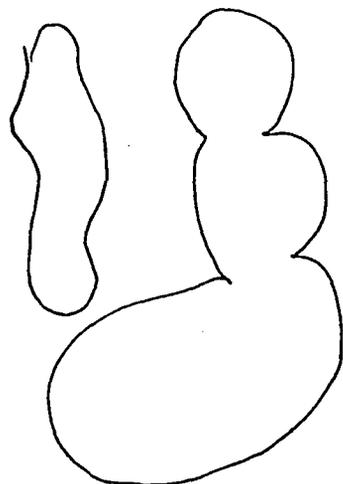


Figure 7. Activity V

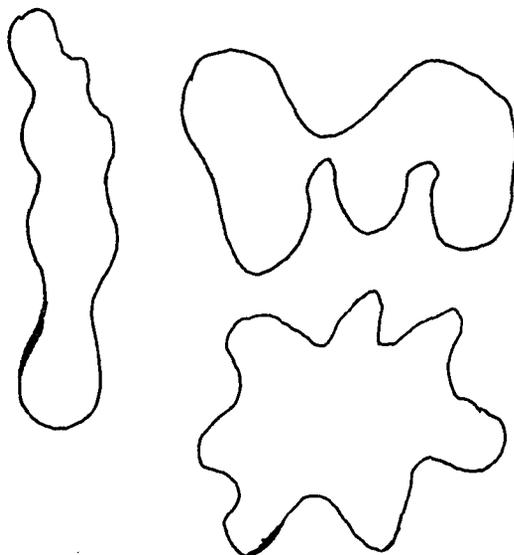


Figure 8. Activity VI

Activity I, II, III, IV, V, and VI. Color only.

Activity VII. Free hand drawing.

Activity VIII. Cut out the activity previously colored.

Activity IX. Cut out scraps of colored construction paper.

Activity X. Paste scraps from Activity IX on white paper.

## APPENDIX F

### TREATMENT SCHEDULES FOR CONTROL GROUP

The individual treatments for the control group were intended to require from ten to fifteen minutes for completion. Occasionally, a subject would indicate that he (or she) was finished before the time had elapsed. In such instances, the subject was encouraged, but not required, to continue. Contrariwise, a subject would sometimes want to continue working past the fifteen minute time limit. When this was the case the subject was allowed to do one more additional activity.

Schedules of the individual treatments are presented on the following pages. Each lesson (L) is identified by an Arabic numeral while the individual activities (A) are represented by Roman numerals. These activities appear in Appendix E. Control subjects are identified by the letter S and the number used to match them with their experimental partner; i.e., S-9 represents the subject who was paired with S-1. Finally, S-16 is the subject who was matched with S-8.

Treatment Schedule for S-9

<u>L</u>	<u>Date</u>	<u>A</u>	<u>L</u>	<u>Date</u>	<u>A</u>
1	4-7-69	I, VII	15	5-2-69	III, VIII
2	8	II, VII	16	5	IV, VIII
3	9	III, VII	17	6	V, VIII
4	11	IV, VII	18	7	VI, VIII
5	14	V, VII	19	8	III
6	15	VI, VII	20	9	VI, VII
7	21	I, VII	21	12	X
8	23	II, VII	22	13	X
9	24	III, VII	23	14	VII
10	25	IV, VII	24	15	IX
11	28	V, VII	25	16	VII
12	29	VI, VII	26	19	X
13	30	I, IX	27	21	X
14	5-1-69	II, VIII			

Treatment Schedule for S-10

<u>L</u>	<u>Date</u>	<u>A</u>	<u>L</u>	<u>Date</u>	<u>A</u>
1	4-7-69	I, VII	15	5-2-69	IV, VIII
2	8	II, VII	16	5	II, VIII
3	9	III, VII	17	6	V, VIII
4	11	IV, VII	18	7	VI, VIII
5	14	V, VII	19	8	VI
6	15	VI, VII	20	9	VI, VII
7	21	I, VII	21	12	X
8	23	II, VII	22	13	X
9	24	III, VII	23	14	VII
10	25	IV, VII	24	15	IX
11	28	V, VII	25	16	X
12	29	VI, VII	26	19	X
13	30	II, VIII	27	21	X
14	5-1-69	III, VIII			

Treatment Schedule for S-11

<u>L</u>	<u>Date</u>	<u>A</u>	<u>L</u>	<u>Date</u>	<u>A</u>
1	4-7-69	I, VII	15	5-2-69	IV, VIII
2	8	II, VII	16	5	V, VIII
3	10	III, VII	17	6	VI, VIII
4	11	IV, VII	18	7	III, VIII
5	14	V, VII	19	8	II
6	15	VI, VII	20	9	VI, VII
7	22	I, VII	21	12	X
8	23	II, VII	22	13	X
9	24	III, VII	23	14	VII, IX
10	25	IV, VII	24	15	IX
11	28	V, VII	25	16	X
12	29	VI, VII	26	19	X
13	30	I, VIII	27	21	X
14	5-1-69	III, VIII			

Treatment Schedule for S-12

<u>L</u>	<u>Date</u>	<u>A</u>	<u>L</u>	<u>Date</u>	<u>A</u>
1	4-7-69	I, VII	15	5-2-69	IV, VIII
2	8	II, VII	16	5	V, VIII
3	9	III, VII	17	6	VI, VIII
4	10	IV, VII	18	7	V, VIII
5	14	V, VII	19	8	VI
6	15	VI, VII	20	9	VI, VII
7	21	I, VII	21	12	X
8	23	II, VII	22	13	X
9	24	III, VII	23	14	VII
10	25	IV	24	15	IX
11	28	V, VII	25	16	X
12	29	VI, VII	26	20	X
13	30	I, VII	27	22	X
14	5-1-69	III, VIII			

