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THE UNIVERSITY OF ALBERTA

REMEDIATION OF PERCEPTUAL-MOTOR PROBLEMS IN EARLY ELEMENTARY SCHOOL CHILDREN

by

LINDA J. MULLER

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "Remediation of Perceptual-motor Problems in Early Elementary School Children," submitted by Linda J. Muller in partial fulfilment of the requirements for the degree of Master of Education in Special Education.

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ABSTRACT

The main purpose of this research was to examine the independence of visual skills from motor skills. By testing perceptual-motor skills of early elementary school children, eighty subjects with perceptual-motor problems and twenty subjects without perceptual-motor problems were identified. The eighty low-scoring subjects were randomly assigned to four groups-- visual training, motor training, attention control and non-treatment control; the other twenty subjects formed a normal control group. For thirty minutes every other day for a three week period, the visually trained group was given activities which emphasized visual skills, the motorically trained group received activities which focused on fine motor skills, and the attention control group listened to fairy tales. Subjects in the nontreatment control group and the normal control group were not given any special activities. One week after the treatment programmes were completed, all subjects were retested.

The results indicated that all four low-scoring groups improved significantly between pre- and posttesting. Posttest scores indicated a significantly greater score for the motorically trained group than for the nontreatment control group. No other significant differences were found between the five groups on posttest scores.

Sex differences in perceptual-motor ability were analyzed and no significant difference was found between the performance of males and females on the experimental task.

Trends in perceptual-motor problems and age were examined. The data indicated that as chronological age increases, deficiencies in perceptual-motor development decrease.

The results of the study suggest directions for future research.

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INTRODUCTION

Background

In recent years increased interest has been focused on handicaps which interfere with academic learning. These handicaps have been labelled learning disabilities. With this expansive interest in learning disabilities came multiple descriptive labels and resulting definitions which reflected both the heterogeneity of the problem associated with learning disabilities and the bias of those advancing the definition. The National Advisory Committee on Handicapped Children has provided a definition which states, in part, that:

> A learning disability refers to one or more significant defects in essential learning processes requiring special educational techniques for its remediation
>
> Children with learning disability generally demonstrate a discrepancy between expected and actual achievement in one or more areas . . . .
>
> Essential learning processes are those currently referred to in behavioral sciences as perception, integration, and expression, either verbal or nonverbal.
>
> Special education techniques for remediation require educational planning based on the diagnostic procedures and findings. (National Advisory Committee on Handicapped Children, 1968, p. 34).

Many of the theoreticians and researchers in the field of learning disabilities have tended to focus on the significance of perceptual and perceptual-motor development in children. In fact perceptual-motor problems appear to have achieved first priority among workers within the domain of learning disabilities. Their concern is not only with the perceptual-motor problem per se, but also with the deleterious effects of such difficulties upon the child's learning and academic achievement. In fact, one hypothesis shared almost universally by members of the perceptual-motor school is that adequate conceptual development is dependent upon accurate perception.

In view of this posited relationship between perceptual-motor development and cognitive development it becomes of concern to those involved in special education to examine the child's perceptual-motor skills and establish programmes for the effective remediation of weaknesses in these areas.

Perceptual-motor theorists (e.g. Kephart, 1960; Getman, 1965; Barsch, 1967; and Frostig, 1961) have for the most part viewed perceptual skills and motor skills as so interrelated that they cannot be separated or examined in isolation. Thus a child with significant defects in one skill--motor development or perception--would be expected to display some impairment of functioning in the other. It is equally possible, however, that visual perception and motor development are independent systems. The diagnosis of perceptual-motor deficits is usually based on the child's performance on tests which require him to copy simple geometric forms. A low score on such tasks has traditionally been interpreted in terms of a perceptual-motor deficit. However, it is obvious that many skills are involved in such task performance. Does the child who fails the task do so because he lacks the motor development for copying it, because he cannot discriminate the form, or because he is unable to integrate these two responses? While one may be justified in inferring from a child's success on these types of tests the integrity of perceptual and motor functions necessary for the performance of the tasks involved, it may well be too broad a conclusion to label the child who fails as deficient in perceptual-motor skills.

Many of the perceptual-motor theorists have developed programmes by which to remediate perceptual-motor deficiencies. In the past few years a large number of studies have been designed to test experimentally the validity of such programmes. Although the programmes vary considerably in their emphasis, no attempts have been made to separate the effects of perceptual training from those of motor treatment.

Researchers and theoreticians involved in the study of learning disabilites have given considerable attention to perceptual-motor development in children. Their focus has been on a global approach to perceptual-motor deficiencies as opposed to examination of perceptual problems and motor problems as two distinct areas of weakness.

Statement of the Problem

This thesis maintains that perceptual and motor skills are autonomous; that a weakness in one area does not necessarily dictate a weakness in the other. Children who display perceptual-motor problems are viewed as having a receptive deficit, i.e. the child does not accurately perceive the visual stimuli; an expressive deficit, i.e. the child cannot make the appropriate motor response; or an integration deficit, i.e. the child cannot integrate the visual stimuli and the motor response.

Remedial programmes have for the most part emphasized integrative techniques for which both visual and motor skills are required. This thesis will examine the effectiveness of receptive training activities and expressive training activities.

The perceptual-motor development of early elementary school children was assessed. The efficacy of receptive (visual) and expressive (motor) programmes with children displaying perceptual-motor weaknesses was examined. The findings of the study generated suggestions for methods of assessment of the child with perceptual-motor deficits and directions for further research in the area of perceptual-motor development.

CHAPTER II

SURVEY OF THE LITERATURE

Introduction

Many modern-day educators feel that children must become proficient in certain perceptual-motor skills for academic success to be realized. They view such skills (e.g. visual-form discrimination, visual-motor fine muscle coordination) as necessary antecedents of school readiness and/or achievement. Most perceptual-motor training programmes are based on the assumption that visual-motor experiences constitute an important factor in the educational involvement of young children. Justification for this assumption relies heavily upon the contributions of perceptual-motor theorists and developmental theorists, and on a large number of correlational studies. Within this chapter a review will be made of relevant perceptual-motor and developmental theories and of empirical studies which have examined the relationship between perceptual-motor skills and cognitive abilities and academic achievement. Research relating to the efficacy of perceptual-motor training programmes will also be examined.

Perceptual-Motor Theories

Kephart

One of the key figures in the area of perceptual-motor development is Newell C. Kephart. Kephart (1960, 1967) postulates that normal perceptual-motor development aids the child in establishing a reliable and solid concept of the world around him. This approach examines the normal sequence of the development of motor patterns and motor generalizations and compares the motor development of children with learning problems with that of normal children.

Children with perceptual-motor problems encounter difficulty with symbolic materials because they have not had an adequate orientation to their everyday environment; specifically, the dimensions of time and space. These children have not organized their information-processing systems to the degree necessary to deal with a curriculum based upon these presumed competencies. As a consequence they are disorganized motorically, perceptually, (perception and the motoric response are considered inseparable for instructional purposes) and cognitively.

A child's first learning is motor learning--muscular and motor responses. Through motor behavior the child interacts with and learns about his environment. Kephart believes that learning difficulty may begin at this stage because the child's motor responses (specific performances) do not evolve into motor patterns (broad generalized abilities). Extensions and combinations of motor patterns lead to motor generalizations. Motor generalizations are the integration and combination of motor patterns into broader motor organizations. Kephart discusses four motor generalizations as being important to success in school: balance and maintenance of posture, contact (sensory-motor activities), locomotion, and receipt and propulsion (objects coming towards and going from the child). Through these four motor generalizations the child acquires knowledge about the space structure of his world.

At the same time as the child is gaining information through motor generalizations, he is getting perceptual information. Because all explorations cannot be made motorically, the child learns to explore perceptually. Perceptual input only becomes meaningful when it is matched with motor information. Kephart terms this process of comparing the perceptual and motor data a perceptual-motor match. If a child is unable to make the perceptual-motor match, he is left with two conflicting worlds--a perceptual world and a motor world.

The development of a time structure also begins with motor responses, continues with perceptual information, and then develops into conceptual information. Kephart has identified three aspects of time as important to learning: synchrony (things happening at the same time), rhythm (equal time intervals), and sequence (events ordered on a temporal scale). As with the dimension of space, many learning disabled children have a poor understanding of events occurring over time.

Kephart's theory implies that children's learning problems stem from a disturbed orientation to the physical world about them. This disturbance, whether of space or of time, is the result of inadequate perceptual-motor learning.

Kephart's theory gives little emphasis to the transition from perceptual-motor development to cognitive development. Also the role of speech and language in the learning process has not been clearly incorporated into the theory.

Getman

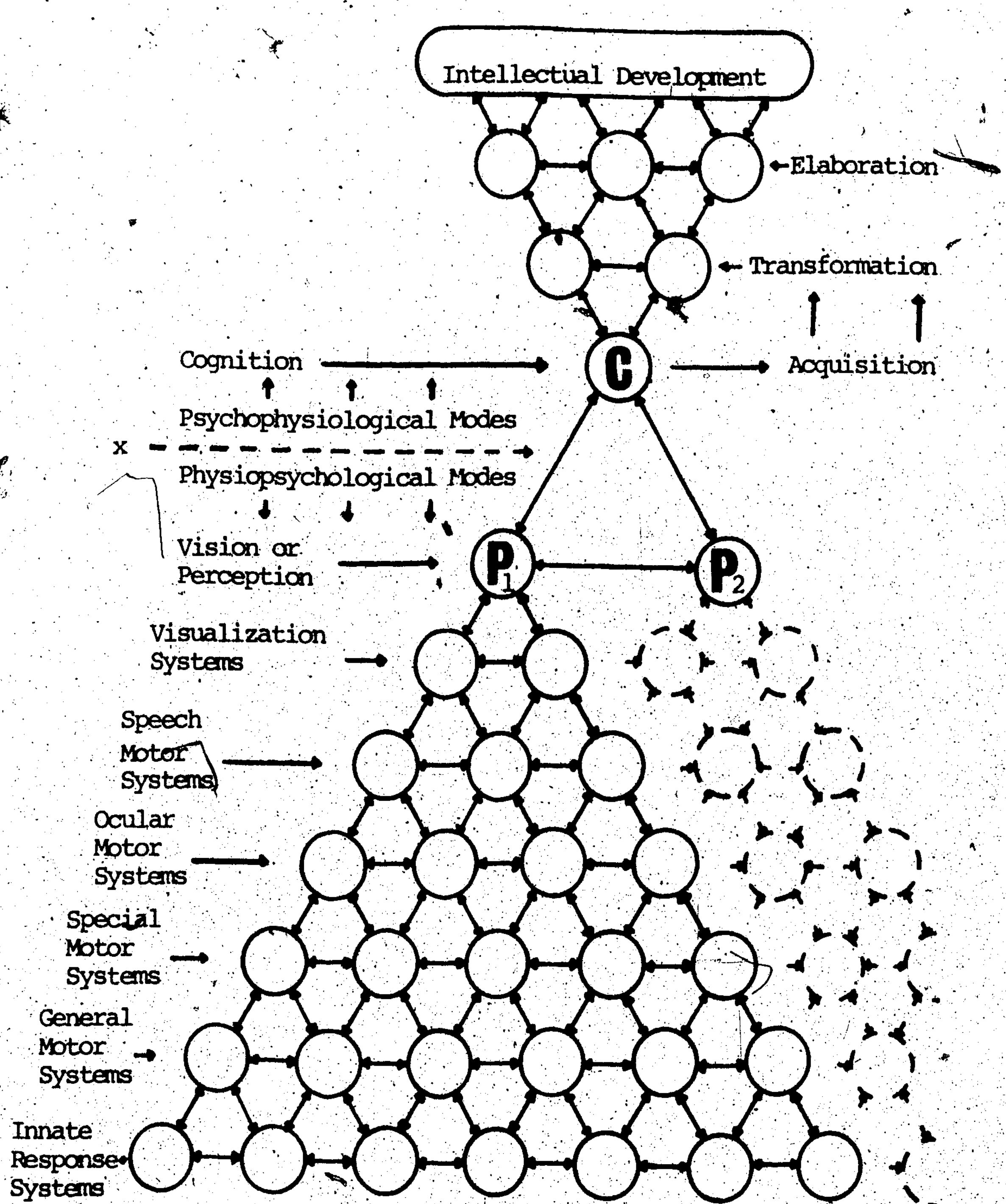
A model of visuomotor development and its interaction with cognitive development has been devised by Gerald N. Getman (1965). Because Getman is an optometrist, his approach reflects his strong interest in the development of vision, which in this model is equated with perception. Vision is defined as the child's learned ability to understand things that cannot be touched, tasted, smelled, or heard, and is the method by which space is revealed as a whole. It is the ability through which the child interprets the world and his relationship to the world. Vision evolves from actions of the entire organism. The human organism cannot be segmented into unrelated parts (eg. visual, motor) but rather vision must be viewed as a total action system.

