THE EFFECTIVENESS OF A SENSORY-MOTOR PROGRAM WITH ACADEMICALLY HANDICAPPED AND NORMAL FIRST GRADE CHILDREN

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CHAPTER I

INTRODUCTION

In the late 1960s Snapp began a program of developmental education which is now known as Chronologically Controlled Developmental Education (CCDE). The program includes developmental exercises, crawling in specified patterns, and deep pressure tactile stimulation from which the sensory-motor activities were drawn for the experimental groups in this study. Although now used in several Texas communities, the efficacy of the CCDE Program has not yet been investigated through rigorous, scientifically designed, and controlled experimental research.

The CCDE Program, which is intended to facilitate human development, has a neurophysiological basis. It consists of a unique combination of methodology drawn from physical and occupational therapy placed in an educational setting. CCDE is consistent with the principles of normal development including the principles of continuity, uniform sequence, and neurological maturation (Illingworth, 1980; Knoblock & Pasamanick, 1974; Mussen, 1970). Snapp, cited by White (1980), posits that the chronology of human development, beginning with conception, follows a precise pattern because the sequence is genetically coded. Snapp, cited by Heiniger and Randolph (1981), states that primitive patterns must develop before higher nervous system functions emerge. Snapp believes that gaps in the developmental sequence result in problems which may impair motoric functioning. He theorizes that the use of environmental controls with specific developmental, sensory-motor activities helps to close developmental gaps, enhance the sensory systems, and improve motor performance.

The methodology utilized in the CCDE Program is similar to aspects of the sensory-motor treatment approaches of such clinicians as Ayres (1972); Bobath and Bobath (1967); Brunnstrom (1970); Fay (1954); Kabat (1965); Knott and Voss (1968); Phelps (1941); and Rood, cited by Stockmeyer (1967). CCDE has its origin in embryonic and fetal development similar to the program of the Domans and Delacato, which is described in the writings of Delacato (1959, 1963, 1966), Doman et al. (1960, 1963), and LeWinn (1969).

Snapp is a licensed physical therapist with extensive clinical background. He has designed a system of therapy which is similar to others, yet is unique. Quotations from Snapp, LeWinn, and Ayres can be analyzed for their similarities. Snapp (1979) stated:

> The human being develops in a chronological scheme. . . . This scheme is a "Timeline Formula" which dictates the sequence of development of all human functions from conception until death. This sequence is genetically coded so that development, especially of the fetus, follows a precise, functional pattern on the preconscious level. Gaps in this developmental sequence during the first trimester of pregnancy may cause errors in cell development of the fetus and result in physical deformity to the various systems or tissues. Toward the end of the first trimester, the first physical activity of the fetus is observable. From this time on, gaps in the genetic developmental sequence usually result in problems in motor coordination and perception. (p. 3)

LeWinn (1969) stated similarly:

> The potentialities of the organism are established at conception through the transmission of the genetic code in the parental germ cells. . . . If the genetic code is transmitted with some defect, as in the numerous inherited diseases, malformations, and disorders which occur in man, the potential of the organism is impaired. Adverse environmental factors may impede or distort the process of neurological organization. This may occur in individuals with good genetic potential or it may further impair neurological organization in those in whom the transmission of the genetic code is abnormal. Whether the genetic code is transmitted with or without defect, in the end, environment becomes the factor which determines the manner and extent to which potential of any type or degree evolves into capability. (p. 57)

Ayres (1972) stated in a section with the subheading "Basic Premises" the following:

> The early developmental steps, determined by evolutionary history, have been "pre-programmed" into the human brain at conception, but ontogenetic experience is necessary for full expression of the inherent developmental tendencies. It is generally

> held that each developmental step is in some way dependent upon a certain degree of maturation of previous steps. . . . (p. 4)

The basic assumptions about genetic coding and the importance of environment both before and after birth made by Snapp, LeWinn, and Ayres are strongly supported in reviews of existing neurological research. Similarly, comparisons of several of the techniques recommended by Snapp with other systems of therapy show many commonalities.

Several noted clinicians have utilized developmental exercises, crawling patterns, and tactile stimulation to remediate sensory-motor deficits. Fay (1954) recognized that motor patterns of man's evolutionary past still reside below the cerebral cortex and that patterning could be employed therapeutically by eliciting the movements through sensory stimuli associated with postural responses. Rood, cited by Huss (1978), proposed a sequence of therapeutic exercises similar to the activities of the maturing infant. Rood (1962) emphasized the use of deep pressure, rubbing, stroking, and vibration to stimulate the proprioceptors. This was followed by exteroceptive light touch and/or rapid brushing. Bobath (1967) asserted that normal sensorimotor patterns could be laid down only on the basis of a normally functioning proprioceptive system. The neurodevelopmental approach involved a series of graded sensory and motor experiences to inhibit abnormal movement. Phelps, Kiputh, and Goff (1956) utilized deep pressure massage for treatment of tactile defensive behavior and postural defects. Facilitation and inhibition of movement were approached also through deep pressure tactile stimulation (Rood, 1954, 1956, 1962). Snapp (1979) emphasized the importance of deep pressure to specific areas on the hands, arms, feet, legs, and back. His rationale for this was that tactile perception develops early in the prenatal period (Preyer, 1937).

The developmental exercises, crawling, and deep pressure tactile stimulation portions of the CCDE Program are explicit and easily incorporated into the classroom or gymnasium setting. It is believed that to be effective, the exercises must be done correctly, in the prescribed sequence, and with the proper environmental controls. Snapp (1979) hypothesized that concomitant physiological benefits that may be achieved from participation in the program include improved arm and shoulder strength, leg, and abdominal strength, reaction and movement time, visual-motor control, and neuromuscular coordination. Generally, the objectives of the CCDE Sensory-Motor Program are to close developmental gaps, enhance the sensory systems, and improve motor performance of the individual with emphasis on quality of movement (White, 1980).

In Piagetian language, the purpose of many motoric therapeutic programs is to prepare the sensorimotor child for preoperational thinking. Piaget and Inhelder (1969) asserted that the young child not only learns best through movement, but that movement abilities have an impact on the intellectual development of the child as he moves through a developmental sequence which is marked by specific cognitive abilities. Rarick (1980) indicated that the acquisition of skill is in every sense an active process requiring mental concentration. Attention must be focused on the requirements of the task until the details of the skill have become fully automated. He expressed that cognitive processes of a complex nature are operating in skill learning, but exactly how they function in the development of specific skills is not yet fully understood.

Ayres (1975) affirmed that the normal development of sensorimotor functions in early life lays the foundation for the acquisition of cognitive processes essential for later academic success. Her theory, while applicable to normal children, is primarily oriented to learning disabled children. Youngsters with learning disabilities frequently have problems in motor coordination which, according to Ayres, are the result of faulty processing and coordination of sensory information.

Sherrill (1981) stated that "no two children with learning disabilities exhibit the same constellation of strengths and weaknesses" (p. 415). Nevertheless, they do appear to display certain behaviors more often than do the normal population. Included among these are hyperkinetic behavior, distractibility, dissociation, perseveration, social imperception, immature body image, poor spatial orientation, and nonspecific awkwardness or clumsiness. As a group, learning disabled children score lower on tests measuring motor performance and physical fitness (Bruininks & Bruininks, 1977). Furthermore, Cruickshank (1967) reported that there may be a discrepancy as great as 4 years between the motor skills level and the chronological age of learning disabled children.

Physical education programs, if conscientiously constructed and implemented, may be of consequence in the amelioration of sensory-motor deficiencies (Crowe et al., 1981). It has been proposed that sensory-motor programs may contribute additionally to increased perceptual abilities, motor skills, self-confidence, attention, and better student-teacher relations, all of which may ultimately affect academic achievement (Zaichkowsky et al., 1980).

The present research study is based on the premise that the developmental exercises, crawling patterns, and deep pressure tactile stimulation of the CCDE Sensory-Motor Program created by Snapp have several denominators which are common to other recognized therapeutic exercise systems. The similarities of these programs offer face validity to the techniques that were used in this experimental research. The purpose of this investigation was not only to indicate the validity or worth of sensory-motor methodology, but to begin to amass scientific evidence concerning the value of these portions of the CCDE Program.

Statement of the Problem

The problem of this study was to determine if participation in the Chronologically Controlled Developmental Education (CCDE) Sensory-Motor Program would improve the motor performance and sensory integration of academically handicapped and normal first-grade children. The experimental groups participated in a 30-minute, daily sensory-motor program of developmental exercise, crawling patterns, and deep pressure tactile stimulation (Snapp, 1979) over a 15-week period. The control groups participated in a 30-minute, daily regular physical education program during the same time period. The four groups, each comprised of 15 children, were selected randomly from students enrolled at Crockett Elementary School, San Marcos, Texas, during the 1981-1982 academic year. Instructional variables were held constant as much as possible for the experimental and control groups except for the teachers and content (activities in which the children engaged).

Data were collected through the administration of the Southern California Perceptual Motor Test (Ayres, 1968) and the Bruininks-Oseretsky Test Short Form (Bruininks, 1978). Findings were reported with respect to the efficacy of the CCDE Sensory-Motor Program proposed by Snapp (1979) in improving sensory integration and motor performance of academically handicapped and normal first-grade children.

Definitions and Explanation of Terms

For the purpose of clarification, the following definitions and/or explanations of terms have been established for the present study.

Academically Handicapped

This term refers to students whose reading performance was below grade level as determined with a criterion-based measure by an evaluation team including the principal, educational diagnostician, and classroom teacher.

Chronologically Controlled Developmental Education (CCDE) Program

Chronologically Controlled Developmental Education is a comprehensive educational program which is designed to facilitate human development (Snapp, 1979; White, 1980). A sensory-motor portion of the program is utilized in this study for the remediation of sensory-motor dysfunctions.

CCDE Sensory-Motor Program

This refers to the sensory-motor program described by Snapp (1979). It includes a series of sequential, developmental exercises, crawling patterns with the head, abdomen, and limbs in contact with the floor, and deep pressure tactile stimulation to specified areas of the body.

Crawling Patterns

Crawling patterns refer to specific forms of locomotion in the prone position with the head, abdomen, and limbs continuously in contact with a firm, smooth surface while visually tracking an extended upper extremity. In the basic crawl both arms pull simultaneously with one hip, knee, and ankle flexed at a time. Vision follows the extended upper extremity on the side of the flexed lower extremity. The homolateral crawl entails simultaneous ipsilateral involvement of the limbs with the lower extremities pushing from the inner surfaces of the knee and foot. The cross-pattern crawl consists of simultaneous movement of the contralateral limbs.

Deep Pressure Tactile Stimulation

Deep pressure tactile stimulation refers to the 8 to 10 pounds of pressure applied with the thumb, knuckle, or several fingers held closely together pressing downward as a unit on specific areas of the body. This pressure is administered while the subject lies prone and/or in an erect sitting position. Pressure points are located 1 inch laterally from the spine on both sides, palms of hands, soles and inner surfaces of feet, upper and lower arms, and upper leg. Each pressure point is held 5 seconds.

Developmental Exercises

These include a series of exercises which utilize sequential movement patterns of flexion, adduction, inward rotation followed by extension, abduction, and outward rotation performed in a dimly lighted area. The movements for some of the exercises are cued by a loud, auditory stimulus (Snapp, 1979).

Environmental Controls

Environmental controls are specified degrees of illumination, various crawling surfaces, and control of noise in the educational environment (Snapp, 1979).

Learning

This term is defined as follows:

> Learning is the process by which an activity originates or is changed through reacting to an encountered situation, provided that the characteristics of the change in activity cannot be explained on the basis of native response tendencies, maturation or temporary states of the organism. (Hilgard, 1956, p. 3)

Light Touch Tactile Stimulation

Light touch tactile stimulation refers to the reciprocal sensations between the skin surfaces of arms and chest wall and inner surfaces of the legs against each other while in the flexed fetal position. This is included as a part of the sequential developmental exercises.

Maturation

Maturation refers to "any change in the individual with age which depends primarily upon organic growth factors rather than upon prior practice or experience" (McGeoch & Irion, 1952, p. 545).

Motor Development

Motor development refers to the process of acquiring management of the body which involves an increase in skill, neuromuscular control, and complexity of function. The development results from both maturation and learning.

Motor Performance

Motor performance is "an inclusive term represented by a score or objective measure of physical fitness, of locomotor skill, or a sport skill at any given moment in time" (Hanson, 1965, p. 9). In this study motor performance refers to the composite score representing 14 subtests of the Bruininks-Oseretsky Test Short Form (Bruininks, 1978).