Treatment Schedule for S-13

<u>L</u>	<u>Date</u>	<u>A</u>	<u>L</u>	<u>Date</u>	<u>A</u>
1	4-7-69	I, VII	15	5-2-69	IV, VIII
2	8	II, VII	16	5	VI, VIII
3	9	III, VII	17	6	IV, VIII
4	10	IV, VII	18	7	IV, VIII
5	14	V, VII	19	8	II
6	15	IV, VII	20	9	VI, VII
7	21	I, VII	21	12	X
8	22	II, VII	22	13	X
9	24	III, VII	23	14	VIII
10	25	IV, VII	24	15	IX
11	28	V, VII	25	16	X
12	29	VI, VII	26	20	X
13	30	II, VIII	27	22	X
14	5-1-69	III, VIII			

Treatment Schedule for S-14

<u>L</u>	<u>Date</u>	<u>A</u>	<u>L</u>	<u>Date</u>	<u>A</u>
1	4-7-69	I, VII	15	5-2-69	IV, VIII
2	8	II, VII	16	5	V, VIII
3	10	III, VII	17	6	VI, VIII
4	11	IV, VII	18	7	III, VIII
5	14	V, VII	19	8	IV
6	15	VI, VII	20	9	VI, VII
7	22	I, VII	21	12	X
8	23	II, VII	22	13	X
9	24	III, VII	23	14	VII
10	25	IV, VII	24	15	IX
11	28	V, VII	25	16	X
12	29	VI, VII	26	19	X
13	30	I, VIII	27	21	X
14	5-1-69	III, VIII			

Treatment Schedule for S-15

<u>L</u>	<u>Date</u>	<u>A</u>	<u>L</u>	<u>Date</u>	<u>A</u>
1	4-7-69	I, VII	15	5-2-69	IV, VIII
2	9	II, VII	16	5	V, VII
3	10	III, VII	17	6	VI, VIII
4	11	IV, VII	18	7	III, VIII
5	14	V, VII	19	8	IV
6	15	VI, VII	20	9	VI, VII, V
7	22	I, VII	21	12	X
8	23	II, VII	22	13	X
9	24	III, VII	23	14	VII
10	25	IV, VII	24	15	IX
11	28	V, VII	25	16	X
12	29	VI, VII	26	20	X
13	30	I, VIII	27	22	X
14	5-1-69	III, VIII			

Treatment Schedule for S-16

<u>L</u>	<u>Date</u>	<u>A</u>	<u>L</u>	<u>Date</u>	<u>A</u>
1	4-7-69	I, VII	15	5-2-69	III, VIII
2	8	II, VII	16	5	IV, VIII
3	9	III, VII	17	6	V, VIII
4	10	IV, VII	18	7	VI, VIII
5	14	V, VII	19	8	III
6	15	VI, VII	20	9	VI, VII
7	21	I, VII	21	12	X
8	23	II, VII	22	13	X
9	24	I, VII	23	14	VII
10	25	III, VII	24	15	IX
11	28	IV, VII	25	16	X
12	29	V, VII	26	20	X
13	30	VI, VII, VIII	27	22	X
14	5-1-69	I, VIII			

## APPENDIX G

### SELECTED TRANSCRIPTS OF TAPE RECORDED LESSONS FOR CONTROL GROUP

Verbal communication between the subjects (S) and the experimenter (E) was not encouraged during the individual lessons. Dialogue did occur, however. Since the nature of this experiment precluded a predetermined dialogue, a sample lesson for each of the control subjects was tape recorded. Four of these recorded lessons are presented here in an attempt to provide the reader with an accurate account of how the individual lessons were conducted. The transcribed recordings selected to appear here were chosen on the basis of the representative nature of their content in relation to all lessons for the group. Unintelligible responses are indicated by U.

S-9 Lesson 20 Time: 10' 52"

E: How are you this morning, Kenny? Hmm? You're not going to talk? No. Would you see how nicely you can color that for me? Would you like to do that? Good. What color is that, Kenny?

S: U.

E: What color?

S: U.

E: Yellow?

S: Yellow.

E: Yellow.

S: U.

E: And that?

S: U.

E: Green.

S: Green.

E: Green.

S: Green.

E: And what color is that?

S: U.

E: Yellow.

S: Yellow.

E: You go ahead and color. You're doing a good job. I like that. You have lots of pretty colors in there, Kenny. Blue? Is that blue? Are you finished with that now? Then would you like to draw me a picture here? Draw a nice picture for me? You do very well at this, Kenny. This is nice. I like it. You have lots of nice colors there, too, don't you. Kenny? Lots of nice colors? Kenny? Can you tell me anything about your picture?

S: U.

E: What is that?

S: U.

E: Pardon me?

S: U.

E: It's nice, isn't it. Are you finished? You want to turn it around so I can see? Can you tell me what that is?

S: Yeah. U.

E: I like the way you did it. It's very nice. Shall I put your name on it. Kenny? Okay? Are you ready to go back outside now? Okay, Kenny. Thank you.

S-10 Lesson 20 Time: 10' 42"

E: Now, Susie. Would you like to color those real nicely for me?

