THE VISUAL-MOTOR SKILLS IN THE PRESCHOOL CHILD WITH A HISTORY OF PREMATURITY

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF ARTS

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

SCHOOL OF OCCUPATIONAL THERAPY

BY

SHIRLEY HOVDE NORTHROP, B.S.

DENTON, TEXAS

DECEMBER 1983

The Graduate School

Texas Woman's University

Denton, Texas

November 8 19 83

We hereby recommend that the THESIS prepared under our supervision by SHIRLEY HOVDE NORTHROP entitled THE VISUAL-MOTOR SKILLS IN THE PRESCHOOL CHILD WITH A HISTORY OF PREMATURITY

be accepted as fulfilling this part of the requirements for the Degree of MASTER OF ARTS.

Committee:

Donald A Davidson
Chairman

Mace E Gilkeson

Harriette A Davidson

Accepted:

Barbara J Cramer
Dean of the Graduate School

ACKNOWLEDGEMENTS

Gratitude goes first to all of the children who have been teaching the author over the years.

The author extends special thanks to Don Davidson, Grace Gilkeson, and Harriett Davidson for their active assistance and support.

Sincere appreciation is extended to the staff at Meyer Center for Developmental Pediatrics for their participation and encouragement.

Lastly, the author is grateful to Allen for his interest and patience throughout this project.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

The number of very low birth weight infants who survive has increased markedly due to all the advances in the design and use of life support systems. Many studies have been conducted to determine the long-term outcome of low birth weight infants. The consensus seems to be that the low birth weight infant is at risk later for some academic problems.

Delays in fine motor skills and adaptive abilities in writing have been observed in children with a history of very low birth weight when evaluated by occupational therapists at the Leopold L. Meyer Center for Developmental Pediatrics, Texas Children's Hospital. If these delays persist they may contribute to major learning problems when children reach school age. If such delays exist the children who are at risk may benefit from supportive or remedial therapy at early ages. They should encounter less difficulty and frustration with writing at school age if they have had the added experience and maturation resulting from therapy.

The visual-motor skills in preschool children with a history of prematurity were explored. Fine motor performances were examined clinically as representative of

visual-motor abilities. The fine motor performances of three-year-old children with histories of prematurity were compared to the fine motor performances of normal three-year-old children born at term.

Purpose of the Study

At three years of age children are expected to build towers of 10 one-inch cubes, place 10 pellets in a bottle in 25 seconds or less, hold crayons with their fingers, and try to cut with scissors. The children's adaptive skills should include the ability to copy a vertical stroke, a horizontal stroke, and a circle as well as the ability to imitate a cross (Knobloch, Stevens, & Malone, 1980). These particular patterns are part of a continuum of visual-motor and adaptive skills. The most advanced visual-motor skill at the academic level is writing.

The purpose of this study was to determine whether children weighing under 1501 grams at birth are performing below age level in fine motor skills, a measure of visual-motor abilities, when tested a three years of age. The fine motor skills with cubes, pellets, crayons, and scissors are precursors to some necessary academic skills.

Hypothesis

The research hypothesis is that three-year-old children who function cognitively within one standard deviation of the mean for their age, who have no physical disabilities,

and who have been low birth weight infants of 1500 grams or under, have weaknesses or deficits in the fine motor skills of building towers of 10 one-inch cubes, placing 10 pellets in a bottle in 25 seconds, holding crayons with their fingers, and trying to cut with scissors as measured by the Revised Gesell Developmental Schedules.

The null hypothesis to be tested is stated as follows: Three-year-old children who function cognitively within one standard deviation of the mean for their age, who have no physical disabilities, and who have been low birth weight infants of 1500 grams or under, will not have weaknesses or deficits in the fine motor skills of building towers of 10 one-inch cubes, placing 10 pellets in a bottle in 25 seconds, holding crayons with their fingers, and trying to cut with scissors, as measured by the Revised Gesell Developmental Schedules.

Variables

Delimitations:

1. The child will have been followed longitudinally at the Meyer Center because of premature birth.
2. The child will have been returned for assessment at or near the time of his or her third birthday.
3. The child will have received a medical and neurological examination by a physician. In addition he or she will have been assessed by the following professionals:

psychologist, occupational therapist, physical therapist, and speech and language clinician.

4. The child must have a recorded birth weight of 1500 grams or under.
5. The child's cognitive abilities will fall within one standard deviation of the mean for his or her age.
6. There will be no evidence of physical disability.

Limitations:

1. A child that has been followed longitudinally because of premature birth may not return for assessment at three years of age by parental choice or other circumstances.
2. The child may have had the advantages of nursery school experience.
3. The child may not have had the advantages of nursery school experience.
4. The child may, because of personality traits, be able to relate well to the examiner.
5. The child may, because of personality characteristics, be unable to relate to the examiner.
6. The child may live in deprived or lower socio-economic circumstances.
7. The child may live in middle or upper socio-economic circumstances.