Patterning

Patterning refers to a specific set of sequential movements performed with vision occluded in which a single limb is moved in a prescribed manner in order to learn the crawling patterns. The individual may be given limited physical assistance by manual manipulation of each limb through the correct sequential movements to promote awareness of which surfaces are in contact with the floor and the degree of flexion of the joints.

Proprioceptive Sensations

This term is defined as follows:

> Proprioceptive sensations are those having to do with the physical state of the body, including position sensations, tendon and muscle sensations, pressure sensations from the bottom of the feet, and even the sensation of equilibrium, which is generally considered to be a "special" sensation rather than a somatic sensation. (Guyton, 1981, p. 597)

Sensory-Motor Programs

Sensory-motor programs include those organized activities in which both gross and fine motor skills constitute an essential part of the training procedure in an attempt to enhance the development of auditory, visual, tactile, vestibular, and kinesthetic perception.

Sensory Integration

According to Ayres (1979) the term is defined as follows:

> Sensory integration is the organization of sensory input for use. The "use" may be a perception of the body or the world, or an adaptive response, or a learning process, or the development of some neural function. Through sensory integration, the many parts of the nervous system work together so that a person can interact with the environment effectively. . . . (p. 184)

In this study sensory integration refers to scores representing six subtests of the Southern California Perceptual Motor Test (Ayres, 1968).

Hypotheses of the Study

The efficacy of the CCDE Sensory-Motor Program was determined by examining the following research hypotheses:

1. The CCDE Sensory-Motor Program as measured by the Bruininks-Oseretsky Test Short Form (BOT-SF) will enhance the motor performance of academically handicapped and normal first-grade children. This enhancement will be documented by a significant difference between pre- and midtests for the normal children and by a significant difference between pre- and posttests for the academically handicapped children.

2. The CCDE Sensory-Motor Program as measured by each subtest of the Southern California Perceptual Motor Test (SCPMT) will enhance the sensory integration of academically handicapped and normal first-grade children. This enhancement will be documented by a significant difference between pre- and midtests for the normal children and by a significant difference between pre- and posttests for the academically handicapped children.

The following null hypotheses were tested at the .01 level of significance.

1. There is no significant difference between the groups on the pre-, mid-, and posttest scores of the Bruininks-Oseretsky Test Short Form.

2. There is no significant difference between the pre-, mid-, and posttest trials on the Bruininks-Oseretsky Test Short Form.

3. There is no significant interaction between groups and trials on the Bruininks-Oseretsky Test Short Form.

4. There is no significant difference between the groups on the pre-, mid-, and posttest scores of the six subtests comprising the Southern California Perceptual Motor Test.

5. There is no significant difference between the pre-, mid-, and posttest trials on the six subtests comprising the Southern California Perceptual Motor Test.

6. There is no significant interaction between groups and trials on the six subtests comprising the Southern California Perceptual Motor Test.

Delimitations of the Study

The study was subject to the following delimitations:

1. The 30 academically handicapped and 30 normal first-grade children serving in the experimental and control groups at Crockett Elementary School, San Marcos, Texas, during the 1981-1982 academic year.

2. A purposive sampling design (Kerlinger, 1973).

3. A four-group experimental design with subjects randomly assigned by the investigator.

4. The validity, reliability, and objectivity of the Southern California Perceptual Motor Test (Ayres, 1968) and the Bruininks-Oseretsky Test Short Form (Bruininks, 1978).

5. The degree to which the CCDE Sensory-Motor Program was modified in the public school setting thereby violating environmental controls proposed by Snapp (1979).

6. The CCDE Sensory-Motor Program for the experimental groups and the regular physical education program for the control groups conducted for 30 minutes daily over a 15-week period.

7. Attendance of the subjects in the four groups for at least 80% of the sessions.

8. The extent to which all subjects can be restricted from participation in motor activities other than those under investigation in the present study.

In Chapter II the review of literature found relevant to this investigation is presented. The premises upon which Chronologically Controlled Developmental Education is based are interwoven in the theories of Fay, Doman and Delacato, Rood, and Ayres. Similarities of these theories to CCDE are discussed as well as experimental studies encompassing crawling patterns, tactile stimulation, and developmental exercise.

CHAPTER II

SURVEY OF RELATED LITERATURE

An increasing number of educators and laymen in recent years have become interested about the possibilities of overcoming or preventing neurological deficiencies in children which may impair their school performance. Further investigation of academically handicapped and non-disabled students on a wide range of motor skills tasks is needed both for the purpose of increasing understanding of the motor characteristics of academically handicapped students and for the purpose of designing more effective motor training programs. The purpose of this survey of literature was to review programs and studies that relate directly to facilitation of motor performance of delayed and handicapped learners. The review of related literature has been categorized under four topics: (a) Sensorimotor Theory, (b) Experimental Programs Incorporating Crawling Techniques, (c) Therapeutic Programs Utilizing Tactile Stimulation, (d) Undifferentiated Sensory-Motor Programs Including Developmental Exercise, and (e) Summary.

Sensorimotor Theory

The theoretical frameworks of various sensorimotor approaches are based mostly on clinical observation and neurophysiological research. The mechanisms of motor control are only beginning to be discovered by neurophysiologists. Much of present day knowledge is based on information gained from experiments with mice, cats, rabbits, frogs, and monkeys (Granit, 1977).

Results of brain research have been interwoven with findings of behavioral observation. From this knowledge, theoretical frameworks have evolved which form the basis of treatment programs. Unifying the concepts and translating them into therapeutic principles and practices require a scientific approach to structuring and testing hypotheses. Intervention programs must be revised continuously as new facts appear. Perhaps truth, like infinity, is forever approached but not likely achieved.

Over a 20-year period, Snapp developed and refined his own approach for use in a clinical setting for children who have learning problems. Snapp theorized a chronology of human movement beginning with the first trimester after conception. Relying heavily upon the work of Hooker (1952), he titled his program Chronologically

Controlled Developmental Education (CCDE). This program is based on the theory that the chronology of human development is a fixed process. Snapp (1979) stated that "the human being develops in a chronological scheme which dictates the sequence of development of all human functions from conception until death." He hypothesized that gaps in the genetically determined sequence may cause errors in development resulting in problems of perception and motor coordination.

The acquisition of motor skills is one of the numerous functions of the brain. Deviations in motor skill patterns may, therefore, reflect improper neural functioning. This assumption has led to the construction of various theoretical approaches that are designed to ameliorate neurological dysfunction and to accelerate the learning of motor skills.

Snapp's techniques are not entirely new. CCDE has its origin in embryonic and fetal development similar to the programs of Fay (1954) and Doman and Delacato (Doman et al., 1960). His methods are similar also to those used in physical therapy (Rood, 1954), which stress developmental exercise and deep pressure stimulation. Additionally, some aspects of Snapp's program emphasize tactile stimulation which is supported strongly by Ayres (1972) in sensory integration therapy. A common denominator among all these approaches is that they attempt to use sensory input to enhance development at the subcortical levels of the nervous system. In this manner, they believe development at lower levels of the nervous system serves as a foundation for higher brain function.

Through exploration of the neurological and physiological bases for sensation and movement, it was apparent that there is a definite sequence which sensorimotor behavior follows. The individual learns first to understand the quality of sensation: pain, touch, temperature, stretch and tension of muscles, pressure, sound, light, taste, smell, position in space, and direction of movement. These are organized at the thalamic level of neural development (Hausman, 1971). This is followed by a primary cortical level which allows the individual to discriminate between different intensities, durations and locations of sensation. It is believed that the motor cortex controls discrete movements; the premotor cortex, patterned movements; the ideomotor area, the sequence of movements; and the frontal lobes, the planning of how activity is to take place (Guyton, 1981). Although the motor cortex exerts a primary role in specialized, discrete, fine-motor coordination and cognitive functions, it cannot perform effectively without adequate function at the brain stem level (Peiper, 1963). Hence, the cortex does not function independently of the lower parts of the brain nor does one part of the cortex perform without the support of other cortical structures. The resulting dependency allows for an efficiency of function. Coordination represents a synchronous integration of the nervous system and is observable in movement which is precise and rhythmical. Coordinated movement occurs when adequate sensory input stimulates impulses through the nervous system in such a way that the components of motion which are desired are facilitated and all else inhibited (Eccles, 1973).

CCDE consists of a unique combination of concepts in teaching children that is fundamentally different from present educational methods. This approach differs from current theories in that it does not teach specific motor skills (i.e., batting a ball, forward rolls, or pencil and paper activities). Rather, the objective is to bridge the gap in the developmental process through developmental activities to enhance the neurological and sensory systems. Snapp, cited by Tyson (1981), maintains that it is not necessary to know the etiology or cause of the learning disability to specify the dysfunction. What is necessary is to establish the environment for development during that learning period and devise a program to enhance sensory abilities. If the brain develops the capacity to perceive, remember, and motor plan, the ability can thereafter be applied toward mastery of both physical and academic skills, regardless of content. Essentially, the primary goal of the CCDE program is modification of the neurological dysfunction interfering with learning rather than merely attacking the symptoms of that dysfunction. It is inferred that by normalizing these conditions through developmental activities, the underlying neurological disorder can be remediated.

In the past, methods of understanding the perceptual processes have been derived primarily from behavioral observations. Early efforts to intervene in perceptual development were directed through eye-hand manipulative tasks or direct practice of deficient skills. This approach was primarily cognitive in that the child was to achieve success through extrapolation. Intellectually he was to "figure things out," employing visual, auditory, and kinesthetic channels. Ayres (1972) observed that the cognitive approach to treatment of children with learning disabilities was unsatisfactory as a method of skill training. She noted that many children became frustrated in the learning process and of those who were successful, many had difficulty generalizing from one situation to another. It became apparent that a child's repeated failure may result from lack of maturity of previous developmental steps. In fact, these developmental gaps may interfere with further maturation. Snapp (1979) purported that most motor problems are not created by damage to the primitive nervous system which includes the spinal cord and brain stem. According to Ayres (1972) the brain stem is a primary integration area of total body sensorimotor function.

The concept of sequential development holds a central position in Snapp's theory. Ayres (1972) contended that "the early developmental steps, determined by evolutionary history, have been 'pre-programmed' into the human brain at conception, but ontogenetic experience is necessary for the full expression of the inherent developmental tendencies" (p. 4). Likewise, each developmental step is in some way dependent upon a certain degree of maturation of the previous step.

Piaget (1952), one of the best-known child development specialists, has noted that each developmental stage assimilates part of the previous one. Piaget and Inhelder (1969) stated that the young child not only learns best through movement, but that movement abilities have an impact on his intellectual development. Piaget (1952) stressed the importance of the early sensorimotor period. This stage, involving primarily motor skills, makes possible meaningful experiences which form the basis of sensorimotor intelligence. The sensorimotor period is critical to the early origins of intelligence and forms a building block for a more complex repertoire of skills.

Ames and Ilg (1964) emphasized also the patterned, lawful, and sequential manner of child development. They observed "reciprocal neuromotor interweaving," a process resulting in a "progressive spiral kind of reincorporation of sequential forms of behavior" (p. 196). Each developmental stage assimilates part of the previous one, and one ontogenetic step in the sequence is not fully perfected before the next begins (McGraw, 1963). Gesell (1940) has reported that the skill and precision of movement of a sequentially lower stage may be practiced at the same time that a child is learning a new position or pattern of movement.

When the brain of a child develops within normal expectations, his phyletic heritage "appears" less important because the genetic programming directs the child through the early developmental stages including rolling over, sitting up, pulling to a stand, and ambulation in prone, quadruped, and a bipedal position. Because the environment normally allows the child to express these sensorimotor patterns, he usually develops them without much guidance or attention. This has led to a tendency to underestimate the significance of the early developmental steps to the maturation of perceptual and cognitive functions. When the development of the brain has deviated from the norm, the resultant behavior can be traced to lower levels of the phyletic scale representing interference in the sequential expression of these developmental patterns. Knowledge of the more primitive functions, in this case, is helpful in understanding current dysfunction and assistance in its remediation. The use of ontogenetic or phylogenetic sequences of motor behavior ha been utilized to stimulate normal development of voluntary movement (Bobath & Bobath, 1967).

The significance of additional, but not substitute control through encephalization of function, is central to the rationale for the CCDE program. The phyletic trend has been toward corticalization of a function (i.e., to transfer control of an activity from subcortical up to the cortical level) (Ayres, 1972). The educator's error, according to Snapp and other sensorimotor theorists, has been the belief that all sensation, perception, and cognition are exclusively cortical. This idea overlooks the possibility that some subcortical function may still be critical to that which evolution has tended to move toward the cortex. The CCDE program's emphasis is toward the subcortical functions in an attempt to bridge the gap in development.

