THE EFFECTS OF SENSORY-MOTOR TRAINING
ON VISUAL PERCEPTION AND
SENSORY-MOTOR PERFORMANCE
OF MODERATELY RETARDED CHILDREN

by

BRIAN JOHN KELLY

B.S. ED., University of Michigan, 1967

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF PHYSICAL EDUCATION

in the school
of

Physical Education and Recreation

We accept this thesis as conforming to the required
standard

THE UNIVERSITY OF BRITISH COLUMBIA

October, 1970.
In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the Head of my Department or by his representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Department of Physical Education and Recreation

The University of British Columbia
Vancouver 8, Canada

Date October 1st, 1970.
The subjects who participated in this study, were twenty-one moderately mentally retarded children enrolled in Oakridge School for the mentally retarded in Vancouver, British Columbia. The I.Q. range of the subjects was approximately 30-51.

The purpose of the study was to determine the effects of sensory-motor training on the visual perception and sensory-motor performances of the moderately retarded subjects. In addition, the investigation was also designed to question the claims of some proponents of perceptual-motor theory, who have suggested that improvement in the sensory-motor area leads to subsequent improvement in perceptual functioning.

The subjects were divided into three groups of seven. Each group was then randomly distributed into one of three treatments. The treatments consisted of two sensory-motor training groups and a control group. The sensory-motor treatments consisted of one program based on the widely-practiced Kephart approach; the second was a series of activities designed by the experimenter. These two training programs allowed for a comparison of the relative effects of the individual treatments on the performance of the subjects.

The two activity groups were subjected to thirty half-hour sessions of sensory-motor training over a seven and one-half week period. The control group spent a concurrent amount of
time involved in regular special education classroom activities.

The Frostig Test of Visual Perception and the Purdue Perceptual-Motor Survey were administered prior to and after the training period. The results were then statistically analysed by a complex analysis of variance and the Scheffe Technique.

The following main conclusions were drawn.
1. In the area of visual perception, sensory-motor training was no more effective than regular special education activities in improving performance.
2. Sensory-motor training resulted in performance gains in the sensory-motor area.
3. Improvements in sensory-motor performance did not result in subsequent gains in the visual perception performance.
4. The two programs of sensory-motor training produced similar performances in both the visual perception and sensory-motor areas.
ACKNOWLEDGEMENT

The author owes a debt of gratitude to Mr. A. Buck and his staff at Oakridge School for all their assistance and co-operation throughout the duration of the study.

Special thanks to Dr. R. Marteniuk for his considerable assistance in the areas of the statistical treatment and experimental design.

I would like to express my gratitude to my advisor, Miss Anne Tilley, for her continuous advice and guidance during the preparation of this manuscript.

Also to the other members of my committee, Mr. R. Poutt and Dr. R. Hindmarsh for their generous contributions.

Finally, without the constant encouragement and unfailing faith of my wife Kathy, this study would not have been possible.
## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I</strong> STATEMENT OF THE PROBLEM</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Problem</td>
<td>4</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>5</td>
</tr>
<tr>
<td>Justification</td>
<td>7</td>
</tr>
<tr>
<td>Limitations</td>
<td>8</td>
</tr>
<tr>
<td>Definitions</td>
<td>9</td>
</tr>
<tr>
<td><strong>II</strong> REVIEW OF THE LITERATURE</td>
<td>11</td>
</tr>
<tr>
<td>Perceptual-Motor Development</td>
<td>11</td>
</tr>
<tr>
<td>Motor Bases of Achievement</td>
<td>13</td>
</tr>
<tr>
<td>Research Regarding the Motor Performance of Mentally Retarded Children</td>
<td>17</td>
</tr>
<tr>
<td>Research Regarding Sensory-Motor Training Programs</td>
<td>21</td>
</tr>
<tr>
<td><strong>III</strong> METHODS AND PROCEDURES</td>
<td>26</td>
</tr>
<tr>
<td>Subjects</td>
<td>26</td>
</tr>
<tr>
<td>Tests</td>
<td>26</td>
</tr>
<tr>
<td>Experimental Design</td>
<td>27</td>
</tr>
<tr>
<td>Statistical Analysis</td>
<td>34</td>
</tr>
<tr>
<td><strong>IV</strong> RESULTS AND DISCUSSION</td>
<td>35</td>
</tr>
<tr>
<td>Results</td>
<td>35</td>
</tr>
<tr>
<td>Discussion</td>
<td>41</td>
</tr>
<tr>
<td><strong>V</strong> SUMMARY AND CONCLUSIONS</td>
<td>47</td>
</tr>
<tr>
<td>Summary</td>
<td>47</td>
</tr>
<tr>
<td>Conclusions</td>
<td>50</td>
</tr>
<tr>
<td>Recommendations</td>
<td>52</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>53</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>61</td>
</tr>
<tr>
<td>A. Statistical Treatment</td>
<td>61</td>
</tr>
<tr>
<td>B. Raw Scores</td>
<td>62</td>
</tr>
<tr>
<td>C. Sensory-Motor Training Sample</td>
<td>63</td>
</tr>
</tbody>
</table>


### LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
</tr>
<tr>
<td>3</td>
<td>38</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
</tr>
</tbody>
</table>

1. Pre and Post-Test Means on the Frostig and Purdue Tests
2. Analysis of Variance of Initial and Final Scores on the Frostig Test of Visual Perception
3. Analysis of Variance on Initial and Final Scores on the Purdue Perceptual-Motor Survey
4. Means Comprising the Groups x Tests Interaction for the Purdue Test
LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURES</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>39</td>
</tr>
</tbody>
</table>

1. Results of Experimental Groups Performance on the Frostig Test
2. Results of Experimental Groups Performance on the Purdue Test
CHAPTER I

STATEMENT OF THE PROBLEM

INTRODUCTION

During the past decade, a great deal of ferment has been created over the development and implementation of a set of sensory-motor experiences intended to function as remedial or therapy programs for children with learning disabilities. The growth of these programs has been fostered by educators and psychologists working with children who are considered to be brain-damaged, mentally retarded or slow learners. These programs are based on theories of perceptual-motor development and the effects of sensory-motor experience upon the successive stages in an individual's development.

Piaget, one of the principal theorists in this area, stated:

Each of the stages of learning is essential for the development of the following stages. Each stage integrates the preceding stage and prepares the way for the following one. (62:85)

These stages according to Piaget, are characterized by sequences of inter-related sensory-motor experiences which are the foundations for perceptual development and subsequent symbolic operations and logical thought.