Getman's visuomotor model (see Figure 1) is one of visual development and learning. The model is an attempt to show developmental sequences and the dependence of each successive stage of development upon earlier stages.

In the first level, the Innate Response Systems are the innate motor responses which are present at birth. They include tonic neck reflex, startle reflex, light reflex, grasp reflex, reciprocal reflex, stato-kinetic reflex and myotatic reflex. At the second level is the General Motor System which includes the motor or locomotion skills of creeping, walking, running, jumping, skip-

Figure 1

The Visuomotor Complex



ping and hopping. The third level, Special Motor Systems, represents a more elaborate combination of the first two systems. Skills included at this level are eye-hand relationships, combinations of two hands working together, hand-foot relationships, voice, and gesture relationships. The Ocular Motor System is represented at the fourth level. The ocular skills include fixation, the ability to locate a target; saccadics, the visual movement from one target to another; pursuits, the ability to have both eyes follow a moving target; and rotation, free movement of both eyes in any and all directions. Speech Motor Systems at the fifth level are composed of babble, imitative speech, and original speech. At the sixth level, the Visualization System, two kinds of visualization are considered: immediate by which one can "see" a coin by feeling it, and past-future by which one can review an event that occurred yesterday or perceive an event that will happen tomorrow. The seventh level, Vision or Perception, represents a single perceptual event which is the result of all the experiences, skills, and systems represented by the underlying levels. P_2 signifies another single perceptual event reached through a similar pyramid of experiences. Through the integration of many perceptions the next level, Cognition, is reached. The portion of the model above this point represents the higher symbolic and more abstract mental processes which lead to intellectual development.

Getman's model presents the development of cognition and intellectual thought as the result of a solid base of the various levels of perceptual and motor learning. The model has been criticized for over-simplifying the picture of the development of learning, for overextending the role of vision and overemphasizing the role of visual perception (Myers and Hammill, 1969). Lerner (1971) has noted the relative neglect of the role of language and speech in learning. The model also infers that some handicapped children who could not experience the hierarchy would be unable to achieve the skills of higher levels. And finally, empirical support for the model seems to be lacking.

Barsch

Ray H. Barsch (1967) has developed a movigenic theory of learning difficulties, which proposes that such difficulties are related to the learner's inefficient interaction with space. Movigenics is defined as the study of the origin and development of movement patterns in man and the relationship of these movements to his learning efficiency. The concept of movigenics is based upon Barsch's premise that human learning is highly related to the individual's performance of basic movement patterns. "Perception is movement and movement is perception. According to this view, any effort to enrich perception and cognition must be initiated as a frank approach to attaining the highest possible state of efficiency in the fundamental patterns of physical movement" (Barsch, 1968, p. 299).

The movigenics theory has ten basic constructs (Barsch, 1967):

1. Man is designed for movement. The fundamental principle underlying the organization of the human system is efficiency of movement.

2. The primary objective of movement efficiency is to economically promote the survival of the organism.

3. Movement occurs in an energy surround. Movement efficiency is derived from the information the organism is able to process from the energy in the physical world.

4. The mechanism by which the human organism derives information from energy forms is his percepto-cognitive system.

5. The terrain of movement is space.

6. Developmental momentum, i.e., the force that pushes man through his childhood in a few short years to an adulthood of sixty years, provides a constant thrust toward maturity and demands an equilibrium to maintain.

7. Movement efficiency is developed in a climate of stress.

8. The adequacy of the feedback system is critical in the development of movement efficiency.
9. Development of movement efficiency occurs in orderly, sequential segments from the simple to the highly complex.
10. Communication of movement efficiency is derived from the visual-spatial phenomenon called language.

Barsch sees the child's learning problem as centered on two classes of the basic learning abilities: sensory-motor integration and perceptual-motor skills. As a result, his theory gives little attention to the roles that auditory skills and language development play in learning.

Frostig

Marianne Frostig is another individaul who has had an impact on the perceptual-motor field. Frostig's published research and materials have focused primarily on assessment and remedial techniques in the area of visual perception. In 1958 Frostig and her associates began developing a preliminary test for the diagnosis and remediation of visual perceptual handicaps. They postulated that visual perception consisted of five abilities: (1) eye-motor coordination, (2) figure-ground, (3) constancy of shape, (4) position in space, and (5) spatial relations (Frostig, 1966). It was ascertained that these five visual perceptual abilities develop independently of each other, and there is a specific relationship between their developmental level and the child's ability to learn (Frostig, Lefever, & Whittlesey, 1961). These abilities became the five areas assessed by the Marianne Frostig Developmental Test of Visual Perception (1966). Deficits in any of the areas tested may be referred to specially prepared exercises, specific to the problem discovered.

For Frostig (1961) perception develops out of the sensory-motor behaviour of the young child. Perception is never divorced from motor activity; not only does it originate in motor behaviour, but also it is followed by motor events. Without proper development of the motor and perceptual abilites, the child will encounter learning difficulties.

Doman and Delacato

Among the most controversial of the perceptual-motor approaches is the "patterning" theory of neurological organization developed by Glenn Doman and Carl Delacato (Delacato, 1966). The basic concept advocated by their approach is that the well-functioning child develops full neurological organization. The theory assumes that ontogeny, the process of individual development, recapitulates phylogeny, the process of species development. Thus, in the progression toward full neurological organization, man proceeds in an orderly way anatomically in the central nervous system, progressing sequentially through the medulla and spinal cord, the pons, the midbrain, the cortex, culminating in the establishment of hemispherical dominance or full neurological organization.

Doman and Delacato maintain that there are six functional accomplishments in man: motor skills, speech, writing, reading (visual), understanding speech (auditory), and stereognosis (tactile). The attainment of these six skills parallels and is functionally related to the individual's anatomical progress toward neurological organization.

The failure to pass through a certain sequence of development at any stage indicates poor neurological organization and will be evidenced in problems in mobility or communication. Doman and Delacato maintain that by determining the level of neurological organization, it becomes theoretically possible to prescribe activities that will improve neurological development and thereby eliviate or prevent learning disorders. According to the theory, when the neurological organization becomes complete, the learning problem is overcome. Treatment procedures (Doman et al., 1967) consist of (1) rolling over, (2) crawling in a circle backwards, (3) crawling without a pattern, (4) crawling homologous, (5) crawling homolaterally, (6) crawling cross-pattern, (7) creeping without pattern, (8) creeping homolgous, (9) creeping homolaterally, (10) creeping cross-pattern, (11) cruising (walking holding), (12) walking without pattern, and (13) walking cross-pattern. The treatment requires children to pass through the above sequential stages to establish hemispheric dominance and thereby full neurological organization.

A number of reports of the success of the method have been presented in the literature. However, other researchers (Robbins, 1966; Glass and Robbins, 1967; Freeman, 1967) have reported the theory, approach, treatment, and research lacking. Ten medical, health, and educational organizations have also jointly expressed their concern about the Doman and Delacato approach (Cruickshank, 1968).

In reviewing the perceptual-motor theories of Kephart, Getman, Barsch, Frostig, and Doman and Delacato, one strong commonality is noted--all assume perceptual-motor development to be a forerunner of conceptual development and that without the proper development of the former the latter will be adversely affected. Also, with the exception of Doman and Delacato, they all veiw perceptual and motor skills as being interrelated and that one cannot be isolated from the other.

Developmental Theories

Several contemporary developmental theorists offer further support of the relationship between perceptual-motor ability and cognitive ability.

Piaget

One of the foremost developmentalists addressing himself to the perceptual-motor-cognitive issue is Jean Piaget. According to Piaget (Flavell, 1963), actions performed by the child form the substance of all perceptual and intellectual adaptation. These actions progress from the overt, sensory-motor ones of the neonate (eg. grasping and sucking objects) to covert, highly organized systems of internalized operations. The latter abstract operations are viewed by Piaget as much action as are the former simple sensory-motor activites. The operations are simply internalized actions.

Piaget speaks of intellectual organization as actions which have been abstracted from earlier, simpler organizations that have been changed in some way, eg. increasingly internalized. Therefore no structure is ever completely new but rather is a generalization of an action from a preceding structure. In this way Piaget sees an adult's formal operations as sensory-motor actions which have been transformed, rather than as some completely different behaviour.

Piaget believes that perception develops as a dependent subsystem within the larger context of sensory-motor learning. The infants perceptions are meaningful only through the mediation of the sensory-motor schemas of which they are a part. The developing perceptual constancies receive their main support from other simultaneous developments. In Piaget's view, sensory-motor intelligence, not perception, provides the basis for later intellectual development and, it is also the matrix within which and from which perception itself originates and evolves (Inhelder & Piaget, 1964).

Following Piaget's logic, it becomes obvious that a disability in motor skills will result in perceptual and cognitive problems.

Bruner

Jerome Bruner is another leading cognitive theorist who has given attention to the link between perception and cognition. For Bruner (1957) problem solving and inference are a model for perception which is arrived at by a series of hypotheses, by trial and check, and by matching to a category. As cognitive development proceeds, perception is less and less dependent on immediately present stimulation and more and more dependent on the perceptual categories which have been formed. Perception involves an act of categorization. There are defining attributes, called cues, in the stimulus input which are used in identifying the category of the object being perceived. Perceptual learning then depends on the construction of a system of categories to which the stimulus input can be matched. As the learning progresses, categories become more available and more prolific, with the result that the input necessary for categorizing tends to become minimal.