Herrick (1956) noted that the function of the human cortex today is still strongly dependent upon brain stem functions. According to Ayres (1972) the brain stem mediates complex sensory integrative and motor responses and is involved with total massive patterning of overt responses of the entire body. It is therefore an important part of the brain in motor skill learning. The cerebral cortex does not provide function that substitutes for that of the brain stem, but adds abilities that enable it to modify brain stem function and to accomplish more complex tasks. According to Eldred (1965), while evolution has favored increased localization of brain functions, it has not eradicated the dependence of each part on the lower or more caudal structures.

The critical role of sensation in brain function has been called to the attention of the professional and scientific world through studies on sensory deprivation. From several studies the following assumptions have developed.

For optimal brain function in man, it is necessary for him to be able to integrate for use a constant stream of stimuli. Rosenzweig (1962, 1966) demonstrated in his studies with rats that biochemical as well as structural brain changes occurred as a result of an enriched environment. Sensory impulses appear to elicit chemical changes in the brain that are critical to the maturation process. Current Soviet theory contends that sensory learning can flow chaotically if the child does not receive adequate stimulation (Zaporozhets, 1965). Neurophysiological therapy is dependent upon the influence which can be exerted on the gamma bias or internal stretch sensitivity of the spindle by use of controlled sensory stimulation.

Whereas academic and other learning involve portions of the cerebral cortex, the higher central nervous system levels are dependent upon lower neural structures for normal function. For that reason, remedial or developmental programs must first be concerned with brain function, particularly the phylogenically older parts. A neurodevelopmental approach is one that intervenes in such a manner as to change the maturational process. The developing nervous system has the capacity to compensate for impairments by forming new connections during the early periods of maturation. The plasticity of flexibility of the formative nervous system enhances the capacity for the modification of interconnections of the functional system of the brain. Intervention programs that therapeutically structure the environment and employ sensory input, motor output, and sensory feedback are believed to lower the threshold of previously unresponsive brain cells (Kandel, 1970). These processes appear to influence neural organization and ultimately establish new engrams, thus facilitating maturation.

Programs Emphasizing Sensory Input

The approaches of Fay, Doman and Delacato, Ayres, and especially Rood, which place an emphasis on sensory input at subcortical levels of the nervous system, can be examined carefully for their similarities with the CCDE program. They are presented in chronological order.

Fay

Beginning in the early 1940s and continuing for nearly two decades, Fay, a neurosurgeon, was involved with the rehabilitation of patients with neuromuscular disorders. Basing his works on Sherrington (1906), he developed "neuromuscular reflex therapy" which incorporated the reflex levels of response to the highest level possible (Fay, 1954). Most of his writings were confined to the rationale and description of procedures for training of gross motor function as a foundation for development of more complex motor skills. His basic premise, which was borrowed from Orton (1937), was that ontogeny recapitulated phylogeny--an individual's neurological development parallels evolution. According to Fay, "reflexes" were in reality fragments of ancient amphibian, reptilian, and mammalian motor patterns that persisted or emerged depending on the degree of control which higher, more recently developed centers of the nervous system, can exert. Hence, his system agrees with the principle of sequential development. Since human movement is based on patterns of muscle activity, not on individual muscle response, Fay (1955) believed that if reflex patterns were elicited properly, functional movement could be established.

Another basic premise of this theory is that continued practice of patterns, actively or passively, leads spontaneously to the development of higher level patterns (Fay, 1954). Three sequential movement patterns were described by Fay and cited by Page (1967). These included the homolateral, homologous, and crossed-diagonal patterns.

> The first pattern of coordinate movement described is termed the homolateral pattern. In the prone posture the head, thorax and pelvis are turned toward the advancing extremity. The contralateral

> extremities are extending. Leading with the eyes and head rotating to the opposite side, the thorax and upper extremities and the pelvis and lower extremities reverse the position in a serialized motion. This pattern is described as an elementary form of forward propulsion which may be observed in the normal human infant. Done in a stationary position it may be used as a basic exercise to develop the necessary coordination for effective movement.
>
> Another pattern described is termed the homologous pattern. This is a bilateral-symmetrical movement. The head is maintained in the midline, although some flexion and extension of the neck may be observed. The upper extremities perform the flexion sequence while the lower extremities perform the extension phase, and the movements are reversed rhythmically. . . .
>
> The next level is termed the crossed-diagonal pattern. As the eyes and head are turned to the left the thorax rotates to the left and the left upper extremity moves toward flexion and the right upper extremity toward extension; the pelvis rotates to the right, the right lower extremity moves toward flexion and the left lower extremity toward extension. (pp. 818-820)

Following the prone position are the all-fours (hands and knees), plantigrade (hands and feet), and erect postures. All three patterns are utilized in the first three positions. Homolateral and crossed-diagonal are employed in the erect position. Depending on the level of development, patterns are done passively, active-assistively, or actively (Fay, 1968).

Doman and Delacato

Fay's work provided the basic foundation for the approach advocated by Delacato, educator and psychologist,

R. Doman, psychiatrist, and G. Doman, physical therapist. These men founded the Institute for the Achievement of Human Potential (IAHP) near Philadelphia in 1963. Their treatment program involved the application of Orton's theory of neurological organization with brain damaged individuals. Central to this theory is the fact that if an individual does not proceed through certain sequential neurological developmental stages, he will exhibit difficulties in speech and mobility. According to this theory, neurological organization is fostered by the correct sequence of infant developmental motor activity. From a background of clinical experience in Philadelphia, Delacato presented his theory in the literature in 1959. The following year, Doman et al. (1960) supported neurological organization and its central concept of "patterning" which involved passive manipulation of the patient's limbs and head.

Although the neurological organization treatment program met with popularity and acceptance from the general public, it was a target of widespread criticism from some members of the medical, psychological, educational, and other professions because of the lack of controlled studies demonstrating its effectiveness. Robbins and Glass (1968) provided the most thorough analysis of this research, not only the theoretical concepts upon which the treatment approach was based, but also the validity of the studies which supported the effectiveness of the training methods. Nevertheless, these techniques are still taught at the Institutes of Human Potential in eight American cities and in three foreign countries. The IAHP in Philadelphia and other institutions have produced some successes with children who have not been helped by other types of treatment (Maisel, 1964). Perhaps one of Delacato's greatest contributions is the interest he generated with respect to improvement of handicapped children. It has not been discerned whether the greatly increased amount of stimulation, care, and affection which is lavished on these children or the increased quantity of sensory input as demonstrated in a controlled investigation (Neman et al., 1974) is the catalyst for improvement.

Rood

Of all the sensorimotor treatment approaches, the one most appropriate to this study is Rood's neurophysiological approach. According to Huss (1970) the basic premise of Rood's system is that through the proper use of sensory stimulation and activity, a correlation of stimulation and purposeful motor response can be obtained on a subcortical level. In activities which bombard the sensory-motor system with more efferent impulses than normal, the muscle contracts and inhibits its antagonist. Rood (1956) advocated stimulation of the exteroceptors in the form of brushing, stroking, squeezing, touch, pressure, pounding, and vibration. The proprioceptors are additionally influenced by the position of the head in exercises, through stretch, muscle contraction combined with stretch, external resistance, and joint compression. Rood's theory which was developed in the 1940s, but not published until the late 1950s, is based on the principle that motor output is dependent upon sensory input.

Combined backgrounds of occupational and physical therapy have influenced Rood's approach to neuromuscular dysfunction. Rood's therapeutic program involves the activation, facilitation, and inhibition of muscle action, voluntary and involuntary, through the reflex arc. Major tenets of her intervention system emphasized controlled sensory stimulation, the use of the ontogenetic sequence, and the need to demand a purposeful response by the use of motor activity. A resume of her therapeutic program which has provided a basis for the work of Ayres (1962, 1972, 1979) is presented in the works of Huss (1969) and Stockmeyer (1967).

The developmental sequence of exercises is an important part of Rood's therapy from which Snapp apparently has drawn some of his exercises. These activities are presented in a sequence comparable to the motor development of the maturing infant (McGraw, 1963). The ontogenetic motor patterns according to Rood, cited by Huss (1978), are: (a) withdrawal supine, or total flexion pattern, (b) rolling with ipsilateral flexion of the limbs, (c) prone lying with hyperextension of the spine (pivot prone position), (d) prone lying with co-contraction of the neck, (e) prone resting on elbows, (f) all-fours (bridge position) with the weight shifting alternately from hands and knees, (g) belly crawling, (h) homologous, homolateral, and reciprocal creeping, (i) static stand with weight shift, (j) shifting weight backward-forward, side to side, and (k) walking.

From a neurological standpoint Rood's intervention program is concerned primarily with the gamma motor system and how it can be utilized most effectively. Eldred and Hagbarth (1954) have reported the effectiveness of cutaneous stimulation to increase gamma efferent stimulation. Rood emphasized also the reflex control of muscles for movement and posture, not only because it is more efficient, but it is less demanding on energy than cortically controlled activities.

Ayres

Ayres' system is based on the idea that disordered sensory integration will account for certain aspects of learning disabilities and that improving sensory integration will help those children who have basic problems in this domain. The objective of therapy is to enhance the brain's ability to learn, thereby modifying the neurological dysfunction interfering with learning. Direct application of tactile sensory stimulation including brushing, rubbing, and pressure is used to send tactile impulses to enhance neural organization (Ayres, 1979). Tactile stimuli provide a primal source of input to the reticular formation which influences muscle tone and increases the probability of muscular contraction (Ayres, 1972). Ayres hypothesized that tactile sensory input is used at lower levels of the brain to enhance efficient movement, adjust the reticular arousal system, and to improve perception in other sensory modalities.

Ayres maintained that maturation must occur at each level of the nervous system to insure integration and assimilation of sensory input and a correct motor response. She incorporated the developmental sequence, control of sensory input, as well as pressure, brushing, and rubbing the skin surfaces to send tactile impulses to various areas of the brain for integration.

Experimental Programs Incorporating Crawling Patterns

Crawling is a major constituent of several therapeutic intervention programs on which research has been conducted. The following review of literature is delimited to studies of academically handicapped and normal children ages 5 to 7 years. These reviews are presented in chronological order.

Robbins (1966) conducted a 3-month investigation to test the Doman-Delacato theory of neurological organization (Delacato, 1959). Three second-grade classes from different schools that had been selected by the Chicago Roman Catholic Archdiocese were compared. Group 1 (*n* = 43), received a traditional second-grade curriculum; Group 2, (*n* = 38), engaged in neurological training activities advocated by Delacato (1959); and Group 3, (*n* = 45), received a program of general activities not consistent with the theory of neurological organization. All groups participated in their specified activities for 30 minutes each day for the 3-month experimental period, resulting in approximately 30 hours of instruction.

All subjects were administered pre- and posttests on the Profile of Development (Doman et al., 1963), the Harris Test of Lateral Dominance (Harris, 1958), the California Short-Form Test of Mental Maturity (Sullivan et al., 1963), and the California Achievement Tests (Tiegs & Clark, 1957). Two-way analysis of variance was used to compare pre- and posttest reading and arithmetic scores on the California Achievement Tests. The F ratios obtained were not significant ($p > .05$). Analysis of covariance was used to compare mean differences in reading between children who were and were not lateralized as determined by the Harris Test of Lateral Dominance. The covariate controlled for differences in creeping. The groups, however, were not significantly different ($p > .05$).

Robbins concluded that activities included in the training program advocated by Delacato (1959) did not significantly increase the reading ability of the experimental subjects as compared with the two control groups. These training activities were cross-pattern crawling, creeping, and walking, avoidance of music, use of specified writing implements, and specific sleeping positions. The results indicated that the experimental treatment did not affect the acquisition of lateral dominance. Robbins rejected the basic tenets of the neurological organization theory.

In discussing the weaknesses of his experimental design, Robbins indicated that the subjects were not selected randomly and that the data were obtained from normal children instead of poor readers for whom the therapy methods had been developed. Robbins perhaps did not weigh the limitations of his study in regard to his conclusion denouncing the theory of neurological organization.

Vivian, cited by Delacato (1966), conducted a study in the Chicago Parochial Schools to improve the reading readiness of 90 normal first-grade children. The experimental treatment was comprised of activities advocated by Delacato (1959) including cross-pattern crawling, creeping, and walking and visual pursuit exercises. The subjects were matched on age and IQ as measured by the Kuhlmann-Anderson Intelligence Test (Anderson, 1961). They were then placed into two groups. Additional pre- and posttests included an unspecified reading readiness test and the Bond-Clymer-Hoyt Developmental Test (BCHDT) (Bond et al., 1961). The reading pretest scores as determined by the BCHDT for the experimental and control groups were reported as "average" and "high average," respectively.