CHAPTER II

REVIEW OF LITERATURE

The Development of Skills in the Normal Preschool Child

The skills which children need for coping with school tasks are developed in a continuum during preschool years. In order to fully understand the importance of the delayed or missing skills it is imperative to have an understanding of the process in acquisition of skills. A thorough knowledge of normal development and its variations is necessary in order to recognize abnormal behavior. It is assumed that physical, neurological, and mental development fall somewhere within the average range when describing a normal or typical preschool child.

Behaviors

Children's behavior is the best indication of their level of functioning. Behavior is rooted in the brain and in the sensory and motor systems. "A behavior pattern is simply a defined response of the neuromotor system to a specific situation" (Knobloch & Pasamanick, 1974, p.3). Because children develop in an orderly fashion, their behavior is an indication of their level of maturity. The quality and the integration of five areas of behavior must be observed because of the complexity of the human organism.

They are adaptive, gross motor, fine motor, language, and personal-social behaviors (Knobloch & Pasamanick, 1974, pp.4-5). These are defined below.

Adaptive behavior. This is felt to be the most important because it "is concerned with the organization of stimuli, the perception of relationships, the dissection of wholes into their component parts, and the reintegration of these parts, in a meaningful fashion" (p.4). The children are expected to show their resourcefulness and problem solving abilities in their adjustment to objects and situations, as well as their coordination of eyes and hands in reaching and manipulating.

Fine motor behavior. This "consists of the use of hands and fingers in a prehensory approach to, grasping, and manipulation of an object" (p.5). Adaptive and fine motor skills are so closely related that the estimate of children's overall maturity is dependent in part on their motor abilities.

Gross motor behavior. This describes "postural reactions, head balance, sitting, standing, creeping and walking" (p.5).

Language behavior. This "includes all visible and audible forms of communication whether by facial expressions, gestures, postural movements, vocalizations, words, phrases or sentences" (p.5). It also includes

mimicry and comprehension of language. The quality of articulation is also dependent in part on maturity.

Personal-social behavior. This is described as "the child's personal reaction to the social culture in which he lives" (p.5). The personal-social behavior patterns are dependent on growth as well as maturity level. It includes abilities in feeding, play, cooperativeness, and responsiveness to training.

Adaptive and Fine Motor Skills

Because the focus of this paper is on the delays in the fine motor skills observed in children with histories of prematurity, detailed discussion of development will be confined to those behaviors.

Vision plays an important part in the development of an infant beginning at four weeks with regard of an object in the line of vision only. At eight weeks infants retain a toy in their hands briefly, a motor task. At twelve weeks the visual and motor channels have begun to integrate when the infants glance at toys in their hands. Gesell (Knobloch & Pasamanick, 1974) stated that at sixteen weeks the two traits, visual regard and active grasp, have become inseparably combined. Infants also look from toys to their hands signifying an awareness of the separateness.

Infants continue to perfect the eye, hand, and toy relationships. At twenty-eight weeks infants make a

transition from the bilateral approach to objects to a unilateral approach, the basis of "handedness". At the same time they are beginning to free their fingers for the more adept handling of small objects. By forty-eight weeks the infant has developed a neat pincer grasp of the pellet, a refined grasp. The adult grasp is no more refined (Knobloch & Pasamanick, 1974).

Infants combine the interest in very small objects and multiple objects at thirty-six weeks of age. They try to hold the bottle and do grasp the pellet, an attempt at problem solving. When they have achieved enough control to put the pellet in the bottle at thirteen months, they have gained enough control to build a tower of two cubes (Knobloch, Stevens, & Malone, 1980). It is at this point that changes in the quality of adaptive and fine motor behavior can be measured.

An infant's prehension leads eventually to the use of tools in childhood. Voluntary release is one of the more difficult prehension skills to master. The extensor muscles of the hand are inhibited in grasping. The flexors are inhibited in releasing. In early childhood it is more difficult to inhibit the flexors. The child may have difficulty with precise placement of small objects throughout the first four years. By age three the child is able to build a tower of ten cubes (Knobloch, et al., 1980)

by releasing a block with slight extension of the metacarpo-phalangeal joint without disturbing the other blocks. Improvement in speed and dexterity in this synergical action should be evident at five years. This same skill enables children to handle tools and other activities more adeptly.

As children develop prehensory skills they begin to imitate markings with a crayon. For this they need the ability to make a movement spontaneously. The examiner's motion must suggest a movement to them. Finally they must be "set" to imitate. They should be able to imitate a vertical line at two years, a horizontal line and a circle at two and a half and a cross at three years (Gesell, Halverson, Thompson, Ilg, Castner, Ames, & Amatruda, 1940). The cross is most difficult because it requires directional discrimination and the ability to coordinate two movements.

Copying is another step in the continuum. To copy a form the child must perceive a it and recognize it in terms of past experience. The child must be "set" to draw and possess the eye-hand control to draw in the proper direction while not being distracted by the change in pattern. At three years of age children should be able to copy a vertical line, a horizontal line, and a circle (Knobloch, et al., 1980).