Based on the theoretical dictates of Piaget (61,62), Hebb (40), Gesell (32) and others, educational psychologists and child development specialists as Kephart (47), Barsch (5),
Doman-Delacato (17), and Frostig and Horne (28) have formulated various sensory-motor training programs. They assert that these programs can provide this basic stage which is necessary for the intellectual development of an individual.

Kephart (47), for example, suggests that the development of academic skills as reading and writing depend initially upon the orderly development of motor patterns.

Research (39, 23) regarding the motor performance of mentally retarded children, has demonstrated that this population is definitely deficient in the area of sensory-motor ability. In terms of perceptual-motor theory, those retarded individuals who have deficits in sensory-motor functioning and undergo sensory-motor training, should be positively influenced in regard to perceptual development.

However, workers (59, 14, 54, 65) who have investigated this premise with various populations of children, have produced differing results.

The question is, whether mentally retarded subjects can benefit from sensory-motor training in areas in which they have been found deficient. Further, is this sensory-motor experience beneficial as a form of indirect stimulation, such as improving perceptual development.

This study was designed to investigate these questions by conducting programs of sensory-motor training utilizing a
3.

population of moderately retarded children. The approximate I.Q. of the retarded population ranged from 30 to 51.
4.

PROBLEM

The purpose of the study was to determine whether moderately retarded subjects could make significant improvements or gains in sensory-motor and visual perception performance, after participating in programs of sensory-motor training. In addition, the investigation would attempt to determine whether gains in sensory-motor performance would be reflected in performance gains in the visual perception area.

SUB-PROBLEM

Two sensory-motor training programs were employed in the study. One program was based entirely on the structure, material presentation and specific activities of the widely practiced Kephart training method and procedure (47). The second program was one designed and organized by the investigator. These two programs of sensory-motor training were designed to allow for comparison of the effects of two varying programs on sensory-motor and visual perception performances. The performances by the subjects in these activity program groups were compared to the performances by a control group in order to determine the relative effectiveness of each program.
5.

HYPOTHESES

The following null hypotheses were examined:

1. There is no difference between the mentally retarded Group A (Kephart program) and the mentally retarded control Group C with respect to visual perception performance after the completion of a training program of sensory-motor activities.

2. There is no difference between the mentally retarded Group B (Non-Kephart program) and the mentally retarded control Group C with respect to visual perception performance after the completion of a training program of sensory-motor activities.

3. There is no difference between mentally retarded activity Group A (Kephart program) and the other mentally retarded Activity Group B (Non-Kephart) with respect to visual perception performance after the completion of training programs of sensory-motor activities.

4. There is no difference between the mentally retarded activity Group A (Kephart program) and the mentally retarded control Group C with respect to sensory-motor performance after the completion of a training program of sensory-motor activities.

5. There is no difference between the mentally retarded activity Group B (Non-Kephart) and the mentally retarded control Group C with respect to sensory-motor performance after the completion of a training program of sensory-motor activities.
6. There is no difference between one mentally retarded activity Group A (Kephart program) and the other mentally retarded activity Group B (Non-Kephart) with respect to sensory-motor performance after a training program of sensory-motor activities.
7.

JUSTIFICATION OF THE PROBLEM

Extensive research by Sloan (71), Howe (42), Francis and Rarick (24), and others has established that the mentally retarded are definitely deficient in sensory-motor ability, when compared to the normal population.

The literature further indicates that very limited research has been conducted in this area with moderately retarded subjects. Cratty (15:193) remarked on this point:

Almost without exception, previous studies have collected data from children classified as educable retarded (I.Q. 50-70), rather than with children whose mean I.Q.'s are below 50.

In addition, the work of Woodward (82:69), has revealed that the moderately retarded population function generally at the sensory-motor level of intelligence. In terms of perceptual-motor theory, training designed to enhance sensory-motor functioning, should be reflected in increases in perceptual development. The data from this study should then be relevant as regards this premise.

Roach and Kephart (64:10) reported that in the intellectual development of an individual, a breakdown can occur at any of the developmental stages. In the case of moderately retarded children, such a breakdown could be attributed to the specific causes of retardation.

Further justification for this investigation is based on
the fact that although mentally retarded have continually com-
prised a significant proportion of the population, physical
educators have only recently become engaged in research and
education involving these individuals.

LIMITATIONS

The sensory-motor training programs used in the investi-
gation, were conducted over a seven and one-half week period.
The length of the training may be a limitation of the study.

Although the two sensory-motor training programs differed
in most respects, the degree of differentiation may be a
limitation.
DEFINITIONS

Perceptual-Motor Theory: the essence of the theory is the presence of a sequence of learning stages through which an individual progresses. Later complex learnings are built upon earlier learnings in a hierarchial fashion.

Sensory-Motor: a. stage; the initial stage of development in the perceptual-motor theory. This stage is conceived of, as the essential basis for later perceptual and cognitive development.

b. activities; group and individual low organization activities requiring co-ordination of overt behaviour, i.e.: balancing, locomotion activities, climbing, rhythmic activities, etc.

Perceptual Development: second main stage of perceptual-motor development based on sensory-motor learnings. Perceptual data are systematized by comparing same with motor system. Through this perceptual-motor matching, the perceptual and behavioural world of an individual come to coincide and subsequently become organized.

Symbolic Operations: the stage of development built on earlier sensory-motor and perceptual stages. These involve the higher processes required for abstract thought and conceptualizations beyond basic thought.

Moderately Mentally Retarded: a term of classification originated by the American Association for Mental Deficiency, to
describe those individuals whose intelligence quotient (I.Q.) falls between 30 and 51 approximately on a scale using 100 as the standard for average or normal intelligence. 

Brain-damaged Children: those individuals who have suffered organic brain damage due to chemical imbalance, anoxia, meningitis, pre and post-natal trauma, etc. This condition usually results in perceptual and behavioural disorders as faulty perception, impaired motor co-ordination, etc.

Slow Learner: those individuals who may show average intelligence, but generally perform below the levels of typical children in both academic and motor ability measures.

Laterality: is an internal process, an awareness within the body of the difference between left and right. It is the right-left gradient which will become the basis for an individual's concepts of the co-ordinates of space.

Directionality: an awareness of the three co-ordinates of Euclidian space, right-left, up-down, before-behind, and the subsequent projection onto outside objects. Directionality develops using laterality as its foundation.

Body Awareness: or body image, a perception of one's body, its parts and its position in space relative to objects in the environment.

Visual Perception: the capacity to interpret and identify the incoming sensory impressions through the mode of sight by comparing them with previous experiences.
CHAPTER II

REVIEW OF THE LITERATURE

The review of the literature was conducted under the following classifications.