The process of matching the stimulus imput to a category is a sequential one. First there is primitive categorization, in the sense of perceptual isolation of an object or event; second, there is a search for cues; third, there is a confirmation check, and then a confirmation completion, by which cue searching is terminated. The hypotheses which direct the search for the right category may reflect the personal needs and values of the observer.

Bruner's theory of perception as a form of conceptualization readily supports the hypothesis that problems in the perceptual sphere will interfere with concept formation.

Wohlwill

The views of Joachin Wohlwill (1962) also confirm the conception-perception relationship advanced by perceptual-motor theorists. Wohlwill sees the child proceeding developmentally from a perceptual level of functioning to a conceptual level of functioning. Perception and conception are conceived to be related on three dimensions: redundancy, selectivity, and contiguity.

A high degree of redundancy of the stimulus input is necessary at the perceptual level; however, the redundancy required at the conceptual level is reduced to a minimum. While the child operating at a perceptual level has a very limited ability to dissociate relevant from irrelevant information, one who is at a conceptual level is able to differentiate the relevant from the irrelevant. Spatial and temporal contiguity are of major importance in perceptual functioning; whereas, conceptual functioning enables one to deal with information which is widely separated in space or time.

These three dimensions--redundancy, selectivity, and contiguity--when taken together give responses of varying specificity. The specificity ranges from those of perceptual judgment, in which inaccuracies are frequent, to the precise and accurate products of the conceptual process.

While not explicitly saying so, Wohlwill's formulations seem to imply that adequate conceptual development is at least partially dependent upon adequate perceptual development.

Gibson

Eleanor Gibson (1969) has proposed a model of cognitive development in which the growing child does not stop using and needing stimulus information but rather learns to more efficiently process the stimuli presented to him. This position is in contrast to Piaget, Bruner, and Wohlwill, all of whom view the child as progressing from a greater to a lesser need for stimulus information. Gibson sees the developing child as learning to respond to additional aspects and subtle nuances and clues of the stimuli. She has stated that although concept formation develops markedly over the years, "it does not follow that our percepts become more and more reflections of our concepts. We do not perceive less because we conceive more. If we did, it would be maladaptive for getting information about what is going on in the world around us" (p. 440).

Gibson recognized that many highly abstract and generalized class concepts are of a more advanced nature than is perceptual learning. Recognition of a concept, however, is always dependent upon prior learning of certain distinctive and invariant features, regardless of the level at which it is apprehended.

Gibson's contention that perception remains an important ability for conceptual thought throughout a lifetime provides further theoretical support for postulating the dependence of conceptual skills on the efficiency and accuracy of perceptual ability.

Thus, the formulations of Piaget, Bruner, Wohlwill, and Gibson, all leading developmental theorists, provide a solid theoretical base for the thesis that perceptual and perceptual-motor problems will result in conceptual difficulites.

Empirical Support for Perceptual-motor-cognition and Perceptual-motor-achievement Relationships

Some empirical evidence also supports the notion of a perceptual-motor-cognition relationship. McConnel (1964), in examining concept learning in preschool and second-grade children, found that perceptual processes can take the place of verbal symbolic processes as mediators. In studying the differential effects of perceptual and verbal pretraining on later concept-formation ability, he found that for both preschool and second-grade children, positive transfer resulted when perceptual training stressed a dimension relevant to the conceptual task, whereas negative transfer resulted when the dimension was not relevant. Furthermore, when the perceptual training was irrelevant but verbal cues relevant, only the older subjects exhibited a positive transfer. For the younger ones, the transfer was negative. The implication of this study for the present discussion is that erroneous perceptual information can impede concept formation at different age levels. These findings support the assumption that the learning disabled child, whose perceptions are frequently faulty, may have difficulty in attemtping to form concepts.

Another study which lends credence to the posited role of perceptual-motor skills in conceptual development was carried out by Ireton, Thwing and Gravem (1970). These investigators found significant correlations between performance at the 8-month age level on the Bayley Mental Scale (which contains mainly perceptual and motor items) and I.Q. at the age of four as measured by the Stanford-Binet. Further analysis revealed that a low score on the Bayley was a better predictor of low four-year I.Q. than a high Bayley score was a predictor of high four-year-old I.Q. The latter finding, in particular, may indicate that an infant with poor perceptual-motor performance tends to exhibit poor conceptual, abstract performance at a later age. Despite the correlational nature of some of the data, making it impossible to prove causal relationships, the results generally support the hypothesized connection between perception and cognition.

These studies on the relationship between perceptual-motor factors and cognitive development, along with the theories of Piaget, Bruner, Wohlwill, and Gibson, tend to support the positions of many theorists in learning disabilities. Because of the educational orientation of learning disability theorists, their concern is with the possible effects of perceptual-motor factors upon academic achievement and, more specifically, upon reading ability, rather than upon cognition.

Kephart (1960), as was previously noted, was one of the first to suggest a cause-and-effect relationship between perceptual-motor abilities and academic achievement. Citing the empirical investigations of Lowder (1956), Potter (1949), Robinson, Letton, Mozzi, and Rosenbloom (1958), and the clinical evidence of Strauss and Lehtinen (1947) and Strauss and Kephart (1955), Kephart posited that perceptual-motor skills (eg. drawing and copying) have a bearing upon academic achievement.

The empirical studies cited by Kephart in addition to being based on correlational data, also showed relationships which accounted for only 15 to 40 percent of the variance, depending on the variables studies. However, Kephart's interest in the perceptual-motor-achievement relationship did open an area of experimental investigation. Unfortunately a number of the studies in this area have suffered from methodological limitations: poorly designed and/or poorly defined measurements, weak controls for subject intelligence, and arbitrary criteria for identifying the poor reader. This is likely the source of many of the conflicting results within this research area. However, even with these limitations, many researchers with varying degrees of success and reliability have been able to relate perceptual-motor handicaps to learning problems.

Keogh and Smith (1967) who performed a well designed longitudinal study found that a good predictor of school achievement, as measured by the reading and spelling subtests of the California Achievement Test in the third grade and the Iowa Test of Basic Skills in the sixth grade, was the kindergarten score on the Bender-Gestalt. In other words, children who performed poorly in visual-motor ability in kindergarten tended to do less well academically in later grades.

To further investigate reading skills and perceptual development, Snyder and Freud (1967) administered several visual-motor measures, Bender-Gestalt, Spiral After-effect, and Necker Cube tests, to 667 first-grade children. The results were compared to those on the Lee-Clark Reading Readiness Test. The authors found sizable correlations between scor[illegible] visual-motor tests and performance on the read[illegible]s test, and concluded that perceptual immaturi[illegible] first-grade level is a major contributor to late[illegible]g problems.

A study by [illegible]ic and Anderson (1970) offers further evidence of a relationship between perceptual-motor ability and academic achievement. On the basis of performance on the Stanford Achievement Test, eighty-six fourth graders were classified as forty-five high and forty-one low achievers. Eleven perceptual-motor tasks devised by the authors to assess abilities involving both gross and fine, static and transport types of motor movement were administered. The high achievers were significantly superior to low achievers on six of the eleven perceptual-motor tests. Performance on the perceptual-motor battery was positively and significantly correlated (around .50) to the performance on the Stanford Achievement Test and the California Test of Mental Maturity. Correlational data for a relationship between perceptual-motor ability and academic achievement is again offered.

In another experiment, Lyle (1969) using fifty-four grade one through six pupils, investigated through factor analysis the relationships among the Wechsler Intelligence Scale for Children, several standard educational achievement tests, and tests of finger agnosia, lateral dominance, and reversals in reading and writing. Lyle identified two orthogonal factors relating to reading problems. One was a factor of perceptual and perceptual-motor distortions, and the other was a weakness in formal verbal learning. Lateral dominance, mixed hand-eye dominance, and finger agnosia were not found to be related to reading ability.

Eighty-seven children from grades one through six who showed severe language deficits and reading difficulties on unspecified tests, guidance evaluations, and teachers' ratings were examined by Coleman (1968). Using tests by Kephart and Barsch, Coleman found that half the children had visual or visual-motor deficits judged severe enough to impede learning.

Further, Coleman (1972) evaluated 4,685 elementary school children with a test of visual-perceptual-motor behaviour. Factor analysis yeilded two factors which predicted 1/3 of the academic achievement of first graders. Of the subjects who failed their academic year, 26% had low visual-perceptual-motor scores.

Thomas and Chissom (1972) assessed the relationship between 3 perceptual-motor tasks and 2 measures of academic achievement from 113 children from kindergarten through the third grade. A significant canonical correlation was found in kindergarten, first, and second grade groups. The correlation for third graders was not statistically significant. These findings tentatively suggest that the relationship between perceptual-motor skills and achievement decreases as age increases.

Using seventh-grade boys, Erickson (1969) tested the ability to integrate successive partial impressions of abstract stimuli into a whole and compared this performance to reading ability as assessed by the Iowa Test of Basic Skills. Erickson found that low performance on the perception test was likely to be associated with reading deficits of one-half to one full grade level.

Singer and Brunk (1967), however, failed to find a relationship between overall academic achievement and performance on a rather specific perceptual-motor task. The task required the child to reproduce a geometric figure presented on a screen with rubber bands and a board filled with pegs. The child was to copy fourteen patterns ranging in difficulty from easy to complex by stretching rubber bands around the appropriate pegs. This study does not necessarily disprove the relationship between perceptual-motor and academic ability, especially in view of the unconventional measure of perceptual-motor ability.

Bibace and Hancock (1969) also failed to find a positive relationship between scholastic and perceptual-motor achievement. They assessed level of scholastic achievement and level of perceptual-motor achievement in boys aged 7-8 and 12-13. Subjects were then given finger mazes of increasing difficulty such that the number of trials and errors in learning each maze would indicate mastery of lower (motor) and higher (conceptual) processes. It was found that some subjects performed well in school despite perceptual-motor deficiencies. Also scholastic achievement rather than perceptual-motor achievement was found to discriminate between groups in terms of their reliance on perceptual-motor or conceptual processes. In other words, some children with perceptual-motor deficits were able to perform well in school and were able to effectively use conceptual processes.

Davol and Hastings (1967) using children from kindergarten through grade three administered a modification of Fleishman's response orientation device. The children were judged by their teachers as either poor or normal readers. The results indicated the poor readers of low socioeconomic backgrounds had significantly poorer spatial orientation ability, which includes responses to left-right, up-down, and before-behind perceptual cues.

Elkind, Larson, and VanDoorninck (1965) assessed sixty children from grade one through six, half rated slow readers and half rated average by unnamed tests. The authors found the poor readers to display significantly inferior skills on their hidden figures test. They concluded that the ability to ignore the nonessential but respond to relevant cues in printed materials is related to the absence of requisite skills in reading.