A reference was made, earlier, to the acquisition of

the unilateral approach to toys as a basis of handedness. Some children will show a dominance at times during the latter part of the first year. Most often, however, the dominance fluctuates from one side to the other. A stronger preference becomes noticeable in some children toward the end of the second year. Dominance of a skilled hand may be one of the products of the maturational process. As previously discussed, eye-hand coordination does improve with age and maturity and normally leads to a gradual development of eye-hand dominance (Gesell, et al., 1940).

The observation of dominance might be helpful because there is found to be a high incidence of confusion and delay in establishing dominance in children with learning disabilities (McCarthy, 1972).

The Development of Skills in the Preschool Child With a History of Prematurity

Because of the multiple problems the preterm infant may encounter during the neonatal period, some discussion of the time spent in the neonatal intensive care unit is appropriate. The very low birth weight infant weighing 1500 grams or under is the one of concern here.

The very sick baby

Since the early 1960's techniques have been developed to treat the very sick neonates within the neonatal intensive care units. Some of the factors which must be

treated include: birth asphyxia, hypoxemia, respiratory and metabolic acidosis, hypotension, hypothermia, hyperbilirubinemia, starvation, dehydration, hypoglycemia, hypocalcemia, hemostatic abnormalities, and infection (Thompson & Reynolds, 1977).

The neonatologist has developed a better understanding of the pathophysiology of the disease processes which has permitted intervenion to manage or prevent abnormalities.

> Such intervention includes provision of a neutral thermal environment; monitoring of blood pressure, central venous pressure, heart rate and respiratory rate; provision of calories and fluids by intravascular infusions, gastric or transpyloric feedings and/or when indicated, by total parenteral nutrition; determination of serum electrolyte, glucose, calcium, and bilirubin levels with management of abnormalities; frequent or continuous monitoring of arterial blood gases to determine the need for elevated inspired oxygen concentrations and/or assisted ventilation with continuous distending pressure or with mechanical ventilation with positive end-expiratory pressure; frequent measurement of fractional inspired oxygen concentrations; detection of hematologic and hemostatic abnormalities; and early detection and management of infections and other intercurrent disorders (Thompson & Reynolds, 1977, p.55).

Outcomes of Infants of Premature Birth

The outlook for the very low weight infant has been improving steadily over the last few years. Fitzhardinge (1976) followed a group of 232 very low birth weight survivors at the Hospital for Sick Children in Toronto for a minimum of two years. They were born between 1970 and 1972 weighing under 1501 grams. Seventy-one percent appeared to

be grossly normal by two years. Twenty-nine percent were classified as abnormal because of major neurological defects or because of their low score on a developmental test. Fitzhardinge goes on to conclude that specific learning disabilities and speech disorders will probably become evident among the apparently normal survivors. Because of this likelihood the families of prematures need continued support to facilitate early detection and intervention when indicated.

Dargassies (1977) feels that reports of studies vary considerably depending on the methods employed, the selection of cases, and the duration of follow up. This leads to different results regarding some important points. First, what is the quality of life? Are they strictly normal? Second, what are the percentages of those with only minor deficiencies which cause some delays in development and those with serious handicaps? Third, what is the nature of the major impairment? Is it related specifically to prematurity? In this study Dargassies initiated a long term follow up of survivors. A handicap was made definitive only after an extensive follow up. The quality of a child's life can be determined only after long term follow-up. On analysis of the data she found that the very premature infant had a risk of one in three of having a neurological handicap. Delays in abilities at the preschool level and

abstract reasoning at seven years are weaknesses which are observed later and may be considered minor handicaps. They can however affect the quality of life.

In a study of infants with birth weights below 1001 grams followed for a period of two years Pape, Buncie, Ashby, and Fitzhardinge (1978) found significant handicaps in 30 percent of the survivors. By 18 months of age severe neurological deficits had been identifies in 9 percent and significant developmental delays in 21 percent. Of the original group of infants 53 percent had died and 33 percent survived without handicap.

Major handicaps can generally be recognized by the ages of one to two. There remains however a group of low birth weight infants who show transient signs suggestive of neurological disorder and those who show some minor neurological signs characterized by behavior. History given by mother may describe her infant in one or more of the following ways: (a) irritable with constant crying and feeding problems, (b) jittery or jumpy, (c) easily startled, (d) stiff to handle and disliking the bath, and (e) very good at standing up on toes like a ballet dancer (Drillien, 1972).

When examined these infants were found to have abnormalities of movement and posture, abnormalities of reflexes, and retardation in development. Drillien (1972)

graded the abnormal neurological signs as follows: (a) no abnormal signs, (b) minor dystonia, (c) moderate dystonia, and (d) severe dystonia.