S: Yes.

E: You always color very nicely, don't you? What color is that Susie?

S: Brown.

E: Brown. Right. And that?

S: U.

E: Green. You like to color?

S: I like pink.

E: Pardon me. What did you say?

S: Pink.

E: Pink.

S: Yellow.

E: Yellow.

S: Red.

E: Red.

S: U.

E: What did you say?

S: Purple.

E: Purple. You're doing a very nice job there, Susie. I like that. That's very pretty, Susie. That's very pretty. You did a good job on that. Do you feel like drawing a picture for me today? Would you like to draw a picture there? And then you can tell me about it. Can you tell me what you drew there?

S: Cat.

E: Cat? Is that what--is that a cat? You're going to finish it now, huh? Can you show me where the cat's tail is? I'll get it. Here you are. You finished? Is that your cat? Is this your cat?

S: Yes.

E: You like cats? That's a very nice cat, Susie. I like that. You do a good job, don't you? Would you like to go back now? I'll help you down. Thank you, Susie.

S-13 Lesson 20 Time: 7' 24"

E: How are you today, David?

S: U.

E: Pardon me? Would you like to color these for me? Will you try to stay inside those lines, there? See if you can stay inside the line. Okay?

S: U.

E: That's a pretty blue shirt you have on today, David.

S: U.

E: You like that blue shirt? It looks nice on you. You've used a lot of pretty colors in that one, haven't you. That looks nice.

S: U.

E: Try and stay on the paper.

S: (Laughs.)

E: What are you laughing at?

S: U.

E: Hmm?

S: U.

E: You're doing a good job there. You like black, don't you?

S: U.

E: Pardon me?

S: U.

E: I didn't hear you. Could you say that again?

S: Kenny Hum.

E: Oh, Kenny.

S: U.

E: Um hmm.

S: Wayne Shields.

E: Um hmm. Wayne Shields.

S: Paul. U.

E: Are you finished with that? Now, would you like to take this one and draw me a picture? See how nice a picture you can draw?

S: U.

E: Pardon me?

S: Goodbye.

E: Are you finished?

S: U.

E: I didn't hear you.

S: U.

E: That's Jenny?

S: That's Jenny.

E: Oh. That's Jenny. You did a nice job there. Can you tell me anything about it.

S: U.

E: Very good, David. Can you tell me something about the picture.

S: U.

E: Can you tell me what it is?

S: U.

E: Pardon me?

S: U.

E: What is this?

S: Color.

E: Colors. You did a nice job on it. Thank you.

S: Thank you.

E: Goodbye.

S-15 Lesson 20 Time: 10' 2"

E: How are you today, Wayne? Hmm?

S: U.

E: Would you like to color these things for me? There's no red there, is there? Here. Why don't you try to stay in the line there? Excuse me?

S: That's okay.

E: I didn't see your foot there.

S: I know. How's Miss Carstensen doing down at the college?

E: Fine.

S: She might be here tomorrow?

E: Thursday.

S: Thursday?

E: Um hmm.

S: She won't be in Friday 'cause there's no school Friday.

E: Right.

S: She won't be in Friday.

E: Right.

S: U. Just on Thursday.

E: Yes. And maybe next week. Are you finished with that? Would you want to put your name on it? Now, would you like to draw a picture on this one? With the colors. You can draw it with the pen and then color it.

S: Whose pen is it?

E: Mine. What is that?

S: U.

E: Who are you drawing? You don't know? You can use the colors for that.

- S: Whistles. Is that a tape recorder down there? Down below.
- E: Yes. See it?
- S: Who turned it on?
- E: I did.
- S: Recording something?
- E: Yes. Is that all right?
- S: I like those kind of tape recorder. I'm going to get one. U.
- E: It's a nice one.
- S: Is that the school's?
- E: The twenty-sixth. You write your name very well, Dave. Hmm? Is that anybody?
- S: I don't know.
- E: You don't know. It's a nice picture, though. I like it. You did a good job. Okay? You want to go back now?
- S: Who else you want?
- E: Pardon me?
- S: You want me to get someone else for you?
- E: Well, I'll ask Mrs. Parsons for somebody else. Okay? Thank you. That's all right. I'll get it off later. Thank you, David.

Note: Although the experimenter greeted the subject as Wayne, his name was David.

## APPENDIX H

### INDIVIDUAL CASE STUDIES FOR EXPERIMENTAL GROUP

The case studies presented here were not intended to be comprehensive. Their main purpose is to provide the reader with information not to be found in a statistical analysis. Secondly, it is hoped that they will provide a clearer understanding of the complex and unique differences to be found in trainable mentally retarded children.

Information included in the case studies drew heavily on the experiment itself as a source. In addition, school records were examined for information pertinent to this study. Since several of the subjects' school files were incomplete at the time of this examination, some case studies rely more heavily on this source than do others. In general, however, each study will provide information on previous psychometric data, measurements of attention span during the training program, and a discussion of the experimenter's observations during the individual lessons. Where available, developmental history and information on social growth will be included. Where a medical diagnosis is given it is cited exactly as it appeared in the school records. All references to V-M refers to the visual-motor activities presented in Appendix B.