The experimental group (n = 45) performed the Delacato (1959) activities for 30 minutes each day for 5 days a week while the control group (n = 45) participated in the regular first-grade curriculum with unstructured physical education during the 30 minute time period. Following the 5-month intervention program, the experimental and control groups were compared on reading as measured by the BCHDT. The difference between the means was statistically significant ($p < .05$). Vivian concluded that the Delacato methods were successful in improving the reading skills of first-grade students.

Glass and Robbins (1967), in a review of Vivian's study, pointed out that possible bias in this research may be attributed to novelty, interest, and motivational effects generated by the enthusiasm of the investigator. It was noted also that 42 of the original 45 subjects in the control group completed the experiment. Only one subject was lost from the experimental group. No explanation of subject mortality was reported by Vivian. Glass and Robbins claimed that no conclusions could be drawn from Vivian's study regarding the validity of Delacato's theory of the proposed treatment.

Edwin, cited by Delacato (1966), conducted a study with 84 kindergarten children for a 6-week period to determine the efficacy of neurological training using the recommended Delacato activities. The 43 children who comprised the experimental group were assigned to an 80-minute, daily schedule of "neurological training" in addition to 25 minutes of listening to stories, folk songs, and nursery rhymes. The control group of 41 children was matched with the experimental group on age, sex, and knowledge of the ABCs. The control group participated in the general program of childcare which included organized games, coloring, lunch, and rest period. Additionally, mothers or some older member of the family were asked to read or tell a story to children in the control group for at least 10 minutes daily. Posttest scores on the Harrison-Stroud Reading Readiness Test (Harrison & Stroud, 1956) increased an average of 82.4% for the experimental group and 37.2% for the control group as compared with the pretest scores. No statistical tests of significance were reported.

Glass & Robbins (1967) indicated that this study can be criticized as being defective in several respects. There were no data demonstrating equivalence of the experimental and control groups at the beginning of the experiment. The treatment of the two groups except for the neurological training was not equivalent. A 22% dropout of subjects occurred which was not accounted for. The method of assigning subjects to experimental and control groups was not specified. Because Edwin used no test of significance, Glass and Robbins examined the difference between the groups in gain scores. A significantly (p < .05) larger proportion of the experimental subjects made gains in controlled attention span than the control subjects. The differences in gains in uncontrolled attention span and in reading readiness were not significant. Glass and Robbins concluded that further evidence was needed to determine the validity of Delacato's claims for the effectiveness of neurological training in facilitating readiness for reading.

Stone and Pielstick (1969) studied kindergarten children in public schools in Elmhurst, Illinois, to determine the validity of Delacato's claims for the effectiveness of neurological training in advancing readiness for reading. The children, 16 boys and 10 girls, were assigned randomly to experimental and control groups of 13 each.

The subjects in the experimental group were exposed to the Delacato training program for 30 minutes a day, 5 days a week, for 18 weeks. This training included the cross-pattern crawling, creeping, and walking as well as the prescribed sleep patterns recommended by Delacato.

The parents were invited to school, and their support was enlisted for a home program. They were taught the procedures of neurological training to insure the continuation of the training over the weekends for 30 minutes each day while the children were not at school.

The control subjects were given 30 minutes daily of games and play activities throughout the experimental period. Their parents were contacted to insure that 30 minutes of attention in some activity would be continued on the weekends.

Pre- and posttest data were collected on the Peabody Picture Vocabulary Test (PPVT) (Dunn, 1959), the Lee-Clark Reading Readiness Test (Lee & Clark, 1962), and the Frostig Test of Visual Perception (FTVP) (Frostig et al., 1964). The data were treated by analysis of covariance to adjust for any differences in pretest means. The data were analyzed separately because each test was considered to be an independent measure of the treatment effects. The results indicated that a significant ($p < .05$) difference occurred from pre- to posttest in favor of the experimental group on the FTVP. The FTVP was designed to measure development in eye-hand coordination, figure-ground perception, form constancy, position in space, and spatial relationships. The experimental group posttest mean difference scores on the PPVT and Lee-Clark Reading Readiness Test did not, however, differ significantly from those of the control group.

This study can be criticized as being deficient in several respects. Stone and Pielstick noted that the test selection for the investigation was poor. Dunn (1959) failed to report long-term reliabilities for the PPVT. Moreover, the fact that mean pretest scores for both experimental and control groups fell in the "high average" classification on the Lee-Clark Test could invalidate its use because of the ceiling effect as well as the findings of the study. Stone and Pielstick reported that, whatever the effects of the Delacato treatment may have been, there was little support for its benefit to reading readiness in kindergarten. The program may be advantageous for children who exhibit deficiencies in sensory or motor development, but this was not studied.

O'Donnell and Eisenson (1969) examined the effects of a Doman-Delacato motor training program on the reading achievement and visual-motor integration of disabled readers with mixed or uncertain lateral dominance. Subjects for the study were drawn from 678 pupils between 7 and 10 years of age who were enrolled in the second through fourth grades in the San Anselmo School District, San

Anselmo, California. Requirements for inclusion in the study were: (a) a score below the 25th percentile on the Stanford Diagnostic Reading Test (Karlsen et al., 1966), (b) an IQ of 90 or greater on the Peabody Picture Vocabulary Test (Dunn, 1959), (c) a grade-placement score on the Gray Oral Reading Test (Gray, 1967) of below 1.9, 2.7, and 3.4, respectively for second, third, and fourth-grade students, (d) either uncertain laterality as indicated by a mixed rating on the Harris Test of Lateral Dominance (Harris, 1958) or mixed laterality indicated by moderate or strong hand, eye, or foot preference on opposite sides of the body, and (e) visual acuity of 20/50 or better for both eyes and auditory acuity of 20 decibel loss or below at 1,000, 2,000, and 4,000 cycles/second for both ears.

Of the 678 pupils, 60 who met these criteria were selected and assigned to one of three groups. All subjects were transported to a single school where they were given three different training programs in separate rooms for 30 minutes each, 5 days a week, for 20 weeks. Teacher assignments to groups were rotated weekly. Group 1 participated in cross-pattern creeping and walking consistent with the Delacato (1963) procedures, visual pursuit, and filtered reading during each session. Group 2 participated in visual pursuit, filtered reading, and selected physical education activities. Group 3 engaged in selected physical education activities during the 30-minute period. Subject mortality for the three groups was 2, 1, and 0 subjects, respectively. Pre- and posttest data were collected on the Gray Oral Reading Test (Gray, 1967), the Developmental Test of Visual-Motor Integration (Beery & Buktenica, 1967), and seven subtests of the Stanford Diagnostic Reading Test (Karlsen et al., 1966). Age, sex, and treatment were used in three-way analysis of variance. The two age levels were young (84 to 95 months) and old (96 to 120 months).

The results of the statistical analysis yielded no significant ($p < .05$) differences on any of the nine criterion measures except for age on the Blending Subtest of the Stanford Diagnostic Reading Test.

This study was designed to overcome some of the limitations of previous investigations of the Delacato training procedures. The sample was limited to young, disabled readers; visual-motor integration was included as a variable; and the training period was conducted over a longer period of time than other studies. Nevertheless, the results revealed no statistical significant differences. O'Donnell and Eisenson concluded that there was little evidence to indicate greater effectiveness of the Delacato training procedures over the regular physical education elementary curriculum in improving the reading achievement and visual-motor integration of young disabled readers.

Neman, Roos, McCann, Menolascino, and Heal (1975) evaluated a sensory-motor patterning program based on therapy methods taught at the Institutes for the Achievement of Human Potential (IAHP), popularly referred to as Doman-Delacato methods of treatment. The research project focused on programs conducted by staff members of the Dallas (Texas) Academy for Human Development (AAHD). The subjects were 66 institutionalized, mildly and moderately retarded residents of Denton (Texas) State School. The mean age of the children was 14.96 years, with IQ scores ranging from 39 to 68. The subjects were matched and then randomly assigned to groups. Experimental Group I received a program of mobility training and sensory stimulation conducted by personnel from the Dallas Academy (an AAHD facility) for the entire experimental period. The motor-training procedures encompassed both gross-motor and visual-motor activities. Experimental Group II participated in a less structured program of physical activities and indoor programming. The physical activities included outdoor games, playground equipment, and parachute games. During the last half of the study, however, they received a sensory stimulation program identical to that given to subjects in

Experimental Group I. Experimental Group II served to control for the effects of (a) individual attention, (b) physical activities, and (c) sensory stimulation. The last control function provided a partial means of estimating the separate effectiveness of the sensory and motor training components of the total sensorimotor training program. The Passive Control Group provided baseline measures; its subjects received testing but no specialized programming. The experimental period continued from November, 1971, to May, 1972, for a total of 7 months. The experimental treatments were for 2 hours a day, 5 days a week.

The instruments utilized were an adaptation of the Lincoln-Oseretsky Motor Development Scale (Sloan, 1955), Illinois Test of Psycholinguistic Ability (ITPA) (Kirk et al., 1968), Frostig Developmental Test of Visual Perception (Frostig et al., 1961), Peabody Picture Vocabulary (PPVT) (Dunn, 1959), Stanford Binet Intelligence Scale (Terman & Merrill, 1960), Wechsler Intelligence Scales for Children (WISC) (Wechsler, 1949), and the Profile of Development (Doman et al., 1963), which was adopted from the Developmental Mobility Scale (Delacato, 1959). The subjects were evaluated on four occasions: September and October 1971; February, May, and June, 1972; and September, 1972.

Multivariate analysis of covariance was used to treat the data. Experimental Group I improved more than the other groups in visual perception as measured by the Frostig Developmental Test of Visual Perception, motor performance as measured by the Profile of Development, and language ability as measured by the Illinois Test of Psycholinguistic Abilities. In every case in which Experimental Group I and the Passive Control Group were compared, significant ($p < .05$) results favored Experimental Group I. Both experimental groups showed greater gains in language development as measured by the ITPA than did the Passive Control Group. In every case in which Experimental Groups I and II were compared and significant results were obtained, Experimental Group I was superior to Experimental Group II.

Significant differences ($p < .05$) in motor proficiency of Experimental Group I were observed on the Lincoln-Oseretsky Motor Development Scale and Stanford Binet Intelligence Scale administered 3 months after the end of the experimental period. In terms of the various treatments, the overall significant findings indicated that Experimental Group I improved more than either Experimental Group II or the Passive Control Group. In some, but not all, instances Experimental Group II improved more than the Passive

Control Group. Neman et al. concluded that the AAHD therapy methods should be recognized as a legitimate approach in the remediation of mentally retarded youth.

Therapeutic Programs Utilizing Tactile Stimulation

Several experimental studies have been conducted with tactile stimulation as the major constituent of the intervention program. The following review of literature is delimited to those studies with academically handicapped and normal children ages 5 to 7 years.

Ayres (1972) tested the hypothesis that children with learning disabilities and certain identifiable types of sensory integrative dysfunction who receive sensory integration (SI) therapy will show greater gains in academic scores than comparable children who receive remedial, academic work for an equivalent amount of time. The sample was comprised of 128 public school children who had been diagnosed as having learning disorders. Data were collected by portions of the Southern California Sensory Integration Tests (SCSIT) (Ayres, 1972), the Illinois Test of Psycholinguistic Abilities (ITPA) (Kirk et al., 1968), the Wide Range Achievement Test (WRAT) (Jastak et al., 1965), and the Slosson Oral Reading Test (SORT) (Slosson, 1963).

The children were divided into four groups. Group 1, an experimental group ($\underline{n} = 30$), and Group 2, a control group ($\underline{n} = 30$), were matched and categorized as having generalized dysfunction with poor scores on postural, ocular, and bilateral integration, praxis, space perception, and auditory language function. Group 3, an experimental group ($\underline{n} = 12$), and Group 4, a control group ($\underline{n} = 12$), were matched and categorized as having exclusively auditory-language problems.

The experimental groups received remedial activity to enhance specific types of sensory integration for 25 to 40 minutes a day, 5 days a week, for 5 or 6 months. The procedures varied from one child to another, each child's program being based on his particular pattern of sensory integrative dysfunction as determined from the pretest scores. The control children received a comparable amount of remedial academic work.

The mean difference between pre- and posttest scores on the WRAT subtests, the composite WRAT, and the composite SORT was determined by $\underline{t}$ tests. Group 1 was significantly better than its control group on the WRAT reading subtest ($\underline{p} < .003$) and WRAT composite ($\underline{p} < .016$). Group 3 was significantly better than its control group on the WRAT reading subtest ($p < .005$) and on the SORT composite ($p < .007$).