In Drillien's study the abnormal signs disappeared at 8 to 12 months of age in 60 percent of the infants showing moderate to severe dystonia. Another 20 percent with moderate to severe dystonia were neurologically normal at one year of age but had a return of abnormal signs later. Some of these were diagnosed as mild diplegia or ataxic. Others changed from hypertonic to hypotonic. Most showed abnormal righting reactions. The remaining 20 percent were diagnosed as having cerebral palsy.

One-third of the children who exhibited abnormal neurological signs in the first year of life were hyperactive whereas only 7 percent of the children considered neurologically normal showed hyperactive behavior. At two to three years of age restlessness and poor concentration interfered with testing. It is suggested that transient dystonia in the first year of life may be indicative of minimal brain damage and possible defects in language development, perceptual and fine motor skills, and behavior problems.

All the surviving children from this study who weighed 1500 grams or less at birth were then included in a controlled study at six and a half to seven years.

Drillien, Thomson, & Burgoyne (1980) concluded that problems in school were related to social grade, evidence of early intrauterine insult, sex, postnatal complications, and neurological and developmental status during the first year of life.

Desmond, Wilson, Alt, and Fisher (1980) have listed the vulnerabilities of the very low birth weight infants. Most of these vulnerabilities will persist throughout the preschool years. Among them are recurring infections, neurodevelopmental disorders, behavior disorders, visual and hearing deficits, speech and language delays and disorders, and academic problems. They state however that the outcome for the majority of infants weighing under 1501 grams appears to be good despite their vulnerabilities.

In the literature being reviewed the surviving very low birth weight preterm infants are generally being classified as either handicapped or normal. There appear to be indications that those who have been classified as normal may have some subtle problems that reveal themselves at school age.

At School Age

The marginally ready child has been identified by Jansky (1975) as a subgroup of five-year-olds who are in a gray area. She describes them as bright children with immaturities in all or several of the following areas: (a)

appear to lag neurophysiologically, cognitively, and emotionally, (b) unable to manage verbal patterns set out in space, (c) memory for verbal sequences and phonetic discrimination is inadequate, (d) marginally behind in comprehension of spoken language, (e) present subtle expressive language problems, (f) scores on standardized reading comprehension tests may range from the 30th to 99th percentile, and (g) nearly all of them have trouble with some aspect of written language. One area of immaturity would probably not present problems. However difficulties in more than one can cause interference with school learning. Jansky makes a comparison with a group of middle schoolers who are about to fail in some of their school subjects. These children had learned to read, but not easily, and did not enjoy it despite good intelligence.

Marginally ready children are described as often messy when eating. They see table activities as work and would rather play. They may find it hard to separate from mother. They cannot keep track of their possession and they are unable to work by themselves. Pencil control may be difficult and drawings may show troubles with spatial orientation. Jansky feels that if help is offered early the child will not suffer frustrations and possibly failure. The marginally ready child may respond quickly to remediation. He needs help before meeting the demands of

first grade. There he will be expected to sit for long periods, fit into schedules, respond to the needs of others, and begin to master complex tasks like reading, writing, spelling, and arithmetic.

Fitzhardinge and Stevens (1972) found in a follow-up study of small-for-date infants that when they reached school age there was a high incidence of failure despite average intelligence. The author recommends that these potential problems be identified before the child begins to experience failure and that physicians, parents, and preschool teachers be made aware of the possibilities of problems. Testing at the preschool level should provide clues to possible future difficulties.

Lubchenko (1963) found in his study of the sequelae of premature birth at ten years after birth there was, among other problems, a high incidence of school failures among children with normal intelligence quotients. Shirley (1938) concluded that premature babies are more retarded in manipulative development than in intellectual grasp and social development.

In a study of cerebral lateral dominance in school age children of premature and full term birth Eames (1957) found that variations other than right handedness occur more frequently among prematures. This could be a minor neurological finding indicative of some types of learning

disabilities particularly in the visual-motor area.

Using a large battery of tests at the end of kindergarten DeHirsch, Jansky, and Langford (1966) found that prematurely born children did less well than maturely born children. On further testing at the end of the first and second grade they found that prematures did progress but the lag persisted. Identification of the lag was based on the general approach to the work as well as on the test scores. Central nervous system functioning was more primitive and behavior controls less firmly established. In addition the level of neurological integration appeared lower with subtle problems in motor, perceptual, visual-motor, and linguistic patterning.

In comparing verbal and performance IQs in the very low birth weight infants Francis-Williams and Davis (1974) found that one-fifth of their sample had performance IQs significantly below verbal IQs with consequent learning difficulties in school. They feel that early recognition of learning difficulties, which appear to be due to disorderly mental development, would do much to give children the time they need to develop a normal capacity for learning.

In following low birth weight children intensively during the first three years of life and then further examining them at school age Drillien et al., (1980) suggested that transient abnormal neurological signs in the

first year of life are predictive of school difficulties. He felt that waiting for school age before coming to any conclusion about minor disabilities and their affect is unacceptable.