A. Perceptual-Motor Development
B. Motor Bases of Achievement
C. Research Regarding the Motor Performance of Mentally Retarded Children
D. Research Regarding Sensory-Motor Training Programs

A. PERCEPTUAL-MOTOR DEVELOPMENT

Perceptual-motor development has long been recognized by child development specialists as a very important component in the normal development of the individual.

Hebb (40:42) regards the first few years of life as crucial periods for perceptual-motor experience. Further, he suggests that these experiences are the basis for establishing the all-important associative tissue and the autonomous central processes, which are essential to the most complex functions of human intelligence.

In regard to early perceptual-motor experience, Sherrington (70:169) stages:

It would seem to be the motor act under urge to live which has been the cradle of mind. The motor act, mechanically integrating the individual would seem
to have started mind on its road to recognizability... As motor integration proceeds, mind proceeds with it, the servant of an urge seeking satisfaction.

Most workers would agree that the behaviour of young children is both perceptual and motoric in nature. Jersild (45:3) declares:

In early childhood, mental and physical activities are closely related and motor activities play a major role in intellectual development.

After considerable experimentation in this area, Getman (33:39) states:

Fundamental to every intellectual activity of the human being...is the skill of motor control and co-ordination. (8:39)

Highly regarded developmentalists as Piaget (62:64) and Gesell (31:36), have outlined developmental schemes that employ sensory-motor experiences in their foundational stages.

Kephart, who has embodied the workings of many prominent researchers in his theoretical considerations, states that:

The early motor or muscular responses of the child, which are the earliest behavioural responses of the human organism, represent the beginnings of a long process of development and learning. To a large extent, so-called higher forms of behaviour develop out of and have their roots in motor learning. (47:55)

The literature leaves little doubt as regards the relative value of early perceptual-motor experiences. Authorities generally agree that there is a hierarchy of intellectual development that has perceptual motor experiences as its base, and that these learnings are essential for further complex and higher levels of functioning.
B. MOTOR BASES OF ACHIEVEMENT

Psychology, special education, optometry and child development specialists in many fields have developed a very intricate, but unified concept regarding the motor bases of achievement.

Kephart (47:8) has emerged as a leader in developing remedial training programs for atypical learners based on the premise that academic skills depend initially on the orderly development of motor patterns. He suggests that movement patterns depend upon posture, locomotion, receipt and propulsion. These are the integral components of an awareness of body position in space or body image. Body image matures through the gaining of both dimensional and directional concepts.

The remedial programs of Kephart (47:160) and Barsh (5:31) and other workers, concentrate on supplying the child with abilities in the areas of balance, laterality, directionality and body image. These, they suggest, are the valid motor bases of achievement.

Regarding these projected motor bases, Ismail and Gruber (43:175) state:

Overall motor co-ordination is highly related to academic success among elementary school children. Such factors as balance, laterality, gross muscle co-ordination, and the like were the effective variables in relation to learning.
Their study further suggests that attention to these generalized motor functions can produce increased achievement in school tasks among elementary school children.

**Laterality.** Laterality or the internal awareness of the two sides of the body and their difference, is one of the motor bases most commonly cited as necessary for learning.

Kephart (64:41) reports that when children, who lack laterality, are confronted with problems of left and right they will reflect their difficulty through letter reversals, reading inaccuracies and other failures in academic skills.

Benton's studies (9:67) of laterality discrimination in children reveal that those who show systematic letter reversals (i.e. 'b' as 'd', 'was' as 'saw') in designating left and right, are typically retarded in language function.

Since most body organs and parts are paired, some authorities insist that laterality is an essential component for total co-ordination. In regard to this contention, Hildreth (41:197) says:

The human body is bilaterally symmetrical. One side mirrors the other. In motor performance such as walking, the limbs move contralaterally. This lateral symmetry of the body contributes to balanced motor adjustment.

Proponents of perceptual-motor programming regard directed movement experience as a method of gaining laterality. Kephart (47:43) indicates that:
It is through experimenting with the movement of the two halves of the body, observing the differences between these movements, comparing these differences in sensory impressions, and so forth, that we sort out the right side from the left.

**Directionality.** Directionality is the projection into space of laterality or the awareness of left and right, up and down and before and behind in the environment.

Kephart (64:78) states that directionality depends on laterality, and until a solid laterality has been developed, the elaborations and extensions necessary for the establishment of directionality in space will be limited and inaccurate. Balance is considered to be the primary motor pattern out of which this differentiation develops.

**Body Image.** Body image or the awareness of one's body in space is generally an extremely important motor base by child development specialists. In reference to the importance of body image, Kephart (47:50) indicates that:

We use our bodies as the point of reference initially—various sensations as tactile, temperature, pain impressions and muscle sensations become welded into an unity which represents the body to us. Out of this, we build a body image. It is this body image which becomes the point of origin for all the spatial relationships among objects outside our body.

Bender (7:21) has pointed out that a fault in body image will be reflected in the perception of outside objects. From an early investigation on body image, Schilder (68:45) concluded:
When knowledge of our own body is incomplete and faulty, all actions for which this particular knowledge is necessary, will be faulty too. We need body image in order to start movements.

Relating body image to academic functioning, Cruickshank (16:44) has expressed the belief that unless a child possesses a co-ordinated and coherent understanding of body image, learning to read and process numbers either doesn't take place or is extremely retarded. In addition, Piaget (61:79) and Gesell (32:74) have suggested that the child develops an initial awareness of space through egocentric localization, or a relation to objects in space through himself. Obviously, a stabilized body image would be required for the projection.

The motor bases discussed in this section are those that dominate the literature in this area. Other workers, as Delacato (18:33) have built more complicated sets around the theory that laterality and dominance, homologons and cross-patterning are necessary requirements for mature body functioning, perceptual enrichment and learning efficiency.

Many researchers are not convinced that the previously mentioned motor bases are entirely valid. However, as Wright (84:53) says:

Until scientific research spells out some new directions, the existing ideas of Kephart, Barsch and others with similar ideas do seem to be clinically effective in a large number of children with neurological disorganization.
C. RESEARCH REGARDING THE MOTOR PERFORMANCE OF THE MENTALLY RETARDED

The literature revealed limited research in regard to the motor performance of the moderately retarded. Therefore, studies involving the mildly retarded (approximate I.Q. 50-74) have been included in this review. In order to show both the type and concerns of research in this area during the past twenty years particularly, the literature in this section has been arranged in chronological order.