In summary these empirical investigations suggest that perceptual-motor disabilities may be at the root of many learning disabilities. However, the correlative nature of the data does not permit unqualified acceptance of the proposition that perceptual-motor disabilites cause learning disabilites. The correlation between the two disabilities may be the result of a causal effect proceeding in either direction, or they may both be related to a third, unknown causative agent. Also, under some conditions of assessment, the relationship between these areas has not been demonstrated.

Considered as a whole, however, the theoretical and empirical evidence available on perceptual-motor development and its relation to cognition and achievment certainly warrants the examination of perceptual-motor development in children and the exploration of perceptual-motor training activities.

Efficacy of Perceptual-Motor Training

Attention will now be focused on studies appraising the effectiveness of perceptual, motor, and perceptual-motor training. The techniques and programmes of Barsch, Frostig, Getman, Kephart, and others have gained widespread popularity and acceptance on the educational scene. Clinical subjective support of these methods has a long tradition; however, it is only within the past few years that attempts have been made to use well-defined research strategies to determine the efficacy of perceptual-motor training. The majority of studies which have experimentally examined the validity of perceptual-motor training techniques have shown the methods to have positive results. However, in terms of the particular training methods used and the characteristics of the populations under study, the investigations have varied greatly. The major focus of this section, therefore, is to review only those studies which have examined the use of perceptual-motor training programmes with subjects similar to those involved in the present study--children in regular classes who have not been differentiated in any way, and are thus assumed to fall within the normal distribution with regard to measured IQ, learning disabilities, and socioeconomic status.

Studies using Frostig's Programme

Rosen (1966) examined the effects of Frostig's programme for the development of visual perception. The subjects, 637 first grade pupils from eight elementary schools, were pretested on the Metropolitan Reading Readiness Test (Hildreth, 1965) and the Marianne Frostig Developmental Test of Visual Perception (DTVP) (Frostig, 1964). Classrooms were randomly assigned to treatment groups, resulting in 12 experimental and 13 control rooms. The experimental classes received 30 minutes per day for 29 days of visual perception training with the worksheets from the basic 100-page workbooks and supplementary worksheets and games from the Frostig Teachers Manual. Control classes received 15 minutes per day of extra reading instruction while 15 minutes were deducted from the experimental classes regular reading period. Both the control and experimental programmes were administered by the regular classroom teacher. Posttest measures were obtained for the DTVP, the Lorge-Thorndike Intelligence Test, Level 1, Form 1, and the Bond-Balow-Hoyt New Developmental Reading Test. Analyses revealed a significant improvement in the experimental group in the perceptual capabilities trained; however, this improvement was not reflected in measures of reading achievement. The extra time the control group was given in reading instruction was found to be more important to reading achievement than time devoted to perceptual training. These findings suggest that while the skills measured by the DTVP appear to parallel various reading abilities, they may in fact be relatively unrelated. Further attention to the DTVP and the Frostig programme (eg. its effect on perception, reading, and school readiness) seems warranted.

Studies using Delacato's Programme

The effectiveness of Delacato treatment on readiness to read in kindergarten children was examined by Stone and Pielstick (1969). A kindergarten class of 26 pupils was randomly assigned to experimental and control groups. Pretest and posttest assessments of intelligence, reading readiness, and visual perception were obtained for all subjects on the Peabody Picture Vocabulary Test (Dunn, 1959), the Lee-Clark Reading Readiness Test (Lee & Clark, 1962), and the Frostig Test of Visual Perception (Frostig, Lefever, & Whittlesey, 1964). The experimental group received 30 minutes of "neurological training" per day for 18 weeks. The training involved cross pattern creeping, cross pattern walking, and sleep pattern. The control group was given 30 minutes of games and play activities per day over the 18-week period. No mention is made of the personnel conducting the programmes. The results showed a significant effect from treatment in favour of the experimental group on the Frostig Test. No significant difference was found between experimental and control groups on posttest means on the Peabody or the Lee-Clark. The authors concluded that there is little support for the notion of the benefit of Delacato's treatment to reading readiness in kindergarten children.

Studies using Kephart's Programme

Ball and Edgar (1967), using thirty kindergarten children, examined the effectiveness of some of Kephart's techniques for developing laterality and body image. Fourteen children were assigned to the training group and sixteen to the control group. Pre- and posttest scores were obtained for all subjects on a group intelligence test (Pintner, Cunningham & Durost, 1946) and on individual administrations of Head's Eye, Hand, and Ear Test (1925), Benton's test of right-left discrimination (1955), and Benton's test of finger localization ability (1959). The work with the training group was conducted over three and one half months, five days a week, for 20 minutes per day. The training procedures were those designed by Kephart (1960) for the development of laterality and body image. The tasks to which greatest emphasis was given were walking board, balance board, chalkboard (directionality and orientation), angels in the snow, skipping, rhythm (especially bongo drums), rope jumping, peas porridge hot, stunts and games (crab-walk, duck-walk, etc.) and trampoline routines on bed springs and mattresses. Control subjects received an approximately equal amount of individual attention during regular classroom sessions from the assistants who conducted the training programme.

Results indicated that the application of Kephart's techniques generalizes to right-left discrimination ability as assessed by Head's test. An essentially equal gain on the finger localization test was obtained by both groups. No significant increases or differences between groups were found for IQ or for the Benton test of left-right discrimination.

Ball and Edgar concluded that the results obtained on Head's test support the claim that generalization occurs from specific sensory-motor training; however, the ability measured by Head's test is a very specific one. The fact that the test is composed of nonverbal, imitative responses, and the fact that significant differences were not found between the training and control groups on Benton's verbal test of right-left discrimination, Benton's finger localization test, and IQ, suggest a need for caution in interpreting these findings as proof of highly generalized gains.

The effects of Kephart's techniques upon motor performance, perceptual performance and academic achievement were examined by O'Connor (1969). The entire first-grade population of an elementary school was randomly divided into an experimental group and a control group. Pretest and posttest data were collected for all subjects on motor ability items used by Carpenter (1942) from the Brace and Johnson tests, the Perceptual Forms Test, the Metropolitan Readiness Test (pretest), the Metropolitan Achievement Test (posttest) and the posttest data on lateral awareness and the Harris Test of Lateral Dominance. During the six month period between the pretests and posttests, the control group received the grade one physical education curriculum from their classroom teacher. The experimental group was exposed to Kephart's motor activity programme which was conducted by the investigator and two assistants with small groups. The programme consisted of balance-beam activities, hopping routines, stunts and tumbling, obstacle course activities, tetherball, movement imitation, soccer-type activities, activities emphasizing basic locomotor patterns, and oculomotor pursuits. Results indicated that the experimental group improved significantly on measures of physical motor ability and on internal lateral awareness; however, external lateral awareness, lateral preference, academic achievement, and the ability to draw geometric forms were not affected by Kephart's programme.

As noted by O'Connor, the pupil-instructor ratios were vastly unequal--ten to one for the experimental group and thirty to one for the control group. The extent to which this difference influenced the results is unknown. Also, as noted previously the experimental group received their training from the investigator and two assistants while the control group was instructed by the regular classroom teacher. Thus the Hawthorne effect may have been operating.

Lipton (1970) examined the effects of a perceptual-motor development programme on perceptual-motor development, visual perception, and reading readiness. Four first-grade classes were randomly divided into control and experimental groups. Pretest and posttest scores were obtained for the students in the classes on the Purdue Perceptual-Motor Survey (Roach & Kephart, 1966), the Developmental Test of Visual Perception (Frostig et al, 1966), and the Metropolitan Readiness Tests (Hildreth, Griffiths, & McGauvran, 1965). The two control classes took part in the conventional primary grade physical education programme. The experimental classes were exposed to a perceptual-motor programme for two 30-minute periods each week for 12 weeks. The programme was designed to emphasize directionality of movement and involved activities which are associated with concepts supported by Kephart (1960) and Painter (1966). The experimental and control programmes were taught by two physical education instructors with each taking one experimental and one control class. Results indicated that the experimental programme produced significantly greater gains in perceptual-motor development, visual perception, and reading readiness as assessed by the above-mentioned instruments than did the conventional physical education curriculum.

The effects of a rhythmic and sensory motor activity programme on body image, perceptual-motor integration, and psycholinguistic competence were investigated by Painter (1966). The twenty lowest functioning children in a class of 40, as determined by Goodenough MA scores, were placed into two groups which were matched on IQ, CA, MA, and sex. The Illinois Test of Psycholinguistic Abilities (McCarthy and Kirk, 1961), the Goodenough Draw-a-Man Test (1926), and the Beery Geometric Form Reproduction (1967) were given before and after training. The Stanford-Binet Intelligence Scale was given prior to training. At the conclusion of training a sensory motor performance test designed by the investigator was given.

One of the groups of subjects was given twenty-one half hour training sessions over a period of seven weeks.

The programme was [illegible] on the theoretical constructs of Barsch (1963) [illegible] (1960) and included gross and fine motor [illegible] nine of Barsch's twelve movement [illegible] suggested that the experimental programme [illegible] significant improvement in the ability to [illegible] figure, amelioration of distortion in the [illegible] a human figure, improvement in visual-motor [illegible], improvement in sensory motor spatial [illegible] skills, and improved psycholinguistic abilities.

While the [illegible] results show significant gains in body image, [illegible] integration, and psycholinguistic competence, the small sample size and lack of control of the [illegible] effect or extra attention effect prohibit the [illegible] firm conclusions.

<u>Studies using the Winter Haven Programme</u>

Keim (1970) attempted to determine the effects of Winter Haven visual-motor training programme on the readiness and intelligence of kindergarten children. On the basis of the Bender Visual-Motor Gestalt Test (scored by the Koppitz System) a group of 74 kindergarten children with visual-motor deficiencies were identified. Half were assigned to the experimental group which received the Winter Haven Programme (McQuarrie, 1967) in addition to regular programming, while the other half formed a control group which received only ordinary kindergarten training. A second control group consisted of children displaying no visual-motor problems.

Pre- and posttest measures showed no significant differences between the groups on the Peabody Picture Vocabulary Test, the Stanford-Binet, or the Bender-Gestalt. Statistically significant differences among the three groups were found on the posttest scores of the Matching and Copying subtest of the Metropolitan Readiness Test. No pretest measures were taken with the Metropolitan.

While these data show the Winter Haven Programme to have failed in producing the anticipated results, methodological weaknesses and lack of information in reporting suggest a need for caution in interpreting the findings.

Studies using a Variety of Techniques

Gill, Herdtner, and Lough (1969) assessed the effects of a programme designed to establish body balance and spatial orientation. Four and a half year old children enrolled in a university laboratory school were randomly divided into an experimental group of fifteen subjects and a control group of thirteen. Children in the experimental group spent 15-20 minutes during the school day involved in body balance and spatial orientation exercises. Upon request, control subjects, without instruction, were allowed to use the experimental equipment. After an unspecified length of time, the children were assessed on a modified version of Witkin's Rod-and-Frame Test and Frostig's Developmental Test of Visual Perception (Frostig et al, 1964). The children in the experimental group were reported to perform significantly better than control children (nursery control and two other groups) on Witkin's Test and on two of the five Frostig subtests (Figure-Ground and Shape Constancy). The authors concluded that "special directed experiences were clearly beneficial to perceptual development" (p. 1183); however, methodological problems weaken this conclusion. The control group seldom requested to use the experimental equipment thus leaving no control for Hawthorne effect. Also, from a statistical point of view, inappropriate conclusions were drawn. By means of analysis of variance four significant F's out of six measures were found. While this indicates that all four groups differed significantly from one another in some way, it does not show which group or groups differed from which. Paired comparisons need to be performed as a further analysis in order to determine the sources and extents of differences.