Learning takes place through all the sense modalities: sight, auditory, tactual, kinesthetic, and olfactory. Should any one of these modalities become inefficient learning becomes more difficult. It has been estimated that 85 percent of all information coming into the body enters through the visual system (Behrmann 1970). Vision is enhanced by the other sensory modalities, particularly the proprioceptive and motor senses. Inefficiencies of the visual-motor system will then affect learning.

Poor eye-hand or visual-motor coordination is one of the many causes of classroom failure. "It is an integral part of the total schema of human growth and development; it is affected by previous experiences and in turn affects experiences and achievements in the future" (Linn, 1969, p.27). When visual-motor coordination is viewed in this way it is possible to see that a developmental lag in this one area can readily affect other areas of learning.

Some preschoolers with disorders of written language do not know how to hold a pencil. They know what they should do but when they try to manipulate their fingers they cannot imitate what they see. Some children keep trying but others

quit because of their failures. Some hold the pencil awkwardly, too tightly, or too loosely. These children need help in learning how to hold a pencil correctly. "The fine discrimination, integration, memory, and coordination of hand, mind, and eye required for the act of writing is infinitely complex" (Johnson & Myklebust, 1967).

The literature reviewed has shown that longitudinal studies of the very low birth weight infants indicate that many of them have developed some problems in academic performance when they reach school age. Among the difficulties are those of marginal readiness or of school failure due to learning disabilities with subtle problems in motor, visual-motor, visual perception, memory, and language performance. Among the factors which might directly affect writing skills are poor motor skills, lack of a skilled dominant hand, poor visual attention to a task, weak visual memory, short attention span, and behavior problems. If a particular population of infants is found to be marginally ready or at risk for a learning disability an evaluation of their performance during preschool years might reveal weaknesses indicative of delays.

The Developmental Assessment

Infants of very low birth weight are being seen at the Leopold L. Meyer Center for Developmental Pediatrics on a longitudinal study. At three years of age they return for

an updated medical history and physical. They are evaluated also by the following professionals: psychologist, occupational therapist, physical therapist, and speech and language clinician. The children selected for this study will include those classified as "normal" who have average intellectual abilities.

Selection of Population

The premature infant is referred for follow up prior to discharge from the nursery. He will then be seen on subsequent visits at nine months, eighteen months, three years, and finally at six years of age. At the nine month visit a complete history is compiled and a physical examination given. Interval history and physical examinations are made at each of the other visits. The Gesell Developmental Schedules will be used at nine months, eighteen months, and three years to determine maturity level. In addition psychological and speech and language testing will be done at the eighteen month and three year visits. The information gathered from the history and the assessments of these visits will be the basis for labelling a child "non-handicapped." The non-handicapped or normal child is one who has come through the stresses of preterm birth without signs of handicap. Some infants may have had transient neurological signs which have disappeared by approximatedly one year of age.

The McCarthy Scale of Children's Ability (MSCA) will be used by the psychologists to determine a general cognitive index. McCarthy (1972) became convinced during her many years of working in preschool settings that a psychometric instrument appropriate to that age group was needed and should be developed. The result is the MSCA. The selection of items was based on her extensive teaching and clinical experience. She chose items which are enjoyable and non-threatening. Eighteen separate tests have been grouped into six scales: verbal, perceptual performance, quantitative, general cognitive, memory, and motor. The results of the test is a general cognitive index which shows a child's cognitive level in relation to other children of his or her chronological age. The general cognitive index has a mean set at 100 with standard deviations of 16. Children with an index falling within one standard deviation of the mean for age are considered to have cognitive functioning within normal limits.

Selection of an Assessment Tool

Many of these selected children have previously been screened with the Denver Developmental Screening Test (Frankenburg, Dodds, Fandal, Kazuk, & Cohrs, 1975). This test has been standardized on a cross section of the population so it would be appropriate in the local geographical area. It was designed to monitor, among

others, children who are at high risk because of perinatal difficulties. It is however a screening test meant to alert a professional to a possible problem. The results would indicate the need for more comprehensive evaluation.

The Gesell Developmental Schedules has been selected as the evaluation tool because of its value in assessing the mental, motor, and neurological development. Gesell (1940) looked on the developmental assessment as a method of determining the individual ways in which a preschool child matures. The relationship of several specific maturing abilities are to be observed. The examination is not a series of tests but a series of situations in which the child is stimulated to respond. It is important to consider the child's history and present status and to use the caretaker as an ally during the examination. The examiner needs to use certain standardized procedures and yet be skilled at balancing uniformity and variation. Perceptiveness in observing children is gained from the experience of seeing comparable children explore similar situations.

Arnold Gesell had a life long interest in child development and began publishing the results of his work as early as 1925 in The Mental Growth of the Preschool Child. He together with Catherine Amatruda developed the clinical tools which have been used to assess infants and childen in

the clinical setting. These tests have been used successfully to predict future development and as a guide for intervention. After the deaths of Gesell and Amatruda, Knobloch and Pasamanick provided long term testing reliability and validity by examining thousands of infants and children in different settings. They revised Gesell and Amatruda's basic text Developmental Diagnosis.