Case Study of S-1

Date of Birth 5-8-62

Experimental Psychometric Data		Previous Psychometric Data
Pretest:	Leiter IQ 48	5-2-66
	Hiskey MA 3-0	Vineland Social Maturity Scale IQ 52
Posttest:	Leiter IQ 65	Cattell Infant Intelligence Scale IQ 52
	Hiskey MA 3-6	Gesell Developmental Schedules DQ 50
Lesson	Measures of Attention	
8	2' 29"	1-22-69
16	4' 32"	Stanford-Binet (L-M) IQ 49
26	4' 41"	

S-1 is described in the school records as a mongoloid who presents no serious management problems at home. An entry dated 5-20-65 states that she "jabbers a good deal-- some speech becoming more comprehensible." She is reported by the mother to be very inquisitive and very active, her only problem being that of yelling because of inability to communicate. A teacher's report of 6-6-68 describes her as well toilet trained, capable of taking off and putting on her wraps without help, not too social and not working to capacity. Poor work habits were also noted.

The experimenter's first impression of the subject was that of an attractive, friendly, out-going child. Early in the training program she talked to herself a great deal while working at the V-M activities. Much of this talk was

unintelligible until she was asked to repeat it. Her attention to the task to be performed was poor and very limited.

Throughout the training program, S-1 was very inconsistent in her ability to count to 4. Of the 6 V-M activities she practiced during the experiment, the V-M requiring counting to 4 (V-M 43) was the only one she was unable to master with consistency. Her ability to pay attention seemed to improve during the course of the training program as may be seen from the measures of attention shown immediately following the psychometric data for this experiment. An examination of her posttest Leiter protocol shows her completing 4 items she had not been able to complete on the pretest Leiter. These were Leiter items IV-1, 3, 4, and V-1. As may be seen from the subject's treatment schedule in Appendix C, all of these items received heavy weighting in her treatment program. Interestingly, although she passed Leiter item IV-3 on the posttest, V-M 43 was the one activity she remained inconsistent about to the end of the experiment.

Case Study of S-2

Date of Birth 8-15-60

Experimental Psychometric Data	Previous Psychometric Data
--------------------------------	----------------------------

Pretest: Leiter IQ 48

8-25-67

Hiskey MA 3-6

Insufficient responses to  
obtain IQ

Posttest: Leiter IQ 53

Hiskey MA 4-0

	Measures
Lesson of Attention	

8	3' 8"
---	-------

16	4' 18"
----	--------

26	5' 4"
----	-------

S-2 is the next to the youngest of 5 sibs. An older sister has been in special education classes and her younger brother was in the control group of this experiment (S-9). She is reported to have had several respiratory infections with high fever as an infant. Associated with the fevers were febrile convulsions.

The subject walked at about 1 year. Speech onset was delayed. Since the family is Chinese, it has been suggested that her slow language development may be the result of a certain amount of bilingual confusion. A medical examination dated 7-18-67 gave the impression of: Organic Brain Damage--etiology unknown.

S-2 is an attractive, pleasant child. On the occasion of every lesson, she would lift the hem of her

dress to call the experimenter's attention to what she was wearing. It is doubtful that she said more than 25 words during the entire course of 27 lessons. In spite of this, it was the writer's opinion and impression that good communications existed during the tutoring relationship. This was due largely to the very revealing facial expressions used by the subject.

During the course of the treatment program the subject had most of her difficulty with V-M 43 and V-M 44. She did not pass either of the corresponding items on the posttest Leiter. Her improvement in posttest Leiter IQ was due to passing Leiter items III-2, 4; IV-2; V-1, 4, and VI-3. With the exception of items V-4 and VI-3, the treatment program had stressed these items.

It was the general impression of the experimenter that the subject needed an inordinate amount of encouragement and assurance throughout the entire treatment program. She was willing to try, but seemed to wait for approval before making any decision final. An examination of the subject's measurements of attention shows considerable improvement throughout the experimental period.

Case Study of S-3

Date of Birth 6-6-60

Experimental Psychometric Data      Previous Psychometric Data

Pretest: Leiter IQ 56                      5-5-67

                  Hiskey MA 4-0              Stanford-Binet              IQ 43

Posttest: Leiter IQ 66

                  Hiskey MA 5-6

                  Measures  
Lesson of Attention

8              3' 28"

16             4' 42"

26             5' 3"

The past history for S-3 reveals several grand mal seizures from the age of 1 year to about 4 years of age. None have been reported since.

The subject sat at 1 year, walked at 17 months and said her first words at 2 years of age. She has been described as having a chronic problem of lack of speech. A medical report of 5-5-67 gave the impression: Organic Brain Damage with associated mental retardation.

The subject is a very friendly and attractive young girl. Unless she was reprimanded though, she persisted in using baby talk. This was consistent with her speech habits in the classroom.

Initially, the subject's attention span was extremely limited. She would look all around the room while

manipulating the materials used in the V-M activities. Her attention seemed to improve during the course of the experiment.

An examination of the subject's posttest Leiter protocol shows that she passed 4 items that had been failed on the pretest. These were Leiter items III-2, IV-3, VI-1, and VII-1. As may be seen from the subject's treatment schedule, all of these items had received considerable attention during the treatment program. Although she had no difficulty in learning V-M items 62, 63, 73, and 84, she was unable to pass the corresponding Leiter items on the post-test.