The effects of perceptual training with kindergarten children were examined by Salome and Reeves (1972). Two morning kindergarten classes formed a control group and two afternoon classes, an experimental group. Instruction for the experimental group included illustrated booklets, visual aids, discussions, and exercises directing attention to visual information located in contour lines. The control group received art instruction in the usual classroom manner. Both programmes were conducted by the regular classroom teachers.

Assessment measures for one control and one experimental group (mean age 5-4) consisted of the drawing of a play trailer truck before and after the experiment and a model barn following the study. The remaining two groups (mean age 4-6) drew a play truck and a caboose before and after the study. Pre- and posttest measures on the Early Childhood Embedded Figures Test were also obtained for the two latter groups. A five criteria, eleven-point rating scale designed by Salome was used to evaluate drawings.

Results indicated that the experimental programme had a significant effect on the drawings of trucks of five year olds only. Significant group differences were also found on Early Childhood EFT posttest scores. The authors suggest that the lack of significant findings on other test measures is a reflection of the younger children performing those tasks being from a laboratory school in which drawing tasks were affected by several unidentified intervening variables. The older children were from a regular suburban school. No mention was made of procedures for training the teachers involved in the experimental programme so that differences in their methods may have effected the findings.

Summary

In view of the faulty reporting and questionable methodological procedures of most of the studies discussed, it would seem premature to draw any definitive conclusions regarding the efficacy of perceptual-motor training.

General Summary

The theoretical and empirical literature on the relationship of perceptual-motor abilities to cognition and achievement suggests a need for further investigation into the nature of perceptual-motor skills. To date, theory and research have largely viewed perceptual-motor problems in a global manner and have given little attention to visual or motor problems in isolation.

Remedial programmes also tend to focus their emphasis on problems of perceptual-motor integration and have ignored those problems which are only visual or only motor in nature. A need exists for the exploration of visual weaknesses and motor weaknesses and of remedial techniques in these two areas.

CHAPTER III

INSTRUMENTS, DEFINITIONS AND HYPOTHESES

Instruments

After examination was made of several tests of perceptual-motor ability, it was decided that the Developmental Test of Visual-Motor Integration (VMI) (Beery and Buktenica, 1967) would provide an adequate measure of perceptual-motor development. The VMI provides a raw score and a perceptual-motor age equivalent. Validity and reliability data are provided by Beery (1967).

Definitions

General Terms

Perceptual-motor developmental lag. Perceptual-motor development, as defined by scores on the Development Test of Visual-Motor Integration, is 10 months or more behind chronological age.

Independent Variables

Visual training. Training activities which require attention to stimuli, e.g. matching, form discrimination.

Motor training. Training activities which require attention to motor responses, e.g. tracing, copying.

Hypotheses

Rationale 1

Perceptual-motor theorists, for the most part, agree that visual perception and motor coordination can not be examined in isolation. They assume a direct relationship between perceptual and motor skills, i.e., a deficit in one area will produce a dysfunction in the other. However, some research does exist which suggests that visual perception operates independently of motor involvement. Newcomer and Hammill (1973) examined the visual perception of motorically handicapped children. Subjects were identified on the basis of low scores on the Ambulation and Manipulation subtests on the Preschool Attainment Record (Doll, 1966). Each subject was administered the Motor Free Test of Visual Perception (Calarusso & Hammill, 1972) and the Bender Visual Motor Gestalt Test for Children (Bender, 1938). The results indicated that motorically handicapped children perform progressively poorer on a test of visual-motor integration as the severity of their motor handicap increases. However, on a motor-free test of visual perception they tend to function appropriately for chronological age regardless of level of motoric disability. They do not have the difficulties with visual perception which are normally attributed to them.

Zach and Kaufman (1972) examined the factors contributing to successful performance on visual-motor tasks. Seventy kindergarten children were given the Bender Visual Motor Gestalt Test (Bender, 1938) and a discrimination test. The correlation between the scores of the two tests was not significant and suggests that performance on the visual task was not related to performance on a task of visual-motor integration. Thus, a child who performs poorly on a perceptual-motor task does not necessarily have a perceptual problem. His problems may be due to poor motor ability or difficulty with the integration of the visual stimulus and motor response.

Hypothesis 1

The evidence provided by Newcomer and Hammill (1973) and Zach and Kaufman (1972) suggests that visual perception and motor development may be relatively separate and independent systems. Therefore children identified as having a perceptual-motor disability may in fact have only a perceptual disability or only a motor disability. One might therefore expect that children who perform poorly on a perceptual-motor task may benefit from a remedial programme with only visual training materials or one with only motor training materials.

1.1 Visually trained subjects will display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures of perceptual-motor integration.

1.2 Motorically trained subjects will display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures of perceptual-motor integration.

1.3 Attention control subjects will not display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures of perceptual-motor integration.

1.4 Nontreatment control subjects will not display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures of perceptual-motor integration.

1.5 Normal control subjects will not display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures of perceptual-motor integration.

1.6 Visually trained subjects will display improvement greater than that of attention control and nontreatment control subjects on posttest measures of perceptual-motor integration.

1.7 Motorically trained subjects will display improvement greater than that of attention control and nontreatment control subjects on posttest measures of 1.12 perceptual-motor integration.

1.8 Visually trained subjects will perform at a level not significantly different from that of normal control subjects on posttest measures of perceptual-motor integration.

1.9 Motorically trained subjects will perform at a level which does not differ significantly from that of normal control subjects on posttest measures of perceptual-motor integration.

1.10 Attention control subjects will display inferior performance to that of normal control subjects on posttest measures of perceptual-motor integration.

1.11 Nontreatment control subjects will display inferior performance to that of normal control subjects on posttest measures of perceptual-motor integration.

1.12 Attention control subjects will display improvement which does not differ significantly from that of nontreatment control subjects on posttest measures of perceptual motor integration.

Rationale 2

In addition to examining the relationship between perceptual-motor development and aspects of achievement and cognition, investigators have also tried to determine whether perceptual-motor ability may be related to achievement at all age levels or only at the earliest ones. Lyle (1969) found visual deficits tended to decline in importance with increasing age through the primary grade years, although such problems were still found in retarded readers in the fifth and sixth grades. Whipple and Kodman (1969) compared poor and normal readers from the fourth and fifth grades. The poor readers were found to be functioning at the level of 6- to 8-year old children in their ability to perform a Gibson and Gibson (1955) perceptual learning task involving the matching of nonsense drawings from memory.

In contrast to this evidence of a continued relationship between perceptual deficits and reading problems, other research has provided data which suggest that at about the fourth-grade level there occurs a shift in emphasis from the visual to auditory mode with regard to reading problems. A well-designed study exemplifying this position was conducted by Katz and Deutsch (1963). Using first-, third-, and fifth-grade black children of low socioeconomic status, they administered a test of reading ability, a modality preference test, a concept formation test, a memory span test, several discrimination tasks, and several perceptual tests involving bimodal, visual-auditory, and stimulation and response patterns. From their results, the investigators determined that poor reading was associated with difficulty in shifting from one sensory mode to another. The poor readers were also found to have greater difficulty in differentiating between qualitatively similar visual and auditory stimuli. They also performed less well on learning and memory tasks involving such stimuli. On simpler tasks, the poor readers had their greatest problems with visual stimuli, but on more complex tasks they performed poorest when dealing with auditory stimuli. While perceptual ability was found to improve with age for poor as well as for average readers, this ability was a slow-growing process for the reading disabled children. As they grow older, therefore, poor readers faced with tasks of increasing complexity apparently do less well on items involving auditory stimuli. This point may reflect a shift in the relative importance of visual and auditory impairment with regard to reading problems.

Sterritt and Rudnick (1966) have provided further evidence for a visual-auditory shift. Subjects listened to tapped out rhythmic patterns and watched sequences of blinking lights. After each presentation the subject was to match a set of dots with the pattern he had just heard or seen. Findings demonstrated that the significance of achievement on the visual task declined with age in relation to reading problems while performance on the task involving auditory presentation took on increased importance. In a follow-up study involving the same experimental tasks with third graders, Rudnick, Sterritt, and Flax (1967) sustained their original conclusions and pinpointed the occurrence of the shift at the fourth-grade level.

Hypothesis 2

The empirical evidence reviewed suggests that at about the fourth-grade level, there is a shift in importance from the visual to auditory problems with regard to reading problems. It would therefore be expected that perceptual-motor problems will decrease as age increases.

2.1 Lags in perceptual-motor development will decrease as age increases.

Rationale 3

The learning disability population as a whole, and reading disabled children in particular, are overrepresented by boys. Sex differences in children with problems of a perceptual-motor nature have also been examined by researchers.

Rosenblith (1965) gave three perceptual tasks to normal children from kindergarten through fourth grades and found no significant difference in either number or type of errors between boys and girls.

In a longitudinal study, Keogh and Smith (1967) administered the Bender-Gestalt test to 73 children at kindergarten, third, and sixth-grade levels. Comparison of performance of boys and girls over the 7-year period showed girls to have better visual-motor ability at kindergarten than boys but that boys were better than girls at grade 3; there was no difference at grade 6.

Gill, Herdtner, and Lough (1968) examined sex differences in performance of nursery, kindergarten and first grade children on Frostig's Developmental Test of Visual Perception (Frostig et al., 1964) and a modified Rod-and-frame Test. Sex was not a differentiating factor on the Frostig subtests; however, first grade boys did score significantly better on the Rod-and-frame Test than girls.

The coding subtest of the Wechsler Intelligence Scale for Children has been used to assess perceptual-motor skills. Studies which have examined the relationship of sex to performance on the coding subtest (Gainer, 1962; Minuchin, 1963; Miele, 1958) have all reported the performance of girls to be superior to that of boys.

The diversity of the findings of studies which have examined sex differences in perceptual-motor ability suggest a need for separate analysis of data from boys and girls.

Hypothesis 3

Perceptual-motor differences due to sex have been explored by a number of investigators but findings to date are inconclusive. The predominance of males in the learning disabled population suggests that girls would be superior to boys in performance on perceptual-motor tasks.

3.1 Female subjects will display superior performance to that of male subjects on measures of perceptual-motor integration.