The Gesell Developmental Schedules have been recently revised (Knobloch, et al., 1980). The changes in the revised schedules are the outcome of the examination of 1000 infants and children of 20 different ages ranging from four weeks to 36 months. There have as a result been shifts that range from 5 percent in fine motor to 16 and 17 percent in personal social and gross motor behaviors. The changes are felt to be the result of improvement in health and economic status that dates back to post World War II. The developmental assessment was designed "to establish normalcy, to reveal even minor deviations in relatively healthy children, and to define maturity and integration of the central nervous system" (Knobloch, 1980, p.2).

In an effort to establish normalcy or to reveal weaknesses in visual-motor skills that may have a bearing on future performance in school, four fine motor skills have been selected for their possible predictive value. These items are as follows: (a) building a tower of 10 one inch

cube, (b) placing 10 pellets in a bottle in 25 seconds, (c) holding a crayon by the fingers when drawing, and (d) trying to cut with scissors. The continuum in developing these particular skills has been described. In order to be competent at paper and pencil skills a child needs the base of skills at three years of age on which to add the refinements necessary to meet the demands of written language.

The preschool child with a history of prematurity has been identified in the literature as being at risk for a variety of learning problems. The items selected from the Gesell Developmental Schedules appear to be an appropriate measure of functioning in a very important area of learning, namely, the visual-motor area. Should a weakness be defined treatment or remediation in that area could alleviate a problem and improve the child's quality of life.

CHAPTER III

METHODOLOGY

Subjects

The subjects for this study are 30 children who have been followed at the Meyer Center for Developmental Pediatrics of Texas Children's Hospital because of their histories of prematurity. They were the three-year-old children most recently evaluated who met the following criteria: (a) premature delivery, (b) birth weight of 1500 grams or less, (c) cognitive abilities within one standard deviations of mean for age, and (d) no physical disabilities.

Three years of age has been selected as a key age for a return visit of the premature to the Meyer Center. Intelligence is testable at this age. Early childhood education becomes available to the children who qualify. It is at this age that some of the predictors of future learning disabilities may be evident (Desmond, et al., 1980).

Instrument

The Gesell Developmental Schedules have been used routinely for assessment of developmental performance of young children seen at Meyer Center. After the revision of the schedules were published in 1980 the new schedules were

used. The Manual of Developmental Diagnosis provides revised developmental quotients with means and standard deviations by age (Knobloch, et al., 1980). The fine motor items of this instrument have been selected for use in this study.

Procedure

Three-year-old children were expected to accept a chair readily and to remain seated for the examination. The test items are presented in a prescribed order by the occupational therapist.

The fine motor items are offered as follows:

1. The cubes are placed on the table and a tower is requested.
2. The bottle and ten pellets are placed on the table in a position where the child can use the preferred hand comfortably. The child is then asked to put the pellets in the bottle as quickly as possible. The child is scored on the best of three trials.
3. The child is given a crayon and paper for drawing. The child grasps the crayon to scribble.
4. The child is offered scissors and paper and asked to try to cut the paper.

Success in completing the fine motor items is based on the following criteria:

1. A tower of 10 cubes stands without assistance from the examiner.
2. Ten pellets are inserted in the bottle singly in 25 seconds or less.
3. The crayon is held by the fingers in an adult fashion as apposed to using a fist.
4. The blades of the scissors are moved up and down but not necessarily with success in cutting.

The child's success or lack of success on each item is recorded on the Gesell schedules. A plus (+) sign is entered if the skill is present. A minus (-) sign is entered if the skill is not present. If a skill is seen as emerging, a plus-minus sign may be used. If the child cannot complete the 36-month item, his or her developmental level is determined by the number of cubes towered, the seconds needed to insert 10 pellets into the bottle, and the ability to turn single or more pages of a book.

A fine motor maturity level was established for each of 30 premature children as his or her evaluation was completed. The maturity level was then used to determine a fine motor developmental quotient (DQ) for each child.

$$DQ = \frac{\text{maturity age}}{\text{chronological age}} \times 100$$

The sum of the fine motor DQ's of the 30 prematures was used to find a mean DQ for the group. The standard deviation (SD) score was calculated using the raw scores. Refer to Table 1 for mean and SD scores.

CHAPTER IV

FINDINGS

Analytic Techniques

In order to analyze the performance of the experimental group a comparison was made to a control group of three-year-olds. The control group consisted of 47 three-year-old children used in the standardization of the Revised Gesell Developmental Schedules. The criteria used for inclusion in this group was as follows: (a) delivery at term, (b) birth weight of 2500 grams or more, (c) single birth, (d) no developmental delay, and (e) no abnormality.

Table 1

Comparison of Performance Scores of Experimental and Control Groups on the Revised Gesell Developmental Schedules

	n	M	SD	t
Experimental Group (Premature birth)	30	84	10.7	3.319*
Control Group (Full-term birth)	47	92	10.0	

* $p < .01$.