Case Study of S-4

Date of Birth 9-2-57

Experimental Psychometric Data	Previous Psychometric Data
--------------------------------	----------------------------

Pretest: Leiter IQ 48

3-11-65

Hiskey MA 6-6

Stanford-Binet (L-M) IQ 50

Posttest: Leiter IQ 62

Columbia Mental Maturity  
Scale IQ 49

Hiskey MA 8-0

	Measures
Lesson	of Attention

8	3' 28"
---	--------

16	4' 20"
----	--------

26	5' 59"
----	--------

According to the mother, this boy's chief problem is discipline, hyperactivity, and distractibility.

The subject was born with a cleft lip and palate. Except for this he appeared normal at birth. At 15 months he began having seizures which have been described as "akinetic seizures." These were followed by deep sleep. A medical report dated 5-21-69 describes S-4 as grand mal convulsive disorder--organically damaged child with associated mental impairment. His medication at the time of the examination was 200 mgs. Dilantin and 64 mgs. Phenobarbital daily.

The subject rolled over at about 8 weeks, sat at 7 months, walked at 21 months, and began to say his first

words at approximately 3 years. He has had some corrective surgery for the cleft lip and palate.

This boy is a neat, attractive, and friendly child. During the first few lessons he manipulated the V-M materials without looking at the model. He appeared to do a lot of guessing. Of the eight V-M activities he practiced during the experiment, V-M 71 and 84 were the only two he did not learn rapidly. These two gave him difficulty until the end of the tutoring sessions. Although he failed the posttest Leiter item corresponding to V-M 84, he was able to complete the Leiter item corresponding to V-M 71.

The subject's improvement in posttest Leiter IQ was due to passing 7 items he had failed on the pretest. These were Leiter items IV-3, V-1, VI-1, VII-1, 2, and VIII-1 and 3. With the exception of VII-2 and VIII-1, all of these items had received heavy weighting in the subject's treatment program.

A comparison of S-4's initial and final measurements of attention indicates considerable improvement during the experimental period.

Case Study of S-5

Date of Birth 7-26-57

Experimental Psychometric Data	Previous Psychometric Data
Pretest: Leiter IQ 37	8-25-67
Hiskey MA 5-0	Estimated Stanford-Binet IQ 43
Posttest: Leiter IQ 45	8-2-65
Hiskey MA 5-0	Bender Visual-Motor Gestalt Test
Lesson of Attention	Score well above critical area for suspected neurophysical damage.
8           3' 38"	
16          3' 15"	8-6-65
26          2' 29"	Vineland Social Maturity Scale
	Informant: Mother
	Age equivalent 3 years, 8 months

The subject has been diagnosed as: Organic brain damage with moderate mental impairment. His face was slightly cyanotic at birth. At 4 years of age he ingested aspirin and was hospitalized over night. According to the medical report at this time, there were no complications nor any symptoms of intoxication from this medication. The subject walked at 13 months but was 4 years old before he began to use single words.

The subject is a good-looking, freckle-faced boy who was always neatly groomed. Generally, his attention was easily distracted. He frequently showed no understanding of

what he was doing. In spite of this he was always ready to participate in the lesson and did show a gain of 8 Leiter IQ points on his posttest measurement. His Hiskey MA score for the posttest was the same as on the pretest.

S-5 passed on the posttest Leiter, 6 items that had been failed on the pretest. He also failed 2 items that had been previously passed. Of the 6 new items passed on the posttest, Leiter items III-3, 4, IV-3, 4, and V-2 had received considerable attention during the V-M treatment program. No V-M activity was used for practice with the sixth item, Leiter V-3. Leiter items IV-1 and V-2, which had been passed on the pretest but failed on the posttest, were not a part of the individual lessons.

This subject was the only one of the group whose measures of attention show a definite pattern of decline during the experimental period. It was the experimenter's opinion that such factors as brain damage and/or psychogenic conditions might have accounted for these decrements.

Case Study of S-6

Date of Birth 6-24-56

Experimental Psychometric Data	Previous Psychometric Data
Pretest: Leiter IQ 48	5-6-68
Hiskey MA 5-0	Stanford Binet (L-M) IQ 42
Posttest: Leiter IQ 61	12-7-62
Hiskey MA 8-6	Stanford-Binet (L-M) IQ 54

Lesson	Measures of Attention
8	4' 4"
16	5' 24"
26	6' 49"

This subject had been originally placed in a class for the educable mentally retarded. She was transferred to a trainable program because she could not do the work required in the educable program. The psychologist who administered the Stanford-Binet in 1963 reported that he was dissatisfied with the obtained IQ as a valid measure of the subject's intelligence. His impression was that of a "feral" child who had been given little or no attention. There was some question of neurological involvement.

The report on the subject's 1968 Stanford-Binet pointed out the Ceiling Age as 3 levels above that previously achieved in 1962 and it was felt that this indicated S-6's intellectual functioning was not static.

The subject is an attractive and unusually pleasant child. Always eager to please, she responded very openly to praise and attention. At the beginning of the experiment, she was taken from her mother and placed in a foster home. Later, and still during the experiment, she was moved from the first foster home placement to another foster home. She seemed to enjoy both foster homes and talked cheerfully and openly about them.

Of all the eight children in the experimental group, this is the subject the experimenter was most optimistic about. Although her posttest IQ gains were impressive, four other subjects showed greater improvements.

S-6 was very quick to learn each of the V-M activities used in her treatment program. V-M 61, which seemed the most difficult for her to learn, required but 5 practice sessions for a perfect execution on the first trial. A comparison of initial and final measures of attention indicate considerable improvement during the experimental period.