CHAPTER IV

METHOD

Subjects

One hundred children from kindergarten and grades one and two classes of two Edmonton Public Schools were selected as subjects. These subjects were obtained by administering the Developmental Test of Visaul-Motor Integration (VMI) to 179 pupils in kindergarten and grades one and two. Eighty children with VMI age equivalent scores at least 10 months less than chronological age were identified. These children were randomly assigned to one of four groups, the groups being described by the nature of treatment, i.e. visual training, motor training, attention control, and nontreatment control. Twenty children with VMI age equivalent scores equal to or greater than chronological age were also identified. These children formed a normal control group. Characteristics of the sample are presented in Table 1. Results of the five groups on pretest administration of the VMI are given in Table 2. To test for homogeneity for the four low scoring groups and for superior ability in the normal control group, a one-way analysis of variance (Ferguson,

Table 1

Subjects Described by Sex, Chronological Age, Grade, and School

Group	Sex		Mean C.A. (months)	Grade			School	
	Male	Female		K	1	2	Clara Tyner	Rutherford
1. Visual Training	11	9	86	3	7	10	9	11
2. Motor Training	13	7	83	3	9	8	13	7
3. Attention Control	6	14	86	4	5	11	8	12
4. Non-Treatment Control	11	9	86	3	7	10	9	11
5. Normal Control	10	10	79	6	8	6	10	10

Table 2

Pretest Results on Developmental Test of Visual-Motor Integration

Group	VMI Raw Score		VMI Age Equivalent		Ratio[1]	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
1. Visually Trained	10.65	1.82	69.55	7.38	80.66	5.94
2. Motorically Trained	9.50	2.20	65.60	8.11	80.86	5.12
3. Attention Control	10.15	1.79	67.60	6.65	79.23	6.85
4. Non-Treatment Control	10.35	1.95	69.00	8.10	79.87	4.86
5. Normal Control	14.12	2.12	89.71	14.87	111.16	9.59

[1]Ratio = $\frac{\text{VMI Age Equivalent}}{\text{Chronological Age}}$ X 100%

1971, pp. 208-221) was performed using the pretest ratio scores. A significant F ratio ($F=76.53$, df_1 4, df_2 88, $p<.01$) resulted. In order to determine among which group means these differences existed, the Newman-Keuls method of multiple comparison (Ferguson, 1971, pp. 272-275) was applied. In this analysis, no significant differences were found between the four low-scoring groups. The normal control group scored significantly higher ($p<.01$) than each of the four low-scoring groups.

Of the 100 subjects, only 93 completed all phases of the study, with groups ranging in size from 17 to 20 subjects at the time of posttesting. Prior to the testing, parental permission was received for the participaltion of the children in the study.

Training Programmes

Visaul training programme.

The twenty subjects who formed the visual training group worked with materials which emphasized visual, receptive skills. Activities ranged from those requiring recognition of large discrepancies to those demanding fine discriminations. In all activities it was necessary for the subject to attend to visual cues.

Motor training programme.

Those subjects in the motor training programme engaged in activities which focused on fine motor skills. The programme included exercises ranging from the tracing of simple forms to the reproduction of complex forms. All activities required a motor response.

Attention control programme.

Subjects in the attention control group listened to fairy tales and answered orally questions relating to the stories they heard. The stories read were often ones which had been requested by the subjects.

Subjects in the nontreatment control group and the normal control group were not given any special activities between pre- and posttesting. Appendix A lists the activities involved in each programme and the materials which were used.

Procedure

The Developmental Test of Visual-Motor Integration was administered to the initial 179 pupils over a period of four days. Testing was done in the schools with groups of not more than 10 pupils. From the test results the 100 subjects were identified and assigned to their experimental group. The subjects in the visual training, motor training, and attention control groups were removed from their regular classroom for 30 minutes every other day during which time they were exposed to their respective experimental programmes. For instruction purposes groups ranged in size from five to seven subjects. The programmes were run for a three week period. One week after the treatment programmes were completed the 93 remaining subjects were retested on the VMI over a two day period. All testing and instructing were conducted by the experimenter.

Scoring

Scoring of pre- and posttests was done by hand by the experimenter according to the standards of the VMI Administration and Scoring Manual (Beery, 1967). The responses of 10 randomly selected subjects were also marked by a graduate student. The two sets of scores, i.e. those of the experimenter and those of the graduate student, had a correlation coefficient of .89 ($p < .01$) which suggests that there was no bias presented by the experimenter's scoring.

CHAPTER V

RESULTS

The results of the experimental investigation were analyzed according to the specific hypotheses presented in Chapter III. In order to assess these hypothesized effects, the one way analysis of variance (Ferguson, 1971, pp. 208-221), Duncan's new multiple-range test[1] (Duncan, 1955, pp. 1-42), the *t* test (Ferguson, 1971, pp. 153-157), and the Pearson product moment correlation (Ferguson, 1971, pp. 96-105, 169-170) were employed.

Hypothesis 1

The first hypothesis predicted that children who perform poorly on a perceptual-motor integration task would benefit from a remedial programme with only visual training materials or one with only motor training materials. The specific predictions are given below as they appeared in Chapter III. A summary of the results is given in Table 3, and in Figure 2.

> Hypothesis 1.1. Visually trained subjects will display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures of perceptual-motor integration.

A *t* test with paired observations comparing pretest and posttest raw scores resulted in a significant difference

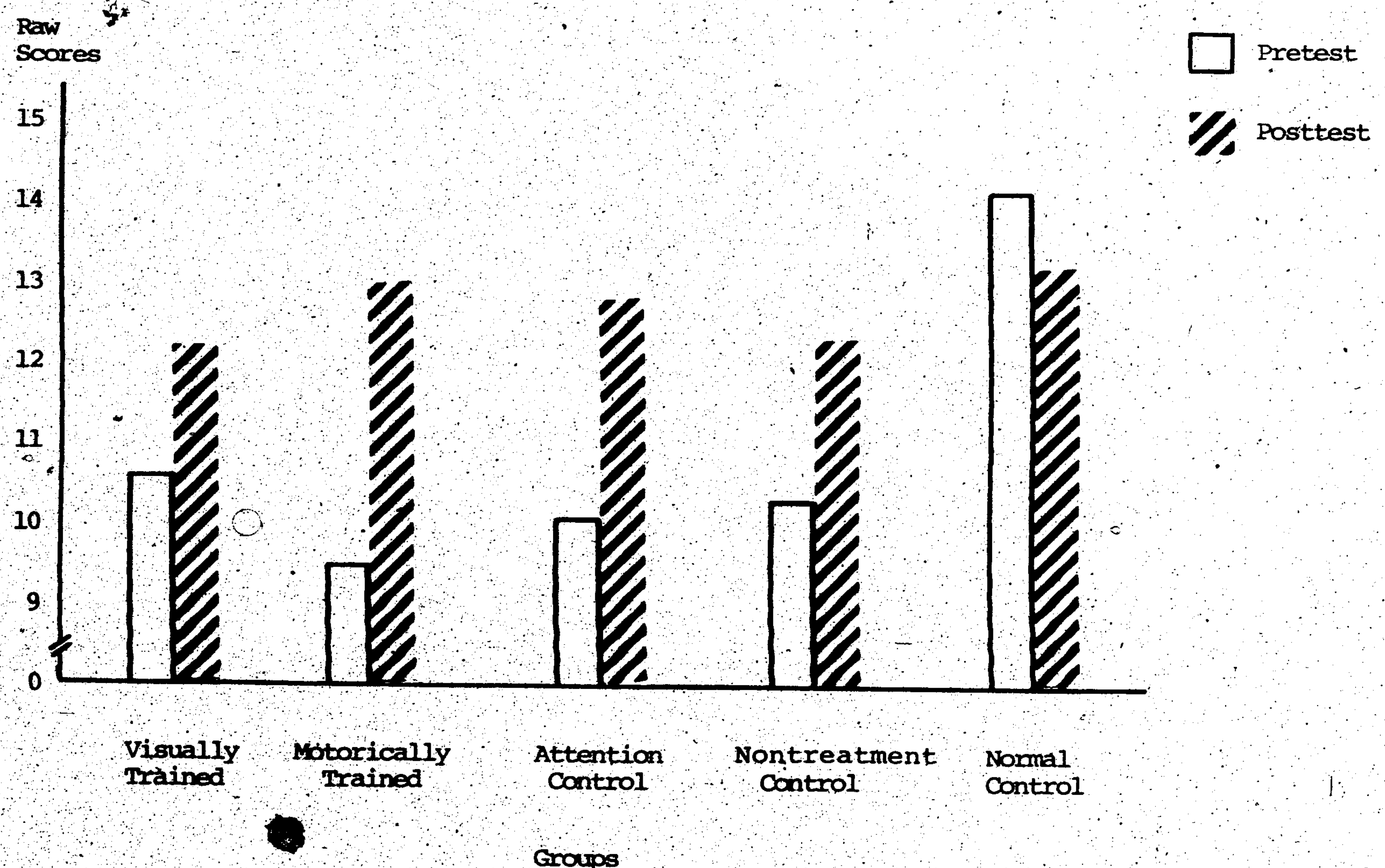
Table 3

Means and Standard Deviations of Raw Scores on Pretest and Posttest VMI Administration

Group	Pretest		Posttest	
	Mean	Standard Deviation	Mean	Standard Deviation
Visually Trained (n=18)	10.56	1.82	12.22	1.93
Motorically Trained (n=18)	9.50	2.20	13.00	2.68
Attention Control (n=20)	10.15	1.79	12.75	2.63
Nontreatment Control (n=20)	10.35	1.95	12.30	2.87
Normal Control (n=17)	14.12	2.12	13.23	2.39

Figure 2

VMI Pretest and Posttest Raw Scores



($\bar{X}$ pretest = 10.56, $\bar{X}$ posttest = 12.22, t = 3.54, df = 17) at the .005 level. The results thus support this hypothesis in the predicted direction.

> <u>Hypothesis 1.2.</u> Motorically trained subjects will display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures of perceptual-motor integration.

A t test with paired observations was performed comparing pretest and posttest raw scores. This analysis resulted in a significant difference ($\bar{X}$ pretest = 9.50, $\bar{X}$ posttest = 13.00, t = 7.5, df = 17) at the .0005 level. The results support this hypothesis in the predicted direction.

> <u>Hypothesis 1.3.</u> Attention control subjects will not display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures of perceptual-motor integration.

A t test with paired observations comparing pretest and posttest raw scores resulted in a significant difference ($\bar{X}$ pretest = 10.15, $\bar{X}$ posttest = 12.75, t = 5.64, df = 19) at the .0005 level. The results of the analysis do not support this hypothesis.

> <u>Hypothesis 1.4.</u> Nontreatment control subjects will not display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures of perceptual-motor integration.

A t test with paired observations was performed comparing pretest and posttest raw scores. This analysis resulted in a significant difference ($\bar{X}$ pretest = 10.35, $\bar{X}$ posttest = 12.30, t = 4.45, df = 19) at the .0005 level. These results do not support the hypothesis.

> <u>Hypothesis 1.5.</u> Normal control subjects will not display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures of perceptual-motor integration.

A t test with paired observations comparing pretest and posttest raw scores did not yield a significant difference ($\bar{X}$ pretest = 14.11, $\bar{X}$ posttest = 13.23, t = 1.54, df = 16) at the .05 level. The results thus support this hypothesis.

> <u>Hypothesis 1.6.</u> Visually trained subjects will display improvement greater than that of attention control and nontreatment control subjects on posttest measures of perceptual-motor integration.