The data obtained in this study was compared with the data from the control group. An analysis was performed using the t test comparing the means and SD scores. The

results showed that the experimental group scored significantly lower than the control group.

Results

The prematurely born children performed less well than the control group of normal children when tested at three years of age, supporting the hypothesis that the low birth weight premature children will have weaknesses or deficits in the fine motor skills of towering 10 one inch cubes, placing 10 pellets in a bottle in 25 seconds, holding crayons with the fingers, and trying to cut with scissors.

From clinical observations during the evaluations the occupational therapist recorded hand preferences among the 30 premature children. If children preferred one hand consistently for the crayon, cubes, pellets, and scissors their dominance was recorded. A preference for one hand was shown when they used one hand consistently for the crayon but alternated hands on the other tasks. Some children alternated hands freely on all tasks including writing with crayons. Normal children may or may not have established dominant hands by three years of age. As many as 30 percent of children without neuromotor impairment may show mixed dominance at three years of age (Knobloch & Pasamanick, 1974). Of interest in this group were the proportions among left, right, and mixed preferences. Seven children clearly had no preferences. Seven had preferences for the left hand

and sixteen for the right. The group of children with left hand preference may be disproportionately large.

CHAPTER V

SUMMARY AND DISCUSSION

Summary

Children with a history of premature birth are followed at the Meyer Center for Developmental Pediatrics. Delays in visual-motor skills have been apparent in the children when tested at three years of age by occupational therapy. This study investigated fine motor skills as a measure of visual-motor abilities. The fine motor performances of three-year-old children with histories of prematurity was compared to the performances of normal three-year-old children born at term. A t test was used to compare performance scores of the experimental group on the fine motor items from the Revised Gesell Developmental Schedules with the performance scores of a control group of three-year-olds. The experimental group was found to score significantly lower than the control group, supporting the hypothesis that prematurely born three-year-old children will have delays in fine motor skills.

Discussion

Lack of skilled hands can hamper a child throughout life. Children may, early in their lives, learn to push aside the activities which they find difficult. Avoidance of these tasks can affect the development of skills

including the use of tools. At school age they become frustrated with handwriting efforts. Their self esteem may suffer due to lack of success. These same children may meet failure when greater demands are made on them.

Occupational therapists are trained to facilitate improvement in hand skills in children through the use of pleasurable activities. Public school programs have provided occupational therapy for children with deficits or abnormalities. The schools do not, however, have funds to serve children who are experiencing immaturities or relatively minor delays in acquiring skills even though lack of intervention may contribute to problems later.

Delays in hand skills have been noted in some of the premature infants when seen at Meyer Center at nine months of age (corrected for prematurity). In an effort to prevent the kind of delays identified in this study, occupational therapists have begun intervention with the infants at this early age through the use of home programs. Because they are very much aware of the infants efforts at manipulating objects at this age, caretakers are receptive to guidance by the therapists. Suggestions are explained, demonstrated, and described in writing for the caretaker of the infants. The program is planned for incorporation into everyday handling and play. Hohlstein (1982) has recommended that a developmental sequence in phases of grasping objects be

observed as a basis for intervention with infants. This strategy has been helpful in relating to caretakers the importance of home programs.

Parents, teachers, physicians, and other professionals who see children with a history of prematurity should be alert to their "at risk" status for visual-motor delays. These children need to have opportunities and encouragement in participating in enjoyable activities in which they can use their manipulatory abilities. They need to be directed to the appropriate level of activities to achieve success.

Recommendations for Future Research

Future research on prematures should focus on writing skills at three years of age. The adaptive skills category of the revised Gesell includes four writing items so may be used as the instrument with particular attention to the writing skills. Another study should compare the performance on the writing items with that of a control group of children with a history of birth at term who fit an established criteria. Other information and observations such as birth weight, handedness, and sex should be recorded during the study of both prematures and controls. Possible correlations of hand skills with sex, birth weight , and hand preference may be found during the investigation. Research on hand dominance is also recommended. It is possible that such a study might provide further information

about the neural functioning, for a better understanding of motor delays and deficits and for implications in therapeutic procedures. A final recommendation is for a study to document the effect of early intervention through home programs.

APPENDIX A

RAW SCORES

OF PREMATURE SUBJECTS

Subjects	Fine motor DQ	Subjects	Fine motor DQ
1	79	6	74
2	73	7	75
3	71	8	94
4	89	9	91
5	81	10	75
Subjects	Fine motor DQ	Subjects	Fine motor DQ
11	78	16	100
12	73	17	92
13	91	18	91
14	89	19	87
15	94	20	92
Subjects	Fine motor DQ	Subjects	Fine motor DQ
21	88	26	102
22	71	27	94
23	87	28	97
24	83	29	87
25	72	30	55

APPENDIX B

TWU Texas Woman's University
1130 M.D. Anderson Blvd., Houston, Texas 77030 (713) 792-7920
SCHOOL OF OCCUPATIONAL THERAPY

PROSPECTUS FOR THESIS

This prospectus proposed by: Shirley Northrop

and entitled:

The Visual-Motor Skills in the Preschool Child with a History of Prematurity

Has been read and approved by the members of (~~his~~/her) Research Committee.