Examination of the Leiter protocols for this subject shows that on the posttest she was able to complete 7 items that had been failed on the pretest. While 4 of these were items for which she had received considerable tutoring on the corresponding V-M activities, 3 were not. Her posttest Leiter IQ and Hiskey MA gains may be interpreted as

substantiating the reports of the 1962 and 1968 Stanford-Binet examinations.

Case Study of S-7

Date of Birth 10-13-52

Experimental Psychometric Data		Previous Psychometric Data
Pretest:	Leiter IQ 51	4-23-68
	Hiskey MA 5-0	Bender indicates serious perceptual motor limitations
Posttest:	Leiter IQ 53	
	Hiskey MA 6-6	11-15-61
Lesson	Measures of Attention	Wechsler Intelligence Scale for Children (estimated on basis of 2 sub-tests) IQ 50
8	4' 7"	1-11-61
16	3' 32"	Wechsler Intelligence Scale for Children (Performance) IQ 51
26	4' 1"	Merrill-Palmer Scale of Mental Tests 65

This subject's two younger brothers were in the control group for this experiment. She has been diagnosed as: Chronic Brain Syndrome of Unknown Cause; Mental Deficiency, moderate. Her speech is still relatively unintelligible although she is able to communicate her wants readily.

S-7 was weaned at 1 year. Toilet training was accomplished at 15 months and she walked at 1 year. Speech began at about 8 years.

An IQ of 50 was estimated on the basis of 2 sub-tests on the Wechsler Intelligence Scale for Children in 1961. The examiner noted that this was not a valid

procedure but felt that the subject had a possible potential for functioning at around IQ 60-70. The subject is a tall, attractive girl who was always eager to join the investigator for the lesson, yet seemed disinterested in what she was doing when manipulating the V-M materials. Of the eight children in the experimental group she showed the least gain in posttest Leiter IQ. She also failed on the posttest Leiter an item she had been able to pass on the pretest. Her change in posttest IQ over the pretest score was due to passing 2 items previously failed and failing the 1 item previously passed. Of the 2 new items passed on the posttest, only Leiter item VII-2 (V-M 72) was included in her treatment program.

S-7 had a great deal of difficulty with most of the V-M activities. She would execute the activities correctly for several days and then revert to being able to do them only if given help. She appeared generally inconsistent in her performances. An examination of the subject's measures of attention seems consistent with her general behavior during the treatment sessions.

Case Study of S-8

Date of Birth 2-7-52

Experimental Psychometric Data	Previous Psychometric Data
Pretest: Leiter IQ 43	5-3-68
Hiskey MA 4-6	Wechsler Adult Intelligence Scale (Full Scale) IQ 46
Posttest: Leiter IQ 62	9-20-62
Hiskey MA 5-6	Estimated IQ 30-35

Lesson	Measures of Attention
8	3' 27"
16	3' 10"
26	3' 31"

The subject has been diagnosed as: Chronic Brain Syndrome associated with Mongolism--Mental Deficiency, Severe.

S-8 was weaned at 2 years. Toilet training was accomplished at 5 years. He has been described as having an adequate grasp of what is said to him and as being able to communicate his wants.

The subject's appearance is typical of children manifesting the Mongolism stigmata. His speech is unintelligible most of the time and he frequently resorts to grunts and groans. Despite this disability the boy communicates well and showed much enthusiasm and excited pleasure during the treatment sessions.

V-M 64 gave this subject difficulty from lesson 7 until the end of the experiment. The item requires duplicating 3 designs with 4 marbles for each pattern. The subject alternately got 1 and 2 designs wrong by reversing the colors. It was not surprising to have him miss the corresponding Leiter item on the posttest by making 1 reversal. A further analysis of his Leiter protocol for the posttest shows that he was able to complete 8 items that had been failed on the pretest. Four of these items had been given considerable attention in the treatment program and included Leiter items VI-1, 3, VII-1, 3, VIII-1, 2, 3, IX-4, XII-2, and 4. The items at Year XII are worth 6 months MA credit each.

An examination of the subject's measures of attention indicates that his attention was relatively uniform during the experimental period.

### Discussion

There is considerable evidence to support the thesis that with practice, the mentally retarded can be expected to exhibit improvement in motor skills performance (Boldt, 1953; Cantor and Stacey, 1951; Johnson and Blake, 1963; Reynolds and Stacey, 1955).

Boldt (1953) presented evidence that short, frequent practice sessions, as compared to massed practice, usually proved to be more effective with retarded subjects on a block turning task. Reminiscence, or improvement from the last trial of a previous session to the first trial on the following session, has been found to be comparable to non-retarded subjects (Baumeister, Hawkins, and Holland, 1966). Warm-up, or the increase in performance level during a specific period of time, has been demonstrated as superior (Baumeister et al., 1966) and inferior (Ellis, Pryer, and Barnett, 1960) in the mentally retarded when compared with normal subjects. It is the learning potential demonstrated by the mentally retarded rather than the initial lack of skill that is important here.

The importance of visual-motor learning has as its basis theoretical (Hebb, 1949) deduction as well as practical observation (Piaget, 1958). According to Luria (1963), the use of verbal mediators act as powerful influences on nonverbal behavior. Luria feels the mentally retarded frequently fail to use verbal mediation when

performing new tasks. To Vygotsky (1962) the ability to think, reason, remember, plan, and organize has its basis in meaningful language. In an attempt to facilitate the visual-motor learning desired in this experiment, each demonstration was accompanied with verbal instructions and directions to the degree that they were felt to be needed. Such communication between the experimenter and the subjects did not alter, but rather enhanced, the essentially visual-motor nature of the task to be learned.