In order to test this hypothesis, visually trained subjects were compared to attention control subjects and nontreatment control subjects on differences between VMI pretest raw scores and VMI posttest raw scores. The one-way analysis of variance (disproportionate cell) on the difference scores of the four low-scoring groups revealed a significant F ratio ($F = 3.02$, $df_1 = 3$, $df_2 = 72$) at the .05 level. In order to determine among which group means these differences existed, the Duncan's new Multiple-range test was applied. In this analysis, no significant differences were found between visually trained subjects and attention control subjects or nontreatment control subjects (difference between visually trained mean and attention control mean = .93, significant studentized range at .05 level = 2.97-1.36; difference between visually trained mean and nontreatment control mean = .28, significant studentized range at .05 level = 2.82-1.30). These results do not support this hypothesis.

> <u>Hypothesis 1.7.</u> Motorically trained subjects will display improvement greater than that of attention control and nontreatment control subjects on posttest measure of perceptual-motor integration.

This hypothesis was tested by comparing motorically trained subjects to attention control and nontreatment control subjects on their differences between VMI pretest raw scores and VMI posttest raw scores. The one-way analysis of variance (disproportionate cell) on the difference scores of the four low-scoring groups yielded a significant F ratio ($F = 3.02$, $df_1 = 3$, $df_2 = 72$) at the .05 level. The Duncan's new multiple-range test was applied to determine among which group means the differences existed. In this analysis, no significant difference was found between motorically trained subjects and attention control subjects (difference between means = .90, significant studentized range at .05 level = 3.06-1.40). A significant difference was found at the .05 level between motorically trained subjects and nontreatment control subjects (difference between means = 1.55, significant studentized range at .05 level = 3.06-1.40).

These results thus support in part the hypothesis.

> <u>Hypothesis 1.8.</u> Visually trained subjects will perform at a level not significantly different from that of a normal control subjects on posttest measures of perceptual-motor integration.

A t test with unequal variances was performed on posttest raw scores for these two groups. The results of the analysis ($\bar{X}$ of visually trained subjects = 12.22, $\bar{X}$ of normal control subjects = 13.24, t = -1.38, df = 33) did not yield a significant difference and thus support this hypothesis.

> <u>Hypothesis 1.9.</u> Motorically trained subjects will perform at a level which does not differ significantly from that of normal control subjects on posttest measures of perceptual-motor integration.

A t test with unequal variances was performed on posttest raw scores for these two groups. The results of the analysis ($\bar{X}$ of motorically trained subjects = 13.00, $\bar{X}$ of normal control subjects = 13.24, t = -.28, df = 35) do not indicate a significant difference and therefore are in support of this hypothesis.

> <u>Hypothesis 1.10.</u> Attention control subjects will display inferior performance to that of normal control subjects on posttest measures of perceptual-motor integration.

A t test with unequal variances was performed on posttest raw scores for these two groups. The results of the analysis ($\bar{X}$ of attention control subjects = 12.75, $\bar{X}$ of normal control subjects = 13.24, t = -.59, df = 37) did not yield a significant difference and therefore do not support this hypothesis.

> Hypothesis 1.11. Nontreatment control subjects will display inferior performance to that of normal control subjects on posttest measures of perceptual-motor integration.

A t test with unequal variances was performed on posttest raw scores for these two groups. The results of the analysis ($\overline{X}$ of nontreatment control subjects = 12.30, $\overline{X}$ of normal control subjects = 13.24, t = 1.08, df = 37) did not yield a significant difference and thus do not support this hypothesis.

> Hypothesis 1.12. Attention control subjects will display improvement which does not differ significantly from that of nontreatment control subjects on posttest measures of perceptual-motor integration.

This hypothesis was tested by comparing attention control subjects and nontreatment control subjects on their differences between VMI pretest raw scores and VMI posttest raw scores. The one-way analysis of variance (disproportionate cell) which was performed on the difference scores of the four low-scoring groups yielded a significant F ratio ($F = 3.02$, $df_1 = 3$, $df_2 = 72$) at the .05 level. The Duncan's new multiple-range test was applied to determine among which group means the differences existed. The results of this analysis supported the above hypothesis in that no significant differences were found between attention control subjects and nontreatment control subjects (difference between means = .65, significant studentized range at .05 level = 2.97-1.33).

Summary of findings for Hypothesis 1.

The first part of this hypothesis (Hypothesis 1.1 through 1.5) was partially supported by the results in that visually trained subjects and motorically trained subjects displayed improved perceptual-motor skills on posttest measures as compared to pretest measures (Hypotheses 1.1 and 1.2) and that normal control subjects did not display improved performance on posttest measures of perceptual-motor integration as compared to pretest measures (Hypothesis 1.5). However, significant improvement on posttest measures as compared to pretest measures was also displayed by attention control subjects and nontreatment control subjects. Hypotheses 1.3 and 1.4 were not confirmed by these results in that it was predicted that significant differences would not exist.

The second part of Hypothesis 1 (Hypotheses 1.6 through 1.12) also received only partial support. Hypothesis 1.6, which stated that visually trained subjects would display improvement greater than attention control subjects or nontreatment control subjects, was not supported by the results. Hypothesis 1.7 was partially supported in that motorically trained subjects displayed greater improvement than did nontreatment control subjects.

However the prediction that the improvement of motorically trained subjects would be greater than that of attention control subjects was not confirmed. Hypotheses 1.8 and 1.9 which stated that visually trained and motorically trained subjects would not differ from normal control subjects on posttest measures were confirmed. However, Hypotheses 1.10 and 1.11 which stated that attention control and nontreatment control subjects would differ from normal control subjects on posttest measures were not supported by the results. Hypothesis 1.12, which predicted that attention control subjects and nontreatment control subjects would display equal improvement was confirmed.

Hypothesis 2

The second hypothesis predicted that visual-motor problems would decrease as age increased. The specific prediction is given below as it appeared in Chapter III.

> Hypothesis 2.1. Lags in perceptual-motor development will decrease as age increases.

In order to test this hypothesis, a Pearson product-moment correlation coefficient was calculated for pretest chronological age and the discrepancy between pretest chronological age and VMI age equivalent for the initial 179 subjects. The results of this analysis ($r = -0.46$, $t = 6.90$, $df = 177$) yielded a significant negative correlation at the .005 level and thus support this hypothesis.

Summary of findings for Hypothesis 2.

This hypothesis which predicted that as chronological age increased perceptual-motor problems would decrease was supported by the results.

Hypothesis 3

The third hypothesis predicted that girls would be superior to boys in performance on perceptual-motor tasks. The specific prediction as stated in Chapter III is given below.

> Hypothesis 3.1. Female subjects will display superior performance to that of male subjects on measures of perceptual-motor integration.

A t test for independent samples with equal variances was performed on pretest raw scores for all the females and males in the initial sample of 179 subjects. The results of the analysis do not support this hypothesis ($\bar{X}$ females = 10.90, $\bar{X}$ males = 10.37, t = 1.50, df = 177).

Summary of findings of Hypothesis 3.

This hypothesis which predicted that female subjects would perform in a superior manner to male subjects on perceptual-motor integration tasks was not supported by the results.

CHAPTER VI

DISCUSSION

The major assumption of this study was that visual perception and motor development are independent systems and that children identified as having a perceptual-motor disability may have only a perceptual disability or only a motor disability.

Hypothesis 1 proposed that children who perform poorly on a task of perceptual-motor integration would benefit from a remedial programme with only visual training or one with only motor training. This hypothesis was based on the studies of Newcomer and Hammill (1973) and Zach and Kaufman (1972) which suggest that children identified as having perceptual-motor problems may in fact have only perceptual or only motor problems. Examining this hypothesis in terms of posttest performance on measures of perceptual-motor integration as compared to pretest performance on measures of perceptual-motor integration, it can be seen that all four groups of low-scoring pupils--visual training, motor training, attention control, and nontreatment control--improved significantly. Also, none of the four low-scoring groups differed significantly from the normal control group on posttest measures of perceptual-motor integration. This significant improvement of the low-scoring pupils represents a minimum gain of ten months in terms of perceptual-motor development over the seven week period between pretesting and posttesting. Such a change in all four groups was not anticipated; however, there would appear to be some confounding factors which may have contributed to this change.

The improvement may be a reflection of skills acquired through classroom instruction. It is quite probable that during the course of the experiment the subjects, through normal educational experiences, acquired improved perceptual-motor skills. Also, teachers may tend to spend more time working with those pupils who are having difficulty in school than with those who are performing at, or above, an average level. Thus, the experimental subjects, in whom perceptual-motor weaknesses were evidenced, may have been receiving extra attention from the teachers. Further, pretesting of the subjects took place eight weeks prior to the end of the school year. Teachers will often give extra emphasis to pupils' specific areas of weakness during the latter part of the year in an effort to bring them up to age level before the end of term. The experimental subjects may therefore have been given extra perceptual-motor activities by their teachers during the course of the experiment. The effects of such activities may have been demonstrated on the posttest which was given in the last week of school.

The change shown by the four groups could also be a function of the VMI, the testing instrument by which perceptual-motor development was assessed. Examination of pre- and posttest scores of individual subjects indicated that an increase of two points, i.e. performance on the posttest yielded two more correct form reproductions than performance on the pretest, would be a statistically significant improvement. A more sensitive instrument, i.e. one which would make finer discriminations, might yield fewer significant findings.

Another possible contributant to the significant improvement in the four low scoring groups was the eagerness of the subjects to please the examiner. The pupils involved in the experimental programmes appeared to enjoy their sessions and saw themselves as "special" in having been chosen to participate in the experimental activities. Those pupils who were not included frequently asked if they could join into one of the groups. Thus, the subjects may have put forth extra effort on the posttest with the assumption that their performance might influence future participation in the programme.

A further examination of the results for the first hypothesis indicated that some of the anticipated differences between groups were not found. Neither the visually trained group nor the motorically trained group differed significantly from the attention control group, and only the motorically trained group differed significantly from the nontreatment control group. These results suggest that training programmes may be no more effective than participation in the regular school programme in stimulating perceptual-motor development. Reviews of recent studies of the value of perceptual-motor training programmes on perceptual-motor development (Hammill, 1975; Hammill, Goodman, and Wiederholt, 1974) indicate that such programmes frequently do not enhance perceptual-motor functioning. Many of the studies which have reported positive benefits of these programmes have contained weaknesses in their experimental designs (eg. Gill, Herdtner, and Lough, 1969; O'Connor, 1969; Painter, 1966). This lack of supportive research would indicate a need for caution in implementing perceptual-motor programmes and that use of these programmes should be viewed as experimental. Mann (1970) has suggested that perceptual-motor training exercises should be abandoned and that attention should instead be focused on "training in academics, development of art skills, increased proficiency in athletic games, expanding abilities of recreative activity [as these] all effectively train 'perception' and are meaningful in and of themselves" (p.37).

However, these notions have not yet been tested empirically.