The significance of difference in change scores among the groups on the SCSIT and ITPA was determined through discriminant analysis. The results indicated that a significant difference did exist among the four groups. Each of the experimental groups was significantly better than its control group on both tests.

Ayres concluded that the statistically greater gains in academic scores of the experimental groups over the control groups were probably related to enhanced sensory integration resulting from the intervention program. Although individually administered to each child on the basis of dysfunctions noted on the pretest, the intervention program provided considerable vestibular stimulation in association with participation in goal-directed activities such as riding a "scooter board" down a ramp. Postural mechanisms were normalized by inhibiting the primitive postural reflexes and activating righting reflexes and equilibrium reactions. Tactile stimulation was attempted as a means of normalizing brain function in general and of providing a somatosensory basis for motor planning.

McKibbin (1973) conducted a study of elementary school children, ages 4 to 10 years, who had coordination difficulties and learning problems. Of the 112 children screened by the investigator, the 27 subjects selected (19 boys and 8 girls) showed specific deficits in tactile perception and motor planning on standardized tests. Only children with normal intelligence and with no known pathology or physical disability were chosen as subjects. The children attended seven elementary schools and four kindergartens in Birmingham, Alabama. Three groups were established: kindergarten children, elementary school children, and children from a suburban school system meeting in an elementary school. The age groups were subdivided into experimental and control groups but the data were collapsed for treatment into one experimental and one control group with age as the covariate.

The 1-hour, daily perceptual-motor activity program was conducted 3 days a week for 16 weeks. For 40 minutes of each hour, both experimental and control groups participated in gross motor activities designed to provide maximum vestibular and proprioceptive-kinesthetic input and maximum tactile stimulation. For the remaining 20 minutes, the experimental group participated in activities enhancing tactile perception while the control group was given eye-hand coordination activities. The tactile stimulation consisted of brisk rubbing of the arms and legs with a dry terry cloth towel, segmental rolling, finger painting with sand, and crawling games. Additionally, the experimental group received a home program of sensory stimulation administered by parents for 30 minutes daily, 2 days a week.

Pre- and posttest data were collected on the Southern California Motor Accuracy Test (Ayres, 1964), two subtests of the Southern California Kinesthesia and Tactile Perception Tests (Ayres, 1966), the imitation of postures subtest of the Southern California Perceptual Motor Test (SCPMT) (Ayres, 1968), and the Developmental Test of Visual-Motor Integration (Berry & Buktenica, 1967). Approximately 2 to 3 months later, additional assessment (Posttesting II) occurred. The tests were the same except the bilateral motor coordination subtest of the SCPMT was substituted for the imitation of postures subtest. Analysis of covariance with the covariate indicating an age adjustment yielded no significant difference ($\underline{p} > .05$) between the groups on any of the tests.

McKibbin concluded that added tactile stimulation was no more or less effective than eye-hand coordination activities in improving perceptual-motor abilities of learning disabled children. When the pretest scores of both experimental and control groups were compared with posttest scores on motor accuracy, localization of tactile stimuli, and graphesia, there was a significant ($p < .01$) improvement for both groups. Retesting of the subjects 2 or 3 months after the first posttest indicated that gains were maintained in both groups.

Ottenbacher, Short, and Watson (1979) conducted an investigation with 43 learning disabled children ages 4 to 10 years to determine if sensory integrative (SI) therapy could enhance the vestibular and proprioceptive systems. Ottenbacher et al. sought to strengthen the clinical observations of Ayres (1972) that the duration of postrotary nystagmus of different subgroups of learning disabled children is affected differentially by therapeutic intervention.

Data were collected through the administration of the Southern California Postrotary Nystagmus Test (SCPNT) (Ayres, 1975). The subjects were divided into three groups depending upon their initial response to the SCPNT. Those children whose duration of postrotary nystagmus was either greater or less than one standard deviation from the standardized mean on the initial test were placed in high or low groups, respectively. Children whose score was within one standard deviation from the mean were placed in the medium group. The subjects were divided further into long and short term therapy groups. Long term SI therapy was 6 months with attendance of 5 hours each month. Short term SI therapy was 4 months with attendance of 5 hours each month.

Treatment of the data by analysis of variance indicated that the children with low initial scores displayed a near doubling of duration of nystagmus after long term therapy, whereas subjects with medium and high nystagmus exhibited a decline in postrotary nystagmus. Ottenbacher et al. concluded that SI therapy may enhance the functional characteristics of the vestibular and proprioceptive systems of some learning disabled children toward operational norms.

Undifferentiated Sensory-Motor Programs Including Developmental Exercise

The following review of literature is delimited to research studies on academically handicapped and normal children ages 5 to 7 years. A variety of perceptual and sensory-motor program were included which represented an eclectic approach to the remediation of learning disorders. Activities recommended by Kephart, Barsch, Luria, and Doman and Delacato were represented.

Rutherford (1964) conducted a study to determine whether a group of normal kindergarten children would increase in reading, number, and total readiness as measured by the Metropolitan Readiness Tests (Hildreth et al., 1949) after participation in a daily 30-minute perceptual-motor training program for 11 weeks. The subjects were 76 children enrolled in four kindergarten classes in a church-supported preschool program in a Texas metropolitan city. The median age for each sex was determined. Subjects whose age exceeded the median were classified as "older", and the rest were designated as "younger". The subjects, 42 boys and 34 girls, were assigned randomly to experimental and control groups. The experimental group participated in a perceptual-motor training program consisting of skills and activities designed by Kephart (1960) including sensory-motor control, eye-hand coordination, and ocular training. Walking boards, obstacle courses, crawling activities, stepping stones, Marsden ball, and low organizational games were included. The control group participated in an unstructured free play program for an identical time period.

Three-way analysis of variance with treatment, sex, and age as the variables indicated that the children who received the perceptual-motor training made significantly

($\underline{p} < .001$) greater gains in total readiness than the subjects comprising the control groups. There was no significant difference when comparing boys with girls or younger and older subjects. There was a significant ($\underline{p} < .01$) difference between the experimental and control groups in mean gain scores of reading readiness; however, this was accompanied by a significant ($\underline{p} < .05$) interaction between treatment and sex. This interaction indicated that the training program was more effective for boys than for girls. There were no significant differences in number readiness. Rutherford concluded that the evidence suggested that perceptual-motor training can enhance the total readiness of kindergarten age children.

Painter (1966) studied the effects of a rhythmic and sensory-motor activity program on perceptual-motor spatial abilities of low functioning kindergarten children. The purpose of the study was to determine improvement in body image, perceptual motor integration, and psycholinguistic competence as a result of participation in a training program based upon Barsch (1965) and Kephart (1960).

The subjects were 20 children, ages 5 to 7 years, of normal intelligence who represented the lower 50% of a class as determined by the Goodenough Draw-a-Man Test (Goodenough, 1926). Experimental and control groups were established with the groups matched on IQ, as measured by the Stanford-Binet Intelligence Scale (Terman & Merrill, 1960), chronological age, mental age, and sex. Pretests administered to all subjects included the Illinois Test of Psycholinguistics Abilities (ITPA) (McCarthy & Kirk, 1961), Goodenough Draw-a-Man Test, and Beery geometric form reproduction subtest of the Beery-Buktenica Visual-Motor Integration Test (VMI) (Beery & Buktenica, 1967).

The experimental group participated in systematic rhythmic and sensory-motor activity program and the control group received a regular kindergarten curriculum with unstructured physical education activities. The training program for the experimental group included the following movement areas of Barsch's Movegenic Curriculum (Barsch, 1965): (a) visual, auditory, and tactile dynamics (b) spatial and body awareness, (c) rhythm, (d) flexibility, (e) balance, and (f) unilateral and bilateral movement. Additionally, the program included the following activities based on Kephart's program: (a) generalization of rhythmic patterns, (b) sequencing of unilateral, bilateral, and cross-lateral movement, and (c) changing of uncoordinated movements to large sweeping movements. The activities were sequenced in level of difficulty to accommodate progress in skill development. The experimental group participated in the training program three times a week over a period of 7 weeks for a total of 21 sessions, each 30 minutes in duration. Limitations of time and available classroom space prevented equivalent time spent with control subjects, thereby allowing for no control of the Hawthorne effect.

Results of a sign test indicated that the experimental group made significant gains over the control group in their ability to draw a human figure ($p < .055$), better body image concepts ($p < .01$), advanced visual motor integrity ($p < .004$), accelerated sensory-motor spatial performance skills ($p < .002$), and enhanced psycholinguistic ability ($p < .055$). Painter concluded that the findings of this study may presumably be generalized to other kindergarten children of similar age and normal intelligence.

Lovelace (1967) completed a study to ascertain if a specially designed perceptual-motor program could improve the fitness, reading achievement, and perceptual-motor skills of normal children. The subjects were 50 children enrolled in the second and third grades at a public elementary school in Argyle, Texas. The children were divided into experimental and control groups at each grade level equated upon the basis of sex and pretest scores on the Glover Physical Fitness Test (Glover, 1962), the Purdue

Perceptual Motor Survey Rating Scale (Roach & Kephart, 1966), and the California Reading Test (Tiegs & Clark, 1957). The experimental group ($n = 25$) participated in a 31-day unit of selected physical activities for 30 minutes, for 5 days a week. This program emphasized the development of laterality, directionality, balance, coordination, and motor fitness. The control group ($n = 25$) participated in free play activities for an identical time period.

A t test was used to determine significant differences between groups on the pre- and posttest. Lovelace found that there was no significant difference in physical fitness or in reading achievement between the experimental and control groups; however, there was a significant ($p < .05$) improvement of the second-grade experimental group over the control group on the Purdue Perceptual Motor Survey Rating scale. Lovelace concluded that a specially designed, 31-day perceptual-motor program does not enhance the fitness or reading achievement of second and third-grade children; however, it may enhance the development of perceptual-motor skills of second-grade children.

McCormick, Schnorbrich, Footlik, and Poetker (1968) conducted an investigation to determine if underachieving first-grade children could improve in reading achievement after participation in a developmentally sequential perceptual-motor training program. The subjects attended Meadows Elementary School in Lisle, Illinois. Three groups of children, seven boys and seven girls in each group, were matched for age and IQ. The 42 subjects were administered the Lee-Clark Reading Test (Lee & Clark, 1958) as a pre- and posttest. There were no significant differences between the groups on the pretest.

Group 1 received perceptual-motor training in 45-minute sessions, two times a week for 7 weeks prior to the beginning of the school day. Their program consisted of cross-lateral crawling, walking patterns, balancing, and jump rope. Throughout the experimental period, elements were added to each exercise, thus increasing the dimensional complexity. Focus on proprioceptive cues was achieved by placing blindfolds on the subjects early in training. Directionality was emphasized with all exercises. Procedures adopted from Luria (1961) and Shands (1960) were implemented to increase attention span and to overcome symptoms of hyperactivity and distractibility.

Groups 2 and 3 served as control groups. Group 2, the Hawthorne group, received a regular physical education program for an identical time period. The activities consisted of low organizational games, tumbling, jump rope, locomotor, throwing, and catching skills, and relays. Group 3, the Control group, received no extra training or attention.

Results of the Wilcoxon matched-pairs, signed-ranks test indicated that the experimental group exhibited gains in reading achievement that were statistically significant from zero (p < .01) while the other two groups did not. McCormick et al. concluded that perceptual-motor training can be a useful addition to the regular physical education curriculum by increasing the child's capacity for academic achievement.

Lillie (1968) investigated the efficacy of a 5-month diagnostically based motor development program as a means of improving the gross and fine motor performance of psychosocially deprived children whose IQ scores ranged from 50 to 85. The subjects were assigned to three groups of 16, 14, and 13 children, respectively. The groups included the Experimental Preschool group (EP) from the Indiana University Laboratory School, the Kindergarten Control group (KC) from a public school in Edinburgh, Indiana, and a Home Control group (HC). All children came from lower-lower socioeconomic class range families. The children were free from any physical or sensory handicaps and had no evidence of serious emotional maladjustment.

An adaptation of the Lincoln-Oseretsky Motor Development Scale (Sloan, 1954) was used as the pre- and posttest measure of motor proficiency. The EP group received 65 diagnostically based motor development lessons, 5 days a week, for 5 months. These lessons included gross motor skills, trampoline, and fine motor activities. The KC group received a typical kindergarten curriculum consisting of instruction in socialization and communication skills, reading readiness, and running games, jig-saw puzzles, bead stringing, coloring, cutting, drawing, and clay modeling. The HC group received no formal instruction.