Attention, essential to learning, is frequently of shortened duration and lessened intensity in the mentally retarded (Zeaman, 1965). The use of novel, three-dimensional materials has been demonstrated to be effective in helping the retarded to focus on the relevant cue of a stimulus dimension (Zeaman, House, and Orlando, 1958). It was hoped that the use of three-dimensional materials that were novel to the subjects would be effective in promoting the desired learning hoped for in this experiment.

Posttest Leiter IQ gains shown by the subjects in the experimental group were impressive. The total gain for the eight subjects was 99 IQ points for a group mean of 12.3 IQ points.

An analysis of the posttest Leiter protocols for the group is revealing. Although there is no hierarchical order in the location of the functions of the communications process throughout the first 12 years of the Leiter, certain

characteristics are to be found in the items most frequently failed by the group.

Visual discrimination at the automatic level presented no problem to the group as a whole until the elements in the visual discrimination aspects of the task became more numerous or complex than that required in previous sub-tests on the Leiter. Leiter item IV-1 presents 2 factors of visual discrimination, form and color. None of the subjects in the group failed this item on the posttest. However, Leiter item IV-2 requires discrimination of 4 colors and correct orientation. Two subjects failed this item on the posttest. Later, on Leiter VI-4, which requires visual discrimination of color, orientation, and sequencing, 7 subjects were unable to complete the task. The V-M activity corresponding to this item had been given considerable attention in 6 of the individual treatment programs. Visual closure, very fine form discrimination, the presence of 4 colors in the discrimination process, and very fine symbol discrimination were also difficult for the group.

There are 29 items at the automatic level through Year XII of the Leiter. The group's gains in posttest Leiter IQ were due, in part, to passing 22 new items at this level; 15 were visual discrimination items and 7 were visual closure items.

There are but 11 items at the representational level through Year XII on the Leiter. Because these are widely

dispersed throughout the 40 sub-tests, and therefore throughout the range of items failed by the group on the Leiter pretest, no clear pattern is evident. The posttest Leiter IQ gains made by the group were due, in part, to passing 22 new items at the representational level; 20 visual association items and 2 visual decoding items.

Since it is the function of the Leiter to discriminate intelligence, regardless of the level or process involved, it may well be that factors of visual discrimination are most influential in determining the failing or passing of an item. However, items at the representational level make up less than one-third of the total items on the Leiter through year XII. Despite this characteristic of the Leiter, exactly one-half of the new items passed by the group on their posttest measurement were at this level. It is apparent then, that while the V-M activities used in the training program for this experiment were effective in remediating deficits at the automatic level, they appeared to be more effective at the representational level.

It is interesting to note that the two subjects showing the greatest gains in Leiter IQ were Down's Syndrome children. Previous researchers (Bilovsky and Share, 1965; McCarthy, 1965) have shown that the Down's Syndrome child is superior in motor encoding (manual expression) when compared with their other psycholinguistic abilities and when compared with non-Down's Syndrome children of the same

mental age. All items on the Leiter, as administered in this experiment, require manual expression.

## REFERENCES

- Allen, R. M., and Jones, R. W. Perceptual, conceptual, and psycholinguistic evaluation. In A. A. Baumeister (Ed.), Mental retardation: Appraisal, education and rehabilitation. Chicago: Aldine Press, 1967. Pp. 39-65.
- Baumeister, A. A., Hawkins, W., and Holland, J. Motor learning and knowledge of results. American Journal of Mental Deficiency, 1966, 70, 590-594.
- Bilovsky, D., and Share, J. The ITPA and Down's Syndrome: An exploratory study. American Journal of Mental Deficiency, 1965, 70, 78-82.
- Binet, A. Les idées modernes sur les enfants. Paris: E. Flammarion, 1909.
- Boldt, R. F. Motor learning in college students and mental defectives. In F. G. Brooks (Ed.), Proceedings of Iowa Academy of Science. Des Moines: State of Iowa, 1953, 60, 500-505.
- Bortner, M., and Birch, H. G. Cognitive capacity and cognitive competence. American Journal of Mental Deficiency, 1970, 74, 735-744.
- Cantor, G. N., and Stacey, C. L. Manipulative dexterity in mental defectives. American Journal of Mental Deficiency, 1951, 56, 401-410.
- Chansky, N. M., and Taylor, M. Perceptual training with young mentally retarded. American Journal of Mental Deficiency, 1964, 68, 460-468.
- Charney, L. The trainable mentally retarded. In S. A. Kirk and B. B. Weiner (Eds.), Behavioral research on exceptional children. Washington, D. C.: Council for Exceptional Children, 1963.
- Clarke, A. D. B. The measurement of intelligence: Its validity and reliability. In A. M. Clarke and A. D. B. Clarke (Eds.), Mental deficiency: The changing outlook. New York: The Free Press, 1965. Pp. 71-91.