Itard's (44:75) work with a twelve year old severely retarded boy caught in the forests of Aveyron in 1800 was probably the first scientific attempt to utilize motor training in the education of a retarded child. His physiological method, and later that of Sequin (69:143) which involved a concentration on muscle training and skill learning, was reported to have relatively little effect on the intellectual development of their retarded subjects.

In the early and mid 1950's, many studies (71), (52), (49), were conducted to investigate the possibility of a relationship between motor proficiency and intelligence in the mentally retarded population. Rabin (63:514) for example, concluded that there is a definite and positive relationship between varying degrees of educable mentally retarded children and
the learning of fundamental muscular skills.

Other investigations prior to 1960 were concerned with comparing intellectually typical and mentally retarded children in many areas of motor performance.

Howe (42:352) compared a group of mentally retarded children with a group of normal children matched in chronological age, sex and social class. He found that the motor ability of the normal boys was significantly superior in all eleven motor tasks employed.

An extensive study by Francis and Rarick (24) clearly indicated that the mentally retarded have considerable motor retardation, and the motor retardation increases with age when compared to an average population of children.

Fallers (23:86) and Head (39:64) found significant differences between retarded and normal children in all sub-tests of the Lincoln-Oseretsky Motor Development Scale.

On a simple response test, a rate of tapping test, a rate of manipulation test and a choice response time test, Beaber (6:79) indicated that the intellectually typical children displayed significantly better performance than the retarded group when the groups were equated to chronological age.

Studies undertaken in the early years of the past decade, began to claim that certain improvements and benefits could be
19.
derived from training in various areas of motor functioning.

Smith and Hurst (73:84) and Solomon (74:87) reported
that an increase in motor ability played a significant role
in peer acceptance. Social maturity is an effect cited by
Stein (76:31) and Turnquist (79:44), as a result of sound,
widely varied physical education programs.

Troth (78:80) credited training in both gross and fine
motor co-ordination tasks with both effecting improvements in
the attention span length of mentally retarded individuals,
and in the ability to recognize certain geometric and percep-
tual forms.

After a four week period of structural motor experiences
in both gross and fine motor exercises, Harrison (37:28)
reported that a group of relatively non-verbal retardates
improved significantly in their ability to unbutton a row of
buttons and other fine motor self-help skills.

The past five years has yielded investigations in this
area with increasing degrees of depth and specificity.

In their discussion on the motor performance of retarded
children, Robinson and Robinson (66:403) stated:

Within the mildly and moderately retarded ranges
of intelligence, one can predict in general that
the brighter children will show relatively less
retardation in learning to walk, motor behaviour,
and fine co-ordination. Although as a group,
they will show significant retardation in these
behaviours.

Ayres (4:334) analytical investigation into perceptual-
motor problems of retarded children revealed five basic areas of dysfunction. These included: body image deficit, lack of awareness of form and body position in space, faulty integration of the two sides of the body, poor figure-ground discrimination, and a significant balancing disability.

In regard to the movement duplication ability of retarded children, Barsch (5:327) indicated:

A mentally retarded child in attempting to imitate another child, becomes bewildered as he struggles to plan what part of him moves first, how to move it and how to complete the action. He obviously suffers from poor cognitive motor planning.

A clinical investigation by Keough and Oliver (46:1009) disclosed a number of motor performance difficulties in a group of moderately retarded boys. These involved slow and deliberate movements, a total response without control of speed and force, an inability to perform a prescribed rhythmical count, and problems in tasks using only one side of the body.

The succeeding section will be concerned with recent research involving the implementation of sensory-motor training programs. This training was designed to provide remedial assistance in some or any of the problem areas designated by the immediately preceeding studies.
D. RESEARCH REGARDING SENSORY-MOTOR TRAINING PROGRAMS

Proponents of sensory-motor training have indicated that these programs can effect significant changes in many areas of development. This section of the literature is specifically concerned with those recent investigations designed to probe various effects of sensory-motor training.

Oliver (58:155) conducted an investigation involving two groups of educationally sub-normal boys at a boarding school. After ten weeks of systematic and progressive physical conditioning, he reported significant positive changes in emotional stability, personality adjustments and intelligence quotient.

A similar study was undertaken by Corder (14:357) using three experimental groups. One group received sensory-motor training; a second special attention group was present at the training, but did not actively participate. A third group acted as a control. The results revealed that the activity group made significantly greater gains than the control group on associated verbal tests, but not on performance I.Q. The activity group's performance on both measures did not differ significantly from that of the special attention group.

An investigation by Allen (1:41) employed two groups of educable retardates. One group was subjected to the Frostig-Horne sensory-motor program; the other served as a control and received no special activities. The results analysed by ANOVA
revealed that the group receiving the training made significant improvement in figure-ground perception, figure constancy and spatial relations.

Haring and others (36:129) undertook an investigation of Kephart's theory using mentally retarded children to determine the effect of gross motor training on visual perception and hand-eye co-ordination. The results revealed significant gains in both areas, after the subjects had engaged in a six month program of sensory-motor training.

A recent study by Painter (59:113) was conducted to determine the effects of sensory-motor training on body image, perceptual-motor integration, and psycholinguistic competence of perceptually handicapped children. After a two month program based on Kephart and Barsch, significant mean gains were produced by the training groups in the expected areas of remediation.

Another group of workers including Doman-Delacato (18), Frostig and Horne (28), and Stauphin (75) have indicated that sensory-motor training can lead to significant improvements in reading ability for retarded children.

Based on this premise, McCormick and others (55:627) divided a population of mildly retarded children into three experimental groups. One group was subjected to sensory-motor training, a second was involved in regular physical education activities, and a third group served as a control. After seven
weeks of training, reading achievement was re-evaluated. The results indicated that the sensory-motor training group made statistically significant gains when compared to other groups.

However, the literature also produced several investigations that question and disagree with the findings of the previously cited studies.

Alley and Carr (2:451) for example, investigated the effects of sensory-motor training on the sensory-motor, visual perception and concept formation performances of two groups of mildly retarded subjects. One group received systematic sensory-motor training over a two month period. A control group spent an equal amount of time involved in non-motor activities. The findings indicated that all the criterion measures reflected improvement from pre to post-test. However, no significant differences were recorded between the two groups. The Hawthorne or special attention effect was cited as a possible factor effecting the significant learning that occurred.

A test of the Doman-Delacato rationale was conducted by Kershner (48:441) in three special schools for the trainable retarded. After an eight month program of typical Doman-Delacato activities, he found no significant improvement in either reading or sensory-motor performance of his subjects.

The findings of studies by McBeath (54), Robbins (65), and Rosen (67) involving perceptually handicapped subjects, have
also indicated that sensory-motor training did not result in improvements in reading ability.