Analysis of covariance indicated no differences in posttest gross motor proficiency among the groups when the covariate adjustment was made for differences in age and pretest scores. Duncan's Multiple Range test revealed significant ($p < .01$) differences in posttest fine motor development in favor of the experimental EP group. The fine motor development of the KC group was significantly ($p < .05$) greater than that of the HC group. Lillie concluded that the difference in fine motor proficiency appeared to have been facilitated by the experimental motor development lessons.

Ames (1969) conducted an investigation to determine if learning disabled second graders could make developmental gains as a result of a perceptual training program. The subjects were 26 perceptually handicapped students enrolled in three public schools in Cheshire, Connecticut. They were chosen as being the lowest third in each school on the Bender Gestalt Test (Koppitz, 1964). The mean IQ on the Slosson Intelligence Test (Slosson, 1963) for the experimental and control groups was 111.7.

The experimental group participated in a specially designed program consisting of exercises and activities to improve coordination and spatial orientation for 30 minutes a day, 5 days a week, for 6 months. The training in each school was carried out by a selected teacher from the school staff under the direction of the project coordinator. The control group participated in the regular curriculum.

Adaptations of the Gesell Developmental Test (Ames & Ilg, 1963) and the Lowenfeld Mosaic Test (Ames & Ilg, 1962) were administered to all students before and after the 6-month period. On the pretests students in all groups ranged from 16.6 to 23.8 months behind the expectation for second-grade children. After the perceptual training program the experimental group ranged only 14.4 to 22.8 months behind the expected norms. On the adapted Gesell Test the children in the perceptual training program gained 8.7 months, whereas the control group gained only 2.5 months in the 6-month period. No statistical tests were used to analyze the data.

Ames concluded that perceptual training can help children who are lagging developmentally although it seems unlikely that this training actually speeds up development. The findings suggested also that those children who function substantially below their expected age level may fall increasingly behind unless intervention is applied.

Fretz, Johnson, and Johnson (1969) investigated the changes in perceptual-motor abilities of elementary age children who were served by the Children's Physical Developmental Clinic at the University of Maryland. The subjects were males, ages 5 to 11 years, referred to the clinic for reasons of poor coordination or emotional and social maladjustment. The experimental group was comprised of 53 subjects, and the control group was comprised of 34 subjects.

Data were collected by the Frostig Developmental Test of Visual Perception (FDTVP) (Frostig et al., 1961), Bender Motor Gestalt Test (Koppitz, 1964), Southern California Kinesthesia and Tactile Perception Tests (Ayres, 1966) and the Wechsler Intelligence Scale for Children (Wechsler, 1949). Examiners for the tests were trained and experienced in working with children. Sex of examiners and order of presentation of the tests were controlled.

The experimental period was 8 weeks in duration. The number of days per week and the length of time of the sessions were not stated. The experimental program consisted of a variety of gymnasium activities, conditioning and coordination exercises, games, and modified sports which were directed by student clinicians. The control group participated in the testing, but did not engage in any special program.

Statistical analysis of the data consisted of appropriate t tests. On each subtest of the Frostig and Bender-Gestalt Tests, the experimental group improved significantly ($p < .05$) whereas the control group demonstrated no significant improvement. The performance and full scale WISC IQ scores of both the experimental ($p < .01$) and control ($p < .05$) groups increased significantly. On four of the six subtests of the Southern California Kinesthesia and Tactile Perception Tests, both groups showed a surprising significant ($p < .01$) decrease. The results of the other two subtests were similar for both groups. Fretz et al. concluded that the perceptual-motor program provided by the Physical Developmental Clinic contributed significantly to the development of generalized motor performance of children with perceptual motor deficits.

McCormick, Schnorbrich, and Footlik (1969) conducted a study to determine if 64 underachieving first-grade children could improve in reading skills after participation in a 9-week perceptual-motor program. Children who attended Jefferson Elementary School in Berkeley, Illinois, were selected as subjects. They were placed randomly in two groups of 32 children each. The Pintner-Cunningham Primary Test (Pintner et al., 1946) was administered to determine IQ and the Metropolitan Achievement Test (Durost, 1959) was used as a measure of reading achievement. The groups were equated with respect to age, sex, IQ, and initial reading achievement prior to the experimental period.

The experimental group performed fine and gross motor exercises formulated by Luria (1961). These activities were performed in a developmental sequence in response to a loud, sharp voice to keep the children alert. This strategy was postulated to stimulate the reticular formation and arouse cortical inhibitory feedback (Clements, 1964). The exercises began with cross-lateral crawling and proceeded through walking, balancing, hopping, skipping, jumping rope etc. During the early stages of training the children were blindfolded in order to focus attention on proprioceptive and vestibular cues. The experimental program was administered to groups of five children for 1 hour a day, 2 days a week, for 9 weeks. The control group participated in the regular physical education curriculum.

Data were analyzed using the Mann-Whitney $\underline{U}$ test. The children in the experimental group were significantly ($\underline{p} < .01$) higher in reading achievement than those in the control group on the posttest. McCormick et al. concluded that the evidence can be interpreted as lending support to the principle that some form of patterned perceptual-motor activities facilitates the development of cognitive skills.

O'Connor (1969) studied the effects of two treatments, (traditional physical education and a perceptual-motor program based on Kephart (1960), on motor performance of first grade students of a public elementary school in Austin, Texas. The subjects were assigned randomly to experimental ($\underline{n} = 44$) and control groups ($\underline{n} = 48$).

Pre- and posttests administered included motor ability subtests used by Carpenter (1942) from the Brace and Johnson Tests, the Perceptual Forms Test (Sutphin, 1964), Metropolitan Readiness Test (pretest) (Hildreth et al., 1949), Metropolitan Achievement Test (posttest) (Durost, 1959), and lateral awareness items from the Harris Test of Lateral Dominance (Harris, 1958). Tests were administered by trained personnel.

The experimental subjects received a Kephart-type motor activity program administered by the investigator and two student assistants. The program included balance beam skills, hopping routines, stunts, tumbling, obstacle course, sports activities, locomotor patterns, movement imitation, and oculomotor pursuits. The pupil-teacher ratio was 10:1. The control subjects received physical education from the classroom teacher which was based on the Austin Independent School District Curriculum Guide for Grade 1. It consisted of games, relays, calisthenics, and folk dance. The pupil-teacher ratio was 30:1.

Findings of analysis of variance indicated a significant ($p < .05$) difference in mean change scores between the experimental and control groups on 16 of the 28 measures of motor performance. All significant differences except those on grip strength favored the experimental group.

A z test was used to determine significant differences between groups on the posttest scores of the lateral awareness and Perceptual Forms Test. There was a significant

($p < .05$) difference favoring the experimental group on internal lateral awareness, but not on the Perceptual Forms Test.

No significant differences were reported between groups on the Metropolitan Readiness and Achievement Tests. O'Conner concluded that the Kephart-oriented program may be useful for improving motor performance of the average first-grader but that change in gross motor ability does not necessarily effect change in perceptual or academic ability of the average first-grade child.

Lipton (1970) proposed a perceptual-motor development program to improve the visual perception and readiness of first-grade children. The 92 subjects in the investigation were in four first-grade classes ($n = 23$) each selected randomly in the Mt. Pleasant School District, New York, and divided into control and experimental groups equated on height, weight, age, and sex.

The Purdue Perceptual Motor Survey (Roach & Kephart, 1966), Developmental Test of Visual Perception (Frostig et al., 1963), and the Metropolitan Readiness Tests (Hildreth et al., 1949) were administered as pre- and posttests. Tests were administered by trained personnel.

Two of the classes comprised the experimental groups and were exposed to a 12-week perceptual-motor program.

The other two classes comprised the control groups and participated in regular physical education classes. The first phase of the experimental program included movement emphasizing directionality, imitation of postures, Angels-in-the-Snow, and other activities which were modeled after Kephart (1960). The second phase of the experimental program involved activities from Painter (1966) which emphasized the use of balance beams, spatial awareness, tactile activities, rhythm and movement, and flexibility.

Two way analysis of variance revealed that differences on all three variables tested were significant ($p < .05$) in favor of the experimental group. There were significant ($p < .05$) interactions for the experimental group on the perceptual-motor and reading readiness measures. Lipton attributed this to the high mean gain under one teacher for the experimental group (13.2) and low mean gain (2.9) for the control group. Lipton concluded that the physical education program based on the methods of Kephart (1960) and Painter (1966) produced significantly greater gains in perceptual-motor development, visual perception, and reading readiness than the regular physical education curriculum.

Martin and Ovans (1972) conducted an investigation to determine if handicapped children ages 3 to 7 years could overcome learning difficulties as a result of a specialized training program emphasizing sensory-motor techniques conducted in a preschool setting. The subjects were 36 children enrolled in the Manitoba Orthopedic School in Milwaukee, Wisconsin. The purpose of the study was to indicate if the children could improve in gross and fine motor coordination, language competency, self-image, and social-emotional adjustment.

The subjects were 12 mentally retarded, 9 physically handicapped, 2 emotionally disturbed, and 13 normal children who were recommended for remedial work. For instructional purposes the children were divided into three groups: (a) kindergarten group, (b) preschool educationally handicapped group, and (c) severely educationally handicapped group. Pre- and posttest data were collected with the following instruments: Caldwell's Preschool Inventory (Caldwell, 1967), subtests from Cratty's Six-Category Gross Motor Test (Cratty, 1969), and a Parental Evaluation Survey by the Milwaukee Public School Research Division.

The training program was conducted 5 days a week, 2 hours a day, for 5 weeks. During the 2-hour period, the children were divided into small groups and rotated among the various developmental activities designed to improve gross motor coordination, language development, auditory skills, manipulative skills, and cognitive abilities.

The findings indicated that the kindergarten group increased its total percentile rank on all the posttests. Results were reported in percentile rank because no test of significance was computed. Of major importance was the fact that most of the children who were untestable on the pretest were testable after a 5-week period of instruction. The severely educationally handicapped group improved also, although the increases were difficult to assess. Martin and Ovans concluded that the performance scores had improved as a result of the developmental program. Obvious drawbacks to the validity of this study included the heterogeneous sample, lack of control group, and no statistical analyses.

Lamport (1974) investigated the effects of a 16-week perceptual-motor physical education program on the self-concept and motor performance of learning disabled children ages 7 to 9 years. This review is limited to the motor performance aspects of the study. The subjects were 102 children chosen from 13 elementary schools in Albuquerque, New Mexico. An experimental group of 50 children (43 males, 16 females) participated in a specific perceptual-motor physical education program designed by Lamport. This experimental program, consisting of two 45-minute classes per week, was taught by regular physical education teachers. A control group of 43 children (25 males, 18 females) participated in the regular physical education program taught by the same teachers.

Data were collected by five subtests of the Test of Motor Impairment (Stott et al., 1972). Data were treated by analysis of covariance. Significant improvement was noted for the experimental group on the static balance test for the 8 and 9 year old boys and the dynamic balance test for the 7 and 8 year old children. The 7 year old girls improved significantly ($p < .05$) in manual dexterity with emphasis on speed, and the 9 year old girls improved significantly ($p < .05$) in the ability to control and co-ordinate the upper limbs.

Lamport concluded that a specific perceptual-motor physical education program for primary age learning disabled and normal children can offer important inherent experiences which may make a difference in motor skill efficiency. The findings of the study indicated also that there may be a sex difference for learning disabled children in the improvement of certain motor skills. A sex difference occurred in balance favoring males and in manual dexterity favoring females.

Sewell (1980) conducted a study of 20 early childhood handicapped children who participated in an adapted physical education program in a public elementary school in Mesquite, Texas. The subjects were 3 to 6 years of age. Gross motor ability was evaluated by selected items from the Denver Developmental Screening Test (DDST) (Frankenburg & Dodds, 1967). Performance of the subjects was compared with that of 25, 50, 75, and 90% of normal children of the same chronological age. The data were analyzed in terms of the number and percentage of items passed and failed on the pre- and posttest. A test of significance was used to determine if the increase/decrease in the total number of items passed/failed was significant ($p < .05$).

The children participated in an eclectic program of gross and fine motor activities 30 minutes a day, 4 days a week, for a 12-week period. With the assistance of four teacher aides, the 48 lesson plans constructed by the investigator were implemented with a 1:6 teacher-student ratio.

Nonparametric statistics indicated that there was no significant difference in the number of subjects performing at the criterion level on the motor tasks of jumping in place, riding a tricycle, broad jumping, and walking backward heel-to-toe. There was a significant ($p < .05$) difference, however, in the number of subjects performing at the criterion level on the motor tasks of balancing on one foot for 1, 5, and 10 seconds, respectively, hopping on one foot, walking forward heel-to-toe, and catching a ball.