- Corder, W. Effects of physical education on the intellectual, physical and social development of educable, mentally retarded boys. Exceptional Children, 1966, 32, 357-364.
- Descocudres, A. The education of mentally defective children. Translated by E. F. Rom from the Second French Edition. Boston: Heath, 1928.
- Doll, E. R. Concept of mental deficiency. American Journal of Mental Deficiency, 1941, 46, 214-219.
- Downie, N. M., and Heath, R. W. Basic statistical methods. (2nd ed.) New York: Harper and Row, 1965.
- Dunn, L. M. Special education for the mildly retarded: Is much of it justifiable? Exceptional Children, 1968, 35, 5-.
- Edgar, C. L., Ball, T. S., McIntyre, R. B., and Shotwell, A. M. Effects of sensory-motor training on adaptive behavior. American Journal of Mental Deficiency, 1969, 73, 713-720.
- Edwards, A. A. Statistical methods. (2nd ed.) New York: Holt, Rinehart and Winston, 1967.
- Ellis, N. R., Pryer, M., and Barnett, C. Motor learning and retention in normals and defectives. Perceptual and Motor Skills, 1960, 10, 83-91.
- Gallagher, J. J. The tutoring of brain-injured mentally retarded children. Springfield, Ill.: Charles C. Thomas, 1960.
- Gunzburg, H. C. Psychological assessment in mental deficiency. In A. M. Clarke and A. D. B. Clarke (Eds.), Mental deficiency: The changing outlook. New York: The Free Press, 1965. Pp. 283-327.
- Guskin, S. L., and Spicker, H. H. Educational research in mental retardation. In N. R. Ellis (Ed.), Inter. rev. res. in m. r. Vol. 3. New York: Academic Press, 1968. Pp. 217-278.
- Hebb, D. O. The organization of behavior. New York: Wiley, 1949.
- Hiskey, M. S. Hiskey-Nebraska Test of Learning Aptitude. Lincoln, Nebraska: Union College Press, 1966.

- Hottel, J. An evaluation of Tennessee's day class program for severely mentally retarded trainable children. Nashville: State Dept. of Education, 1958.
- Itard, J. M. G. The wild boy of Aveyron. 1894. Translated by G. Humphrey and M. Humphrey, 1932. Reprint, New York: Appleton-Century-Crofts, 1962.
- Johnson, G., and Blake, K. A. Learning performance of retarded and normal children. Syracuse, N. Y.: Syracuse University Press, 1963.
- Kirk, S. A. Public school provisions for severely retarded children. Albany, N. Y.: Interdepartmental Health Resources Board, 1957.
- Kirk, S. A. Early education of the mentally retarded. Urbana: University of Illinois Press, 1958.
- Kirk, S. A. Educating exceptional children. Boston: Houghton Mifflin, 1962.
- Kirk, S. A. Research in education. In H. A. Stevens and R. Heber (Eds.), Mental retardation: A review of research. Chicago: University of Chicago Press, 1964. Pp. 57-99.
- Kirk, S. A., and Johnson, G. O. Educating the retarded child. Cambridge, Mass.: Houghton Mifflin, 1951.
- Kirk, S. A., McCarthy, J. J., and Kirk, W. D. Examiner's manual: The Illinois test of psycholinguistic abilities. University of Illinois, Board of Trustees, 1968.
- Kodman, F. Sensory processes and mental deficiency. In N. R. Ellis (Ed.), Handbook of mental deficiency: Psychological theory and research. New York: McGraw-Hill, 1963.
- Leiter, R. G. The Leiter International Performance Scale. Part I. Evidences of the reliability and validity of the Leiter tests. Chicago: C. H. Stoelting Co., n.d.
- Leiter, R. G. The Leiter International Performance Scale. Part II. Instructions for giving and scoring the individual tests. Chicago: C. H. Stoelting Co., 1966.

- Lord, F. M. Tests of the same length do have the same standard error. Educational and Psychological Measurement, 1959, 19, 233-239.
- Luria, A. R. The mentally retarded child. New York: Pergamon, 1963.
- McCarthy, J. Patterns of psycholinguistic development of mongoloid and non-mongoloid severely retarded children. Unpublished doctoral dissertation. University of Illinois, 1965.
- Montessori, M. The Montessori method. 1894. Translated by A. E. George, 1912. Reprint. New York: Schocken Books, 1964.
- Piaget, J. The growth of logical thinking in the child. New York: Basic Books, 1958.
- Reynolds, W. W., and Stacey, C. L. A comparison of normals and subnormals in mirror drawing. Journal of Genetic Psychology, 1955, 87, 301-308.
- Seguin, E. Idiocy: And its treatment by the physiological method. New York: Bureau of Publications, Teacher's College, Columbia University, 1907.
- Tate, M. E. A study of the performance of selected groups of five-year-olds on the Leiter International Performance Scale. Unpublished doctoral dissertation. State University of Iowa, 1950.
- Tate, M. E. The influence of cultural factors on the Leiter International Performance Scale. The Journal of Abnormal and Social Psychology, 1952, 47, 497-501.
- Tate, M. W., and Clelland, R. M. Non-parametric and short-cut statistics. Danville, Ill.: Interstate Printers and Publishers, 1957.
- Vygotsky, L. S. Thought and language. Cambridge, Mass.: MIT Press; New York: John Wiley, 1962.
- Weber, E. W. Mentally retarded children and their education. Springfield, Ill.: Charles C. Thomas, 1963.

- Zeaman, D. Learning processes of the mentally retarded. In S. F. Osler and R. E. Cooke (Eds.), The biosocial basis of mental retardation. Baltimore: The Johns Hopkins Press, 1965.
- Zeaman, D., House, B. J., and Orlando, R. Use of special training conditions in visual discrimination learning with imbeciles. American Journal of Mental Deficiency, 1958, 63, 453-459.