What did the literature reveal in regard to the effects of sensory-motor training on sensory-motor performance. In conjunction with their studies investigating the effects of sensory-motor training in various perceptual areas, Corder (14:357), Painter (59:113) and Oliver (58:155) found that significant sensory-motor gains resulted from training in this area.

However, Alley and Carr (2:451) and Kershner (48:441) concluded that the sensory-motor performance of the retarded subjects in their investigations did not improve as a result of training.

Further evidence has been provided on this subject by two investigations involving greater specificity. Lillie (51:803) conducted his study over a five month period to determine the effects of motor development lessons on the motor proficiency of mildly retarded children. The results revealed that the training group improved significantly in fine motor performance.

The mildly retarded subjects employed in an investigation by Gearhart (30:93) were subject to three months of sensory-motor training. The findings revealed that the subjects made significant gains in three of the five sensory-motor areas tested.
In general, the literature designed to measure the effects of sensory-motor training appears to have gained greater scientific sophistication in the past decade. However, as Williams (81:29) stated:

A careful look at the literature reveals that there is little systematic research which scientifically quantifies the effects of programs of physical activity upon the cognitive-perceptual functioning of the mentally retarded individual.
CHAPTER III

METHODS AND PROCEDURE

Subjects. The subjects who participated in this study were twenty-one moderately retarded children enrolled at Oakridge School for the trainable mentally retarded. The school is operated by the Vancouver School Board in Vancouver, British Columbia. All of the subjects were drawn from three junior classes, lived in their parental homes and were transported daily to school.

The total sample of twenty-one subjects were divided into three groups of seven. The groups were selected with the provision that four male and three female subjects be included in each group.

The groups were then randomly assigned to the three training programs employed by the study. The experimental groups formed were:

1. Group A - (Kephart based activity group)
2. Group B - (Non-Kephart activity group)
3. Group C - (Control or non-motor activity group)
Tests. The tests employed in the study included the Frostig Developmental Test of Visual Perception (25) and selected items from the Purdue Perceptual-Motor Survey (64). The total raw score of the Frostig test and the total combined score on selected items of the Purdue test were utilized to test the various hypotheses.

The Frostig Developmental Test of Visual Perception measures five operationally defined perceptual skills.

1. Hand-Eye Co-ordination. A test of hand-eye co-ordination involving the drawing of continuous straight, curved, or angled lines between boundaries of various width or from point to point without guide lines.

2. Figure-Ground. A test involving shifts in perception of figures against increasingly complex backgrounds. Intersecting and "hidden" geometric forms are used.

3. Constancy of Shape. A test involving the recognition of certain geometric figures presented in a variety of sizes, shadings, textures and positions in space, and their discrimination from similar geometric figures. Circles, squares, rectangles, ellipses and parallelograms are used.

4. Position in Space. A test involving the discrimination of reversals and rotations of figures presented in series. Schematic drawings representing common objects are used.

5. Spatial Relationships. A test involving the analysis of simple forms and patterns. These consist of lines of
various lengths and angles which the child is required to copy, using dots as guide points.

The Purdue Perceptual-Motor Survey is concerned with measuring four basic components of sensory-motor performance.

1. Balance and Posture. Balancing, jumping, skipping, hopping on one, two, or with alternate feet constitute the main tasks in this sub-test.

2. Body Image or Differentiation. These tasks involved identification of body parts, imitation of movement and body differentiation skills.

3. Perceptual-Motor Match. The tracing of geometric shapes on a chalk board are the primary tasks in this sub-test.

4. Ocular Control. The tasks in this area involve the subject following objects with his eyes in many directions.

**Experimental Design.** The study was carried out over a three-month period. Initially, the three experimental groups; the Kephart and the non-Kephart activity groups and the control group, were pre-tested with the two measures described on the preceding pages of this chapter. Following this two and one-half week testing period, the two activity groups, Kephart and non-Kephart, were each subjected to thirty half-hour sessions of separate sensory-motor training programs during a seven and one-half week period. The control group spent a concurrent amount of time in activities that did not involve gross motor
activities. At the conclusion of these programs, a two and one-half week post-testing session was conducted with the same measures employed in the pre-test situation.

Testing Procedures. The tests were administered solely by the investigator both before and following the training period. In order to ensure optimal testing conditions, several preliminary provisions were undertaken. Prior to the actual tests' administrations, experienced test examiners provided the investigator with observational opportunities and personal assistance to allow for complete familiarization with the test material.

In addition, the investigator conducted a pilot study by examining subjects of the same population who were not involved in the actual study. The pilot study permitted both practical and further understanding of the administration methods for the two tests.

In the actual testing situation, consistency was maintained throughout the pre and post-test periods. All subjects were individually tested in the same facility with similar materials and methods, and a rotating testing schedule was used in each session. Both tests could be scored with a high degree of objectivity through a careful adherence to the scoring instructions in the respective test manuals.
Training Procedures. Prior to the beginning of the investigation, a pilot study employing other subjects of the same population was completed. This preliminary study permitted practice and familiarization with the teaching and presentation approaches, the equipment and facilities, and allowed for a working knowledge of the population that would be involved in the training program.

The controls engaged in the actual study included using only naive subjects or those who had no previous specific involvement with either the tests or the activities programs. In addition, all three experimental groups spent an equal amount of time in their respective treatments. The daily training sessions were constantly rotated to ensure that a single group was not involved in the same time period every day.

In an attempt to control the Hawthorne Effect or personal effect, the investigator was the sole individual involved in the training of all three experimental groups. There was also a conscious effort by the experimenter to maintain equal levels of enthusiasm throughout the three programs.

Training Programs. The training itself consisted of two sensory-motor activity programs to which Groups A and B were subjected, and the control group program. The control Group C received no activities involving gross motor skills.
Instead, they received regular classroom activities in a special education setting.

Experimental Group A received a training program consisting of sensory-motor activities as presented by Kephart (47). These activities were graduated in difficulty and included five of the six areas outlined by Kephart. These areas involved:

1. walking board activities, i.e.: walking forward, backward, sideways on various size surfaces, walking holding objects, walking with eyes closed, turning around on the board, and other board-based activities.

2. balance board activities, i.e.: balancing on the board at various levels, with varying bases, while holding objects, bouncing balls, while turning, catching bean bags, etc.

3. angels-in-the-snow, i.e.: subjects lie on their back or front and move certain designated sides of the body or limbs, also includes unilateral, bilateral, and cross-lateral movements.