Based on the results of the study, Sewell concluded that preschool handicapped children can improve gross motor performance on selected motor tasks in a specially designed physical education program which is individualized to accommodate a diversity of handicaps and abilities. Although the subjects made some significant improvement in gross motor performance, Sewell recommended the use of a smaller teacher-student ratio for more individualized instruction. This was needed especially for those children with a great number of motor deficits.

Clark (1980) conducted a study to determine the efficacy of a developmental movement program in improving motor fitness of academically handicapped children ages 6 to 11 years. The mean ages of the experimental and control groups were 7.8 and 8.0 years, respectively. The mean IQ scores of the experimental and control groups were 63.44 and 70.85, respectively. The two groups were statistically equal on both age and IQ.

The experimental group, comprised of 18 children from two elementary schools in Denton, Texas, participated in a developmental movement program for 25 weeks, twice a week, for 45-minute periods. The activities included a variety of ball skills, gymnastics and tumbling skills, and other basic locomotor and nonlocomotor tasks. These activities were taught by university students in a practicum setting on the Texas Woman's University campus, and a 1:1 student teacher ratio was thus maintained. The investigator served as the supervisor of the practicum.

The control group, comprised of 20 children matched as closely as possible on sex and educational classification with those of the experimental group, participated in a physical education program provided by the investigator at two elementary schools in Lewisville, Texas, for the same time period. The student-teacher ratio, 1:10, however, was not identical for both groups.

Data were collected through pre- and posttest administration of items selected from the Motor Fitness Test for the Moderately Retarded (Johnson & Londeree, 1976). The six items included the standing long jump, 50-yard dash, softball throw for distance, bent-knee sit-ups in 30 seconds, flexed arm hang, and a tumbling progression. Findings were based upon the results of one-way analysis of covariance. A significant (p < .05) difference between the experimental and control groups, favoring the experimental group, occurred on only one motor fitness item, the tumbling progression.

Based upon the results of this study, Clark concluded that the experimental developmental movement program did not improve the overall motor fitness of the 18 academically handicapped subjects as measured by the Motor Fitness Test for the Moderately Mentally Retarded. Tumbling was a skill taught within the developmental movement program whereas the other test items were used exclusively in the evaluation. Clark stated that this fact may have accounted for the significant difference in pre- and posttest scores on the tumbling progression test item.

Summary

Various theoretical frameworks which form the basis of treatment programs designed to ameliorate neurological dysfunction and accelerate the learning of motor skills were discussed. The use of sensory input to enhance development at the subcortical levels of the nervous system are common denominators among the programs of Fay, Doman and Delacato, Rood, and Ayres.

Each of the sensory-motor systems has contributed to a knowledge base for therapeutic intervention programs. The Fay and Doman-Delacato systems have used reflexes as initiators of movement. Both systems are based on the recapitulation of the phylogenetically older patterns of movement in treatment to achieve the ontogenetic patterns and higher integrated levels of motor functioning. Fay emphasized patterns of movement and attended to sensory inflow as a method of eliciting the pattern. Snapp appears to have drawn the homolateral and crossed-diagonal patterns in his exercise program from Fay's work. Snapp advocated that the crawling patterns originate from the prone position with the individual actively, rather than passively involved. The research of Hein and Held (1962) inferred that sensory feedback of active motion is necessary for development of skilled motor performance. Their studies with passive movement did not result in co-ordinated movement under test conditions.

Rood focused attention on the gamma motor system and stimulation of the nervous system, particularly through the exteroceptors with pressure, light tactile stimulation, pounding, and joint manipulation. She formulated a developmental exercise sequence which is similar to that of the human infant.

Ayres based her neurobehavioral theory on principles of neuromuscular development. Fay (1955), Delacato (1959), Rood (1962), and Snapp (1979) hypothesized similarly that normal neuromuscular development is dependent upon maturation of each level of the central nervous system. Ayres (1972) theorized that maturation must occur at each level of perceptual motor development to insure integration and assimilation of sensory input and a meaningful effectual motor response. Snapp incorporated deep pressure and light touch sensations in his program similar to that of Ayres and Rood.

Experimental studies involving crawling patterns and tactile stimulation as the primary constituent of the program were presented in chronological order. Other programs incorporating developmental exercise and a combination of therapeutic concepts were discussed. The research findings of Robbins (1966), Stone and Pielstick (1969), and O'Donnell and Eisenson (1969) revealed that sensory-motor programs incorporating crawling techniques were not significantly better than regular programs of physical education or reading in the improvement of motor and reading performance of primary-age children. Conversely, the research of Vivian and Edwin, cited by Delacato (1966) and Neman et al. (1975), supported the Doman and Delacato method. Of those studies utilizing tactile stimulation to enhance sensory integration and perceptual motor abilities, Ayres (1972), McKibbin (1973), and Ottenbacher et al. (1979) reported positive findings. Among the undifferentiated programs sensory-motor programs, Rutherford (1964), Painter (1966), O'Connor (1969), and Lipton (1970) reported improvement in motor performance whereas Lovelace (1967), Ames (1969), Lillie (1968), Fretz et al. (1969), Sewell (1980), and Clark (1980) did not report as many significant findings on motor performance in favor of various sensory-motor programs.

CHAPTER III

PROCEDURES FOR THE STUDY

The problem of this study was to determine if participation in the Chronologically Controlled Developmental Education (CCDE) Sensory-Motor Program would improve the motor performance and sensory integration of academically handicapped and normal first-grade children. The procedures followed in the development of the study are presented under the following headings: (a) Preliminary Procedures, (b) Selection of the Instruments, (c) Selection of the Subjects and Assignment to Groups, (d) Collection of the Data, (e) Planning and Implementation of the Experimental Period, (f) Treatment of the Data, and (g) Preparation of the Final Report.

Preliminary Procedures

As part of the preliminary procedures, the investigator surveyed, studied, and assimilated related literature. A tentative outline of the proposed study was developed and presented to the dissertation committee. Permission to conduct the experimental program was procured from the San Marcos Independent School District administrative personnel and principal of Crockett Elementary School. A copy of the letter of approval appears in Appendix A. A letter was distributed to the parents or guardians of the children participating in the study. A copy of this letter is included also in Appendix A. The prospectus for the investigation was submitted to the office of the Dean of the Graduate School and approved.

The investigator reviewed available instruments to measure motor performance and sensory integration. Many of the motor performance tests required sophisticated equipment available only in laboratory settings. Most of the instruments which purported to measure sensory integration were not standardized.

Selection of the Instruments

The Bruininks-Oseretsky Test of Motor Proficiency Short Form (BOT-SF) (Bruininks, 1978) and the Southern California Perceptual Motor Test (SCPMT) (Ayres, 1968) were selected as the data collecting instruments for the investigation on the basis of the following criteria: (a) content validity, (b) reliability coefficients of .85 or higher on the composite test battery or .50 or higher on each subtest, (c) inter-rater reliability of .90 or higher, (d) administrative feasibility, (e) established norms, (f) previous use with academically handicapped children as indicated in the literature, (g) appropriateness for age range of sample population in the study, (h) relevance to the objectives of the sensory-motor program, and (i) standardization of the test directions.

Bruininks-Oseretsky Test Short Form (BOT-SF)

The 14-item BOT-SF assessing the following factors: (a) running speed and agility, (b) balance, (c) bilateral coordination, (d) strength, (e) upper-limb coordination, (f) response speed, (g) visual-motor control, and (h) upper-limb speed and dexterity, were measures of motor performance for this study. The test description, instructions, and student booklet for the BOT-SF appear in Appendix B.

The Bruininks-Oseretsky Test (BOT) is based on the Oseretsky Test of Motor Proficiency which was first published in the United States by Doll (1946). Bruininks began the development of the BOT, which is the latest revision of the Oseretsky Test, in 1972. The BOT is an individually administered test which purports to measure motor performance of children from 4.5 to 14.5 years of age.

Substantial agreement exists between the behaviors assessed by the BOT and those based on factor analysis studies of motor development (Cratty, 1967; Fleishman, 1964; Guilford, 1958; Harrow, 1972; & Rarick et al., 1976). The BOT measures (a) four out of six perceptual motor traits postulated by Cratty, (b) seven out of 11 psychomotor abilities and five out of nine physical fitness factors described by Fleishman (1964), (c) six out of seven psychomotor abilities identified by Guilford (1958), (d) 10 of the areas identified by Harrow (1972), and (e) six out of eight motor proficiency factors identified by Rarick et al., (1976). The similarity between the results of these factor analyses and the BOT lended support to Bruininks' grouping of subtest items. The following factors were differentiated on the BOT: (a) Factor 1--fine motor coordination, (b) Factor 2--upper-limb coordination, (c) Factor 3--balance, (d) Factor 4--strength, and (e) Factor 5--bilateral coordination. Thus, Bruininks attests to the content validity of the BOT.

Test-retest reliability data were gathered from a sample of 63 second-grade children and 63 sixth-grade youth chosen from two schools near Minneapolis, Minnesota. The test battery was administered within a 7 to 12-day period. Test-retest reliability coefficients for the BOT-SF were .87 for Grade 2 and .84 for Grade 6 (Bruininks, 1978).

Objectivity for the BOT was established by three individual testers. The protocols of 30 subjects chosen at random from the standardization sample were scored independently. In general the interobserver reliability resulted in correlations of .90 or higher (Bruininks, 1978).

The BOT-SF standardization program conducted in 1973, entailed 38 schools with 765 children representing the North, Central, South, and West regions of the United States and Ontario, Canada. The sample included learning disabled and other students enrolled in special education. The results of this program were published in the BOT test manual (Bruininks, 1978). This manual was stated clearly and provided normative data including standard scores, percentile ranks, and stanine scores for the short form. The manual contained also a description of the tests, equipment, and data collected in the standardization procedures. The test directions were clear, concise, and standardized.

The test met the criterion of administrative feasibility. It can be conducted in a gymnasium stage area, or classroom where lighting and ventilation are adequate. Approximately 15 to 20 minutes per child is required to administer the 14-item BOT-SF. Equipment for the test is provided in the Bruininks Kit with the exception of a gymnasium mat and stopwatch.

Although the BOT-SF has not appeared frequently in the literature, several studies have employed this test with educationally handicapped children (Bruininks & Bruininks, 1977; Broadhead & Bruininks, in press).

Southern California Perceptual Motor Test (SCPMT)

The SCPMT includes the following subtests: (a) imitation of postures (IP), (b) crossing the midline (CM), (c) bilateral motor coordination (BMC), (d) right-left discrimination (RLD), (e) standing balance (eyes open) (SBO), and (f) standing balance (eyes closed) (SBC). These subtests were the measure of sensory integration for this study. The test description and instructions for the Southern California Perceptual Motor Test appear in Appendix C.

The development of the SCPMT has evolved through clinical application and research over several decades. The items were selected originally from tests used with brain-injured adults. The structure of the six subtests appropriate for use with children ages 4 to 8 years began about 1962. Content validity was assured through item selection based on correlations between individual items and a composite test score or between composite test scores of different forms of the test with another criterion measure (Ayres, 1968).

The imitation of postures (IP) subtest requires the subject to assume a series of positions or postures demonstrated by the examiner. Execution of the task is believed to require motor planning. The test appears to be drawn from a similar test of Berges and Lezine (1965).

The crossing the midline (CML) subtest, requires the subject to point to the contralateral eye or ear. The test is believed to reflect the degree of integration of function of the two sides of the body. This test is similar to Head's (1926) hand, eye, and ear test which was modified to eliminate the verbal element.

The bilateral motor coordination (BMC) subtest requires smoothly executed motor patterns repeated one or two times. While motor planning is involved, the test appears to evaluate the ability of the two upper extremities to move together in an integrated pattern. All items involve touching the palms of the hands to the thighs in a quick, light tap. The primary difference between this test and the two former tests is that the child is not to imitate the examiner until after the demonstration. This test is similar to the multi-limb coordination tests of Fleishman's (1964) test battery of psychomotor abilities.

The right-left discrimination (RLD) subtest contains a compilation of usual items included in tests of discriminating right from left on self, another person, and location of an object. This test is similar in content to items on the Purdue Perceptual Motor Survey (Roach & Kephart, 1966), which has been used extensively in research.

The standing balance (eyes open) (SBO) and standing balance (eyes closed) (SBC) subtests require the student to balance while standing on one foot with arms folded on the chest with elbows flexed. The SBC subtest eliminates visual perception and its contribution to balance. The SBO and SBC subtests are similar to balance tests used in the motor performance test batteries of Brace (1927), Crowe et al. (1981), Fait (1978), Fredericks et al. (1972), Sloan (1955), Stott et al. (1972), Vodola (1976), and Winnick (1979).