A few well-designed studies (eg. Bosworth, 1967; and Mould, 1965) have reported significant improvement in perceptual-motor skills after specific training. Some weaknesses in the design of the present study may have contributed to the relative ineffectiveness of the training programmes. It was expected that those subjects who received visual training would differ significantly from those subjects in the attention control and no treatment control groups; however, this was not the case. The visual training activities may have been more effective if the subjects were assigned to the visual training group on the basis of identified visual weaknesses. The test instruments described by Calarusso and Hammill (1972) and Zach and Kaufman (1972) would appear to be appropriate for identifying such deficiencies. In this study subjects were randomly assigned to the four low-scoring groups. Because of this random assignment, one does not know if subjects were receiving appropriate treatment, i.e., were those subjects to whom visual training activities were given the subjects with visual problems?

The visual training activities might have had a greater effect if they had been offered over a longer period of time. The majority of studies which have examined the effectiveness of perceptual-motor training have extended over a considerably greater length of time than the 210 minutes of remediation given in the present study. An increase in the programme's length may also have served to lessen the effect which receiving special attention appeared to have on some of the subjects.

Examination of scores of subjects who received motor training indicated that they too did not differ significantly from the subjects in the attention control group. They did, however, differ significantly from the nontreatment control group. The fact that a difference was found between the motorically trained group and the attention control group suggests that with a longer operation of the remediation programme it may have yielded more significant results.

As was suggested with the visually trained programme, the motor training programme may have been more effective if subjects were assigned to the programme on the basis of an identified motor weakness. Newcomer and Hammill (1973) suggest a method by which such identification could be made. If such a method were used, those subjects for whom the motor training would be maximally beneficial would be in the motor training programme.

Comparison of pretest-posttest gains indicated that the subjects in the motorically trained group did evidence the greatest gain. The subjects in this group, while not significantly lower, did have the lowest pretest average. They therefore had the greatest room for improvement. The gain evidenced by the motorically trained group could also be a reflection of the fact that their training activities most closely approximated the responses required on the testing instrument. Also, these training activities would be appropriate not only for those with motor deficiencies, but also for those with problems in perceptual-motor integration. Thus, one would expect that there were more subjects in this group receiving appropriate activities than in the visually trained group.

In the second hypothesis the relationship between lags in perceptual-motor development and age was examined. The results of this study indicated that as chronological age increases, the lag in perceptual-motor development, i.e. the discrepancy between chronological age and age level of perceptual-motor ability, decreases. This finding adds further support to existing literature (Katz and Deutsch, 1964; Lyle, 1969; Rudnick, Sterritt, and Flax 1967; and Sterritt and Rudnick, 1966) which has demonstrated that as age increases there is a decline in the importance of perceptual-motor deficits.

Various explanations can be offered for this relationship. Lyle (1969) explained the disappearance of perceptual-motor problems with increasing age as a reflection of learning belatedly taking place. The young child may enter school at a time when he is not developmentally ready for the experiences which school is offering. Once he has reached a stage of developmental readiness, he can benefit more from his school experiences. Thus, the young child may display greater perceptual-motor deficiencies than the older child.

Also, the increased exposure to fine visual-motor coordination tasks during years in school may result in greater improvement in perceptual-motor skills. The kindergarten pupil is in his first year of exposure to such tasks; the second-grade pupil, in his third year. These additional years may have a positive compounding effect.

Another possible explanation for this relationship is that with an increased number of years in school, there is also an increased probability of children with serious learning problems being removed from the regular classroom. Thus, at the younger age levels there is a greater chance of having pupils in the regular classroom with serious deficiencies than there is at the higher age levels.

The third hypothesis of this study examined sex differences in perceptual-motor ability. In general, research within the field of learning disabilities has indicated that there is a significantly greater number of males than females in the population of learning disabled children. The literature related to sex differences in children with problems of a perceptual-motor nature reports varied findings. Some investigators (Gill, Herdtner, and Lough, 1968; Keogh and Smith, 1967; and Rosenblith, 1965) have reported no differences in the performance of males and females on tasks of perceptual-motor ability; others (Gill, Herdtner, and Lough, 1968; and Keogh and Smith, 1967) reported superior performance by males; and still others (Gainer, 1962; Keogh and Smith, 1967; Miele, 1958; and Minuchin, 1963) reported superior performance by females. The diversity of these findings may reflect differences in ages of subjects and differences in testing instruments. The results of the present study did not indicate any differences in perceptual-motor ability of males and females. Of the 179 pupils tested, 49 females and 51 males were identified as having perceptual-motor problems. These findings, while unexpected in terms of the trend within the learning disabled population, are supported by the work of Rosenblith (1965) and Gill, Herdtner, and Lough (1968).

Implications for Further Research

The relative ineffectiveness of the remedial programmes examined in the present study may reflect weaknesses in the experimental procedure for which control should be introduced in any replications of this research.

One of the limitations of this study was that the testing instrument, by which pre- and posttest assessments of perceptual-motor problems were made, did not appear to be sufficiently sensitive. If an instrument by which finer discrimination of levels of ability were used, more significant results may be found.

In this study subjects were randomly assigned to visual training and motor training groups. As a result, a number of these subjects were likely assigned to a remedial programme which was not the most appropriate one in terms of their specific weakness. It would, therefore, seem advisable that further testing be introduced by which the specific area of weakness--visual, motor, or visual-motor integration--could be identified. Group assignment would then be based on the results of such testing and pupils would thereby be exposed to appropriate training activities.

The remedial programmes of this study were in operation for a relatively short period of time. Since in a year the average child will probably spend over 900 hours in school, the 3.5 hours for which training activities were offered cannot be considered a very long period of time. Offering the programmes for a greater number of hours might serve to increase their relative effectiveness.

The population from which the sample was selected for this study had an inherent limitation in that during the course of the experiment they were exposed to their regular school curriculum which may have offered additional perceptual-motor activities. In future studies, classroom activities should be monitored so that the experimenter is aware of what related activities are being given in the classroom. An alternate approach would be to select a sample which is free of these confounding influences of the classroom; for example, children in a day care centre which is oriented towards being a care facility rather than a teaching facility.

In this study, testing and instruction were done by the experimenter. If further investigations of this nature were to be carried out, testing of pupils should be conducted by a person other than the one by whom the remedial programmes are being offered so that pupils' posttest responses will be less influenced by attempts to please the examiner.

A particularly useful methodological framework into which future studies could be placed is that of longitudinal research. This design would permit investigation of the effects of improved perceptual-motor skills on academic achievement. A child may be brought up to an acceptable level of perceptual-motor development, but this does not guarantee that he will automatically and immediately improve in academic achievement. He must further learn academic and more conceptual abilities if he is to improve in these areas also. It is only through long term research that such further learning could be recognized.

Also, little is known of the long-term development of individuals exhibiting developmental disabilities. Longitudinal research would provide such information for children with lags in perceptual-motor development.

Although only a few specific areas of concern for future research have been discussed here, a need does exist for research in every aspect of perceptual-motor development of learning disabled children. Systematic evaluation of available teaching materials, many of which are untested, would also appear most appropria

Summary

The present study sought to investigate the effectiveness of two remedial programmes, one which emphasized visual training activities and one which focused on motor training activities, with children exhibiting perceptual-motor difficulties. In addition to the programmes' effectiveness, the study examined sex differences in perceptual-motor development and the relationship of perceptual-motor deficiencies to chronological age.

The literature regarding perceptual-motor development has tended towards a global view of perceptual-motor problems and has given little attention to the examination of visual or motor problems in isolation. Remedial programmes have also emphasized problems of perceptual-motor integration and largely ignored problems which are only visual or only motor in nature. This study maintained that perceptual skills and motor skills are autonomous; that children who display perceptual-motor problems have a visual deficit, a motor deficit, or an integration deficit. It was hypothesized that children who evidenced perceptual-motor problems would benefit from a visual training programme or a motor training programme.

Assessment of perceptual-motor skills of early elementary school children enabled identification of 80 subjects with perceptual-motor problems and 20 subjects without perceptual-motor problems. The low-scoring subjects were randomly assigned to four groups--visual training, motor training, attention control, and non-treatment control; the other subjects formed a normal control group. For thirty minutes every other day for a three week period, the visual group was exposed to visual training activiites, the motor group was given motor training activiites, and the attention control group listened to fairy tales. The nontreatment control and normal control groups did not receive any special activities. Perceptual-motor skills of all subjects were reassessed one week after the treatment programmes were completed.

Analysis of the data yielded significant improvements for all four low-scoring groups between pre- and posttesting. Posttest scores indicated a significantly greater score for the motorically trained group than for the nontreatment control group. No other significant differences were found between the five groups on post-test scores.

Analysis of sex differences in perceptual-motor ability yielded no significant difference between the performance of males and females on the experimental task.

The relationship of perceptual-motor deficiencies to chronological age was examined. The data indicated that as chronological age increases, deficiences in perceptual-motor development decrease.

The results of this investigation provide some suggestions for further research in the area of perceptual-motor disabilities.

FOOTNOTES

[1]Duncan's new multiple-range test provides a method by which multiple comparisons among means can be made.

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APPENDIX A

Training Activities and Materials

Visual Training Programme

1. Form boards. Shapes are fitted into their appropriate spaces. Visual discrimination boards. Chicago: Educational Teaching Aids. Division of Daigger & Company, Inc., 1970.
2. Bead designs. Designs are reproduced with beads on a string. Building bead patterns. Ideal. Large coloured beads. Ideal.
3. Matching. Matching geometric shapes to patterned sheets. Shapes puzzles. Chicago: Developmental Learning Materials.
4. Matching and finding shapes. Matching geometric forms to printed forms embedded in figures. Reading readiness kit. Follett Publishing Company, 1968.
5. Bingo. Finding geometric shapes which match standard. Learning lotto. Negative & positive, shape, geometric pictures; same & different. Princeton, New Jersey: Creative Playthings, 1968. Perceptual bingo. Erie program/1-part 2. Boston: Teaching Resources, 1969.
6. Matching game. Matching geometric forms on dice

to those on playing board. Visual perceptual exercises. Erie program/1-part 1. Boston: Teaching Resources Corporation, 1969.

Motor Training Programme

1. Templates. Tracing geometric forms. Visual-motor template forms. Erie programe/1-part 3. Boston: Teaching Resources, 1969.
2. Tracing. Tracing lines and patterns. Experiential perceptual-motor exercises. Dubnoff school program 1, level 2. Boston: Teaching Resources, 1968. Sequential perceptual-motor exercises. Dubnoff school program 1, level 1. Boston: Teaching Resources, 1968.
3. Chalkboard activities. Vertical line, circle, square, triangle, and diamond are drawn on chalkboard. Pupils trace forms with finger. Pupils then draw forms on chalkboard and trace perimeter, first with finger then again with chalk.
4. Tracing, colouring and cutting geometric forms. Perceptual-motor development. Fairbanks-Robinson program/1 level 1. Boston: Teaching Resources, 1969.
5. As (3) but with more complex forms.
6. As (4) but with more complex forms.

7. Follow the dots form completion. Pupil first follows the cues and then copies freehand. Perceptual developmental cards. Oak Lawns, Illinois: Ideal School Supply Company, 1969.

Attention Control Programme

1. Stories. Pupils listen to stories and answer questions relating to the stories.

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