4. stunts and games, i.e.: numerous individual locomotion stunts - running, skipping, hopping, climbing, throwing and others. Ball-oriented games and many traditional games were conducted in this area.
5. Rhythmic activities, i.e.: these activities included movement to music, drum beating, piano playing, foot stomping, and rhythmical group games.

Sensory-motor training was also received by experimental Group B, the non-Kephart group. However, there were some definite differences between the two programs in terms of approach or material presentation, desired objectives, and the activities employed in the treatments.

As regards the teaching or instructional approach, Group A, the Kephart program, was engaged in very structured training which utilized a relatively limited number of activity areas. Whereas the non-Kephart training approach was constantly varied and the range of activities was both wider and more flexible, the exploratory or discovery methods in physical education were emphasized with the non-Kephart group. Creativity, exploration, thought provocation, independent action and group awareness, as well as gains in physical skills were some of the objectives sought by this latter program. The Kephart training was more concerned with those objectives resulting from direct improvement in physical skills as balancing, jumping, hopping and others.

The subjects who participated in Group A, the Kephart program, underwent a series of specific movements sequentially
programmed from the simple to the more sophisticated in an effort to gain proficiency in this particular skill area. However, the activities of Group B were continually characterized by freedom of movement. Here, children were encouraged and stimulated to experiment with and experience their environment through movement. In addition, the training of the latter group placed an emphasis on child leadership, free play and group activities.

Further, each group employed many activities that were not practiced by the other group. For example, Group B utilized the many variations of climbing, hanging, walking and jumping on the large climbing apparatus, whereas the Kephart group program made very limited use of this particular piece of equipment.

Group B, the non-Kephart group, received a program based primarily on the following components.

1. see and move, i.e.: subjects move in direction of leader using similar or different modes of locomotion, pantomining of various objects as trees, houses, animals and others.

2. hear and move, i.e.: subjects move according to auditory cues - in all directions, with all modes of locomotion, at varying speeds, with or without objects, holding hands, etc.
3. body shapes, i.e.: subjects experience various body shapes - tall, small, wide, short, in relation to others, to things and many variations on the climbing apparatus.

4. rhythmic activities, i.e.: subjects move to varying rhythmic patterns initiated by drum, piano, voice, with various modes of locomotion as dancing, running, hopping, stretching, crawling, twisting, over obstacles, through hoops, following a leader and others.

5. stunts and games, i.e.: subjects discover and explore ways of throwing balls, using bean bags, making circles, squares, straight lines, singularly or with the group, using equipment as climbing apparatus, horses, bats, benches in problem seeking, self-directed and various other ways.

For all three groups, daily lessons were prepared and followed to allow for a planned program in all three training sessions.
Statistical Analysis

The pre and post-training performance scores obtained from both tests were statistically analysed by a complex analysis of variance with three variables. The variables employed in the ANOVA were groups, tests and subjects which were nested within groups.
RESULTS

The results of the statistical analysis are presented in the succeeding tables and figures.

Table 1 presents the pre and post-test means on both the Frostig Test of Visual Perception and the Purdue Perceptual-Motor Survey.

### TABLE 1

<table>
<thead>
<tr>
<th>Test</th>
<th>Groups</th>
<th>Pre-Test Mean</th>
<th>Post-Test Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frostig</td>
<td>Group A</td>
<td>20.4</td>
<td>25.8</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
<td>23.2</td>
<td>29.5</td>
</tr>
<tr>
<td></td>
<td>Group C</td>
<td>20.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Purdue</td>
<td>Group A</td>
<td>16.2</td>
<td>23.1</td>
</tr>
<tr>
<td></td>
<td>Group B</td>
<td>18.8</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td>Group C</td>
<td>18.0</td>
<td>18.0</td>
</tr>
</tbody>
</table>
Frostig Results

TABLE 2

Analysis of Variance of Initial and Final Scores
on the Frostig Developmental Test of Visual Perception

<table>
<thead>
<tr>
<th>Variation</th>
<th>SS</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>176.33</td>
<td>2</td>
<td>88.17</td>
<td>1.43³</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Ss (Gps)</td>
<td>1109.14</td>
<td>18</td>
<td>61.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tests</td>
<td>252.60</td>
<td>1</td>
<td>252.60</td>
<td>52.52¹</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Gps x Tests</td>
<td>20.33</td>
<td>2</td>
<td>10.17</td>
<td>2.11²</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Ss (Gps) x Ts</td>
<td>86.57</td>
<td>18</td>
<td>4.81</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹An F of 4.41 was required for significance at the 5 percent level
²An F of 3.55 was required for significance at the 5 percent level
³An F of 3.55 was required for significance at the 5 percent level

The analysis of variance performed on the Frostig test scores, as shown in Table 2, indicates an F for the groups effect of 1.43. Since this F was statistically non-significant it was concluded that the three groups, over the two tests, were equal in terms of visual perception.

Table 2 also reveals that a statistically significant F of 52.50 was obtained for the tests effect. This F indicated that significant learning occurred over the three groups from initial to final score performance on the Frostig test.
As indicated in Table 2, the groups by tests interaction was statistically non-significant. This revealed that although learning took place from the initial to the final scores, there was no significant group differences in learning among the three groups.

FIGURE 1

Results of Experimental Groups Performance on Frostig Test

![Graph showing results of experimental groups performance on Frostig test. The graph illustrates the size of scores with means of initial and final scores for three groups: Group A, Group B, and Group C.]

The graph in Figure 1 represents the initial and final score performance of the three groups on the Frostig test. Figure 1 graphically interprets the findings of the groups by tests interaction, that is, each group made performance gains from pre-test to post-test and the gains were statistically similar for each group.
Purdue Results

TABLE 3

Analysis of Variance of Initial and Final Scores

on the Purdue Perceptual-Motor Survey

<table>
<thead>
<tr>
<th>Variation</th>
<th>SS</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>108.62</td>
<td>2</td>
<td>54.31</td>
<td>2.34&lt;sup&gt;3&lt;/sup&gt;</td>
<td>&gt;.05</td>
</tr>
<tr>
<td>Ss (Gps)</td>
<td>416.28</td>
<td>18</td>
<td>23.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tests</td>
<td>197.17</td>
<td>1</td>
<td>197.17</td>
<td>62.40&lt;sup&gt;1&lt;/sup&gt;</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Gps &amp; Tests</td>
<td>99.48</td>
<td>2</td>
<td>49.74</td>
<td>15.74&lt;sup&gt;2&lt;/sup&gt;</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Ss (Gps) &amp; Ts</td>
<td>56.85</td>
<td>18</td>
<td>3.16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup>An F of 4.41 was required for significance at the 5 percent level
<sup>2</sup>An F of 3.55 was required for significance at the 5 percent level
<sup>3</sup>An F of 3.55 was required for significance at the 5 percent level

The complex analysis of variance performed on the test scores of the Purdue Perceptual-Motor Survey, shown in Table 3, indicates an F of 2.34 for the groups effect. This F was statistically non-significant. Thus, there were no differences among the three groups when their scores were averaged over the two tests.