This research:

XXX Is exempt from Human Subjects Review Committee review because the study is of existing data and the subjects cannot be identified directly or through identifiers linked to the subjects.

_____ Requires Human Subjects Review Committee review because

Research Committee:

Chairperson, Donald A Davidson

Dallas Campus _____ Denton Campus _____ Houston Campus XXX

Texas Children's Hospital
P.O. Box 20269, Houston, Texas 77225
Operated jointly with St. Luke's Episcopal Hospital
and Texas Heart Institute in the Texas Medical Center

Meyer Center for Developmental Pediatrics

August 23, 1983

Texas Woman's University
The Graduate School
Denton, Texas 76204

TO WHOM IT MAY CONCERN:

Shirley Northrop has the approval of the Meyer Center for Developmental Pediatrics to retrieve from their files the data for her thesis: The Visual-Motor Skills in the Preschool Child with a History of Prematurity.

Sincerely,

Murdina M. Desmond M.D.

Murdina M. Desmond, M.D.
Director
Meyer Center for Developmental Pediatrics
Texas Children's Hospital

MMD/ek

REFERENCES

Behrmann, P. Activities for developing visual perception. San Rafael, CA: Academic Therapy Publications, 1970.

Dargassies, S. Long-term neurological follow-up study of 286 truly premature infants, I: Neurological sequelae. Developmental Medicine and Child Neurology, 1977, 19, 462-478.

DeHirsch, K., Jansky, J., & Langford, W. Predicting reading failure. New York: Harper and Row, 1966.

Desmond, M., Wilson, G., Alt, E., & Fisher, E. The very low birth weight infant after discharge from intensive care: Anticipatory health care and developmental course. Current Problems in Pediatrics, 1980, 10(6), 1-59.

Drillien, C. Abnormal neurological signs in the first year of life in low birth weight infants: Possible prognostic significance. Developmental Medicine and Child Neurology, 1972, 14, 575-584.

Drillien, C., Thomson, A., & Burgoyne, K. Low birth weight children at early school: A longitudinal study. Developmental Medicine and Child Neurology, 1980, 22, 26-47.

Eames, T. Frequency of cerebral dominance variations among school children of premature and full term birth. Journal of Pediatrics, 1957, 9, 51-53.

Fitzhardinge, P. Follow-up studies on the low birth weight infants. Clinics in Perinatology, 1976, 3, 503-516.

Fitzhardinge, P., & Stevens, E. The small for date infant II neurological and intellectual sequelae. Pediatrics, 1972, 50, 50-57.

Francis-Williams, J., & Davis, P. Very low birth weight and later intelligence. Developmental Medicine and Child Neurology, 1974, 16, 708-728.

Frankenburg, W., Dodds, J., Fandal, A., Kazuk, E., & Cohrs, M. Denver developmental screening test reference manual. Colorado: University of Colorado Medical Center, 1975.

Gesell, A., Halverson, H., Thompson, H., Ilg, F., Castner, B., Ames, L., & Armatruda, C. The first five years of life. New York: Harper & Row, 1940.

Hohlstein, R. The development of prehension in normal infants. The American Journal of Occupational Therapy, 1982, 36, 170-176.

Jansky, J. The marginally ready child. Bulletin of the Orton Society, 1975, 25, 69.

Johnson, D., & Myklebust, H. Learning disabilities, educational principles and practices. New York: Grune & Stratton, 1967.

Knobloch, H., & Pasamanick, B. Gesell and Amatruda's developmental diagnosis (3rd ed.). New York: Harper & Row, 1974.

Knobloch, H., Stevens, F., & Malone, A. Manual of developmental diagnosis. Hagerstown: Harper & Row, 1980.

Linn, S. Hand-eye coordination. In J. Arena (Ed.), Teaching through sensory-motor experiences. San Rafael: Academic Therapy Publications, 1969.

Lubchenco, L. Sequelae of premature birth. American Journal of Diseases of Children, 1963, 106, 101-115.

McCarthy, D. Manual for the McCarthy scales of children's abilities. New York: The Psychological Corporation, 1972.

Pape, K., Buncie, R., Ashby, S., & Fitzhardinge, P. The status at two years of low-birth-weight infants born in 1974 with birth weights less than 1,001 grams. The Journal of Pediatrics, 1978, 92, 253-260.

Shirley, M. Development of immature babies during their first two years. Child Development, 1938, 9, 347.

Thompson, T., & Reynolds, J. The result of intensive care therapy for neonates: I overall neonatal mortality rates, II neonatal rates and long term prognoses for low birth weight neonates. Journal of Perinatal Medicine, 1977, 5, 57-59.