As expressed in Table 3, a statistically significant F of 62.40 was determined for the tests effects. This F indicated that significant learning occurred from the initial to final score performance on the Purdue test.
Table 3 further shows that a statistically significant F of 15.74 was found for the groups by tests interaction. This indicated that somewhere among the three groups significant differences in learning occurred.

In order to determine where these differences occurred, a further statistical analysis, the Scheffe Technique (35:107), was employed. The critical value that was required for the difference between any two means, in the interaction, to reach statistical significance was 4.01.

FIGURE 2

Results of Experimental Groups Performance on Purdue Test
TABLE 4
Means Comprising the Groups x Tests Interaction for the Purdue Test

<table>
<thead>
<tr>
<th>Groups</th>
<th>Initial Score</th>
<th>Final Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>16.2</td>
<td>23.1</td>
</tr>
<tr>
<td>B</td>
<td>18.8</td>
<td>25.0</td>
</tr>
<tr>
<td>C</td>
<td>18.0</td>
<td>18.0</td>
</tr>
</tbody>
</table>

Inspection of Table 4 reveals that the difference between the initial and final scores of Groups A and B produced critical values above the 4.01 required for statistical significance. However, the value for Group C did not produce the critical value of 4.01 required for statistical significance. Therefore, the activity Groups A and B, made significant performance gains on the Purdue test. However, the performance of Group C, the control group, resulted in no significant differences from initial to final score.
DISCUSSION

This investigation was conducted to determine the effects of sensory-motor training on the visual perception and sensory-motor performance of moderately retarded subjects. It was also the intent of this study to compare the relative effects of two varying programs of sensory-motor training on visual perception and sensory-motor performance of the subjects.

These problems will be discussed in terms of the six null hypotheses employed in the study.

Hypothesis 1. There is no difference between Group A and Group C in regard to visual perception performance after sensory-motor training.

Hypothesis 2. There is no difference between Group B and Group C as regards visual perception performance after sensory-motor training.

Both of these null hypotheses were not rejected as no significant differences in visual perception performance were determined when either activity Group A or B was compared to control Group C. The results comply with those obtained by Alley and Carr (2:454) and Haring (36:129) who also reported no significant differences in visual perception performance between activity and control groups after sensory-motor training.

Hypothesis 3. There is no difference between activity Group A
and Group B in regard to visual perception performance after sensory-motor training.

This null hypothesis was not rejected since no significant differences in visual perception performance occurred between Group A, the Kephart program, and Group B, the non-Kephart program, after sensory-motor training.

However, the statistical analysis further indicated that all three groups recorded similar significant gains in visual perception performance from pre to post-training. Why did these performance gains occur? The following factors are proposed as possible explanations for these significant changes in performance.

Since the investigation was conducted over a three month period, the pre and post-test sessions were approximately eight to nine weeks apart. Therefore a maturation effect could possible account for these significant performance differences. A second factor that may have evoked this performance response involves the testing procedure, for in both the pre and post-testing situations, identical test material was administered to the participating subjects.

Another possibility that could be advanced is the Hawthorne Effect, or special attention effect. This effect occurs in experimental situations dealing with human subjects as a result of such aspects as the enthusiasm of the experimenter, which could lead to atypically high degrees of
motivation on the part of the subjects. In this study, the fact that the subjects were pleased and excited to be involved in a special project could have produced the presence of the special attention. This particular point was reinforced daily as the subjects had to leave their classmates and teacher to take part in the training.

Kershner (48:149) reports that this special attention effect is probably a very important factor in any investigation dealing with retarded children.

Since there were no group differences in perceptual performance, the sub-problem of the study which was designed to compare the affects of the two sensory-motor programs in this area remains unanswered.

Hypothesis 4. There is no difference between activity Group A and control Group C, in regard to sensory-motor training.

Hypothesis 5. There is no difference between activity Group B and control Group C as regards sensory-motor performance after sensory-motor training.

Both of these null hypotheses were rejected, as the results expressed statistically significant differences in sensory-motor performance between activity Group A and the control Group C; and between activity Group B and control Group C. In each case, the group that had undergone sensory-motor training, made significant gains in sensory-motor performance.
The control Group C made no gains in performance from pre to post-training.

Since many of the components of the Purdue test were also incorporated into the Kephart training program of Group A, it could be argued that this group's post-test performance gains were a result of experience with the test. However, Group B was not subjected to any activities or tasks specifically related to the test, and this group also recorded significant performance gains after training. Therefore, the sensory-motor training was probably a significant factor in the resultant performance gains made by the activity groups. This factor might be further defined as a positive transfer effect from the training to the test performance which resulted in significant learning.

Recent studies by Lillie (51:807) and Gearheart similarly reported significant performance gains after sensory-motor training.

Hypothesis 6. There is no difference between Group A and Group B in regard to sensory-motor performance after a program of sensory-motor training.

This null hypothesis was not rejected as both groups recorded statistically similar gains in sensory-motor performance. Therefore, Groups A and B produced the same post-training performances on both the sensory-motor and visual
perception tests.

If sensory-motor training can effect changes in sensory-motor performance on learning as these results suggest, it leads to the wider question: What other treatments or training can produce similar changes? Initially it appears that the specific training areas and approaches suggested by Kephart (47), Delacato (18) and others, may not need to be as restricted or structured as their schemes dictate.

As stated in the first chapter, considerable discussion has waged regarding the relative merits of sensory-motor stimulation for mentally retarded children. As indicated in the review of the literature, many researchers have proposed that this form of stimulation leads to or is a prerequisite for more complex perceptual training. However, the results of this investigation suggest that significant gains in sensory-motor performance do not necessarily result in gains in perceptual performance.

Therefore, this study supports the premise that learning by this population is more specific than that indicated by considerable previous research.

A possible explanation of this specificity concept involves the idea that each activity consists of both perceptual and motor components. If subjects are subjected to training that is loaded with motor components, their learning
would be reflected in the motor area. Conversely, if perceptually loaded training was presented, learning would occur in the perceptual area.

This study employed heavily loaded motor components in the training and significant learning occurred in the sensory-motor area. Whereas none of the three groups received training in specific visual perception activities, no group differences in performance resulted in this area.
CHAPTER V

SUMMARY AND CONCLUSIONS

SUMMARY

The subjects who participated in this study were twenty-one moderately mentally retarded children enrolled in three junior classes in Oakridge School for the mentally retarded in Vancouver, British Columbia. The I.Q. range of the subjects was approximately 30-51.

The purpose of the study was to determine the effects of sensory-motor training on the sensory-motor and visual perception performances of the moderately retarded children. A sub-problem compared the relative effects of the two sensory-motor training programs on visual perception and sensory-motor performance. One program was based entirely on the Kephart training approach and procedures; the other was a program designed by the investigator which emphasized the discovery on exploratory method of teaching physical education. These two activity programs differed in terms of the instructional and material presentation and the type and variety of activities.

The literature revealed that very limited research had been conducted in this area with moderately retarded children. In addition, the studies that have been undertaken have rarely been duplicated. This leaves many claims of these studies
lacking substantial support.

The subjects were distributed into three groups of seven, which included four males and three females in each group. The groups were then randomly placed into one of three treatments. The treatments consisted of activity Group A, the Kephart based training program, Group B, the non-Kephart activity program, and Group C, the control group.

The two activity groups, A and B, were subjected to thirty half-hour sessions of their respective sensory-motor training programs over a seven and one-half week period. Group C, the control group, spent a concurrent amount of time in regular special education classroom activities, which did not involve gross motor functioning.

Prior to and following the training period the subjects were individually tested with the Frostig Test of Visual Perception and selected items of the Purdue Perceptual-Motor Survey. The results were then statistically analysed by a complex analysis of variance and the Scheffe Technique was used for determination of group differences where applicable.

Six null hypotheses were employed in the investigation to examine the effects of sensory-motor training on the sensory-motor and visual perception performance of the subjects.
In order to control the teacher variable in the training, and to allow for testing consistency, the investigator was the sole instructor and examiner in the training and testing situations.

This investigation was also designed to question the claims of some proponents of Perceptual-Motor theory, who suggest that improvement in the sensory-motor area leads to or is a prerequisite for subsequent improvement in perceptual functioning. In terms of this study, an improved performance in the sensory-motor area after training would be reflected in performance gains in visual perception.
CONCLUSIONS

In regard to the effects of sensory-motor training, the following conclusions were drawn:

1. With reference to visual perception, the performance of the two-sensory-motor training groups was similar to that of the control group. Thus, sensory-motor training was no more effective than regular special education activities in improving performance in visual perception. However, significant performance gains were recorded in this area for all three groups. It was suggested that these gains may have resulted from such factors as maturation, special attention or learning of the test by the subjects involved.

2. Since the two groups that received sensory-motor training made significant performance gains, and the control group's sensory-motor performance remained at the pre-test level, sensory-motor training was probably the significant factor effecting these gains. These findings lead to the wider question: What other kinds of training can produce the similar effects?

3. Increases in sensory-motor performance by the activity
groups did not result in subsequent gains in visual perception performance.

4. Performances by both sensory-motor training groups in the visual perception and sensory-motor tests were found to be similar. Consequently, sensory-motor programs, which are less structured and less restrictive than Kephart and others, may prove to be equally effective.

5. The results of this investigation support the premise that learning by moderately retarded children is specific.

6. Although the study does not support many assertions by proponents of sensory-motor training, it also does not offer evidence that such programs are wasteful or harmful.
RECOMMENDATIONS

Considerably more research is required in this area with the moderately retarded population. This research should be in the form of duplication of important studies, with measures whose validity has been definitely established.
BIBLIOGRAPHY


47. Kephart, N.C., Slow Learner in the Classroom, Columbus, Ohio: Chas. E. Merrill Books, 1960, pp. 21-68.


APPENDICES
The data was analysed by a complex analysis of variance, using sum of squares, mean squares with the appropriate degrees of freedom. Three variables were involved in the ANOVA, tests groups and tests with subjects nested within groups.

The Scheffe Technique was used to determine where the significant differences between groups occurred.

Formula:

\[ S^2 = (K-1) F_{2,18} (.05) \]

\[ = 5 \times (3.55) \]

\[ = 17.75 \]

\[ S = 4.21 \]

\[ \bar{V} \psi = \text{MSe} \left( \frac{1}{n_1} + \frac{1}{n_2} \right) \]

\[ = 3.16 \left( \frac{1}{7} + \frac{1}{5} \right) \]

\[ = 3.16 \times (0.288) \]

\[ = 0.910 \]

\[ \bar{V} \psi = 0.954 \]

\[ SV \psi = 4.01 \]
APPENDIX B

RAW SCORES

A. Frostig Test of Visual Perception

**Pre-Test**

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>29</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>23</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>17</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>26</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>7</td>
<td>13</td>
<td>21</td>
<td>10</td>
</tr>
</tbody>
</table>

**Post-Test**

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35</td>
<td>33</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>22</td>
<td>35</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>22</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>5</td>
<td>38</td>
<td>29</td>
<td>27</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>16</td>
<td>28</td>
<td>12</td>
</tr>
</tbody>
</table>

B. Purdue Perceptual-Motor Survey

**Pre-Test**

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>19</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>16</td>
<td>18</td>
</tr>
</tbody>
</table>

**Post-Test**

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
<td>32</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>29</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>19</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>24</td>
<td>30</td>
<td>19</td>
</tr>
<tr>
<td>7</td>
<td>24</td>
<td>19</td>
<td>20</td>
</tr>
</tbody>
</table>
APPENDIX C

SENSORY-MOTOR TRAINING DAILY SAMPLE

A. Activities for Group A (Kephart based program)
   - walking sideways on the walking board
   - running in circles, squares, backwards and sideways
   - angels-in-the-snow, move the right leg up, now the left leg, etc., move only this side of the body
   - throwing balls against the wall and catching them, bounce the ball on the floor and catch it, rolling the ball on the floor to another child
   - identifying body parts, the leader calls out a body part and the child responds by pointing to it
   - marching in time to the beat of a drum

B. Activities for Group B (Experimenter-designed program)
   - locomotion activities - move anyway you want, move in another way, move using one leg, move on the floor, off the floor, following someone, with your eyes closed, like an animal, etc.
   - obstacle course - can you get to the end of the gymnasium without touching the floor? how else can you get there?
   - move to the music, move to the music you are making, in
all directions, all over the gymnasium, like a bird, with someone else, etc.

- climbing apparatus - how high can you climb? what other stunts can you perform on this apparatus? swing, hang, etc.

- free play - do whatever you want for the next ten minutes.