The six subtests of the SCPMT were compiled as a result of a factor analysis (Ayres, 1965). Content validity is supported by the similarity of these subtests to other published perceptual and motor performance tests.

Estimates of test reliability of the SCPMT were computed by retesting 239 children by a different examiner, 5 to 15 days after initial testing. The correlations were reported for each half-year age range from 4-0 to 8-11 years. The product moment correlations for the 6-0 to 7-11 year-old children ranged from .29 to .69 for the IP subtest; .39 to .59 for the CM subtest; .38 to .60 for the BMC subtest; .34 to .54 for the RLD subtest; .59 to .68 for the SBO subtest; and .16 to .51 for the SBC subtest. All of the reliability coefficients for this age range were significant at $\underline{p} < .01$ or $\underline{p} < .05$ except for the SBO coefficient .16.

Ayres (1968) noted that intertest stability contributed only a portion of the information needed to determine the usefulness of a test in detecting sensory-motor dysfunction. Another contributing factor is the variance. The larger the variance, the less well the test can differentiate between normal and subnormal function. The standard deviations for the six subtests of the children ages 6-0 to 6-6 years were 3.9, 5.7, 4.4, 5.0, 38.9, and 5.3 for the IP, CML, BMC, RLD, SBO, and SBC subtests, respectively. Accordingly, the relatively small standard deviations contributed to a small standard error of measurement which is also an important guide in determining the discriminating quality of a test. The standard error on the six SCPMT subtests for the 6-0 to 6-6 year-olds was

2.2, 3.6, 2.8, 4.1, 24.9, and 4.9 for the IP, CML, BMC, RLD, SBO, and SBC subtests, respectively. The standard deviations and standard errors of the mean for the 6-7 to 7-11 age levels were similar to those of the 6-0 to 6-6 year age level. Ayres (1968) concluded that the test was effective in detecting slight deviations from the average sensory-motor functioning.

The SCPMT is easy to administer, requiring little equipment and time. Understanding simple verbal directions is required, but reliance on conceptual ability has been kept to a minimum. Although individually administered, the test requires only 20 minutes. The test manual is written clearly and concisely, and the protocol is easy to follow. The test directions are standardized, and the subtests are administered in a specific sequence. The reliability data and descriptive statistics in the test manual are easily interpreted and logically displayed.

In 1967, the six subtests of the SCPMT were standardized on 1,004 children ages 4 to 8 years. The geographic and socioeconomic levels of metropolitan Los Angeles, California, were represented. Children were selected from public and private schools, organizations, and child care centers. The average number of pupils for each sex by age category was approximately 50. Descriptive statistics of the combined scores of boys and girls are presented in the test manual by half-year intervals. Numerous tables of standardized scores are included.

The SCPMT exists as a subtest within the Southern California Sensory Integration Tests (SCSIT) (Ayres, 1980) which have been used extensively in published research. Buros (1978) cited 18 references including studies with normal and academically handicapped children. The SCPMT has been employed in the research of Ayres (1966_b, 1969_a, 1969_b, 1972_b, 1976), Hanson (1973), Johnson et al. (1968), McCracken (1975), McKibbin (1973), Punwar (1970), Rider (1973), and Silberzahn (1975).

Proger, cited by Buros (1978), stated that the SCPMT appears to be a well-thought out product of an acknowledged expert in special education. The conceptual framework on which these tests are based centers around hypothesized sensory integrative mechanisms (Ayres, 1972). Barton concluded that the test promises to be a valuable instrument as it is refined through further research.

Selection of the Subjects and Assignment to Groups

Cluster purposive sampling was selected as the sampling design. Crockett Elementary Schools, San Marcos, Texas, comprised the cluster from which individual subjects, ages 6 to 8 years, were drawn. This cluster was selected on the basis of the administrator's willingness to provide subjects for the study and to facilitate the implementation of the proposed stringent experimental research design. It was believed to be representative of other public elementary schools in the San Marcos area. Subjects were primarily from lower middle income families of Hispanic origin. The sample consisted of 70.0% Hispanic, 26.7% Caucasian, and 3.3% Black. Purposive sampling is defined by Kerlinger (1973) "as a form of non-probability which is characterized by the use of judgment and a deliberate effort to obtain representative samples" (p. 129). Two groups of subjects were selected therefore on the basis of specific criteria. The group designated as normal (n = 30) met the following criteria: (a) first-grade students, (b) ages 6 to 8 years, and (c) reading on grade level as determined on the basis of a criterion-based measure by an evaluation team including the principal, educational diagnostician, and classroom teacher. The group designated as academically handicapped (n = 30) met the following criteria: (a) first-grade students, (b) ages 6 to 8 years, and (c) reading below grade level as determined on the basis of a criterion-based measure by an evaluation team including the principal, educational diagnostician, and classroom teacher. All subjects were free from any physical impairment which would prevent active participation in the sensory-motor or regular physical education programs. Additionally, they were certified by the school nurse as free from visual and hearing acuity problems.

The research design entailed the use of four groups: two experimental and two control. The subjects within each classification were placed randomly into groups. Random assignment allowed the laws of probability to operate regarding the equality of the groups with respect to age, sex, racial background, and reading achievement.

Collection of the Data

Personal data were collected through documentary analysis of materials in the educational files of the subjects. Chronological age, racial background, and reading performance level were recorded for each subject. Descriptive data for all subjects are presented in tabular form in Chapter IV.

The administration of the Bruininks-Oseretsky Test (BOT-SF) and Southern California Perceptual Motor Test (SCPMT) required the selection and training of three assistants. A graduate assistant in the physical education department and two senior physical education majors of Southwest Texas State University, San Marcos, Texas, were selected on the basis of their extensive experience with primary-age children. The investigator conducted three 1-hour training sessions to explain and demonstrate the test items and scoring procedures to the assistants. This was followed by practice sessions until proficiency was achieved. All data were subsequently collected by these assistants and the investigator.

The examiners were introduced to the students prior to the pretest by the director of physical education of Crockett Elementary School. The students were told that the evaluators were going to administer physical education tests.

The tests were administered in the same area where each physical education class was conducted. The testing area for the experimental groups for the BOT-SF comprised the stage, adjacent cafeteria, and asphalt slab area; the testing area for the control groups included the gymnasium and asphalt slab area. Two evaluators worked simultaneously gathering data in the experimental and control group classes during each 30-minute physical education period from 1:30-2:00 p.m. and 2:00-2:30 p.m., respectively.

The testing area for both the experimental and control groups on the SCPMT was in an enclosed area adjacent to the cafeteria. The test was administered individually to students according to standardized directions. Two different evaluators gathered the data; however, only one test was administered at a time because of the limited space.

Time was allocated for the examiners to establish rapport with the students. Initial testing with each group included a brief explanation and demonstration of the test items. After the specified practice trials, the tests were administered individually according to standardized directions presented in Appendices B and C. All data for the BOT-SF and SCPMT were recorded on standardized score sheets in Appendices D and E, respectively.

The pretests were conducted during the last 3 weeks of January, 1982. The midtests were administered during the second and fourth weeks of March, 1982, and the posttests during the last 3 weeks of May, 1982, following the 15-week experimental period. Conditions for the mid- and posttest were identical to those during the pretest. The raw data for all groups on the pre-, mid-, and posttest were compiled and presented in Appendices F, G, and H, respectively.

The pretest data were collected on two different occasions within a 2-week period for each test so that test-retest reliability coefficients could be calculated for the sample (n = 60) in this study. Reliability was determined by the intraclass reliability method (Safrit, 1976) using the BMDP2V computer program (Dixon & Brown, 1979) on the six subtests of the SCPMT and the composite score of the BOT-SF. Additionally, objectivity was determined for the SCPMT by computing the interobserver reliability coefficient for two data collectors on the pretest with the Interactive Statistical Packages computer REGRES. Objectivity was determined for the BOT-SF by computing the interobserver reliability coefficient for three data collectors on the pretest using the intraclass reliability method (Safrit, 1976) with the BMDP2V computer program (Dixon & Brown, 1979).

Planning and Implementation of the Experimental Period

The purpose of the CCDE and the regular physical education programs was to enhance motor performance and sensory integration of first-grade children. The specific objectives of the lessons were as follows: (a) to improve static and dynamic balance, (b) to improve bilateral coordination, (c) to improve hand-eye/upper body coordination, (d) to improve fine motor coordination, (e) to improve motor planning, (f) to improve R-L discrimination, (g) to improve reaction/movement time, (h) to improve upper limb speed/dexterity, (i) to improve abdominal strength), and (j) to improve leg strength and power. A chart is presented in Appendix I which describes in detail how these objectives were met by both the experimental and control groups.

Lesson plans for the experimental groups were constructed by the investigator and implemented by a graduate assistant in the physical education department of Southwest Texas State University, both of whom were certified CCDE teachers. Lesson plans for the control groups, designed to meet the same instructional objectives, were formulated and taught by the regular physical education teacher. Sample lesson plans for the experimental and control groups are included in Appendices J and K, respectively. The complete set of lesson plans for both groups remains on file at Texas Woman's University, Denton, Texas.

The experimental sensory-motor program was conducted on an enclosed stage area and adjacent cafeteria at Crockett Elementary School, San Marcos, Texas, 5 days a week, for 15 weeks from January 11, 1982, to May 21, 1982.

Time alloted for school holidays was not included in the 15-week period. The daily 30-minute period for each experimental group consisted of developmental activities recommended by Snapp (1979). The lessons consisted of developmental exercises, deep pressure tactile stimulation, and crawling in specified patterns. The amount of time spent on each of these activities varied each day according to the physical abilities of the students. The teacher-student ratio was 1:15. The investigator monitored the program at least three times each week.

The teacher for the experimental group was a 27 year-old Caucasian female who held a bachelor's degree from Southwest Texas State University and was certified by the Texas Education Agency in elementary education and all-level physical education. She had 2 years of teaching experience at the elementary level. Her background included an additional 80 classroom and laboratory hours in CCDE instruction with certification.

The regular physical education program was conducted in the gymnasium and/or asphalt slab area at Crockett Elementary School, San Marcos, Texas, for the same time period as for the experimental group. The control groups' classes were held for 30 minutes. The lessons consisted of warm-up exercises and stunts, low organization games, skill practice at teaching stations, obstacle courses, and rhythmical and movement exploration activities. The control groups' activities were conducted according to the San Marcos Independent School District Physical Education Curriculum Guide for K-1 (Burruss & Cobarruvias, in press). The teacher-student ratio was 1:15. The investigator monitored the program at least three times each week.

The teacher for the control group was a 39 year-old Caucasian female who held a bachelor's degree in physical education from Southwest Texas State University and was certified by the Texas Education Agency for teaching at all levels in physical education. Her teaching experience included 10 years at the elementary level and 5 years at the secondary level.

Treatment of the Data

The procedures that follow describe the treatment of the data. After the tests were scored, raw data for the pre-, mid-, and posttests were organized into appropriate tabular form for inclusion in Appendices F, G, and H, respectively. Descriptive statistics including range, mean, standard deviation, and standard error of the mean were computed for age and seven dependent variables using the BMDP2D computer program (Dixon & Brown, 1979). These dependent variables were as follows: (a) Bruininks-Oseretsky Test Short Form (BOT-SF), (b) Imitation of Postures (IP), (c) Crossing the Midline (CML), (d) Bilateral Motor Coordination (BMC), (e) Right-Left Discrimination (RLD), (f) Standing Balance with Eyes Open (SBO), and (g) Standing Balance with Eyes Closed (SBC).

In order to examine the null hypotheses for the study, two-way analysis of variance with repeated measures was used. This particular statistical technique was selected as it allows the differences between pre-, mid-, and post-test trials to be examined. The data were analyzed on the Digital Electronic Corporation, Model 20 computer of the Texas Woman's University, Denton, Texas, by the Analysis of Variance and Covariance Including Repeated Measures Program (BMDP2V) created at the University of California at Los Angeles (Dixon & Brown, 1979). Tables for Chapter IV were developed following the format recommended by Huck, Cormier, and Bounds (1974). Tables were developed for motor performance and six dependent variables comprising sensory integration. If significant ($\underline{p} < .01$) differences were found, Tukey B post hoc multiple comparison tests were calculated to determine where the significant differences occurred. The formula for the contrast value ($\underline{C}$) is given in Appendix L. A matrix of cell means indicating group and pre-, mid-, and posttest differences for each dependent variable was presented and appears also in Appendix L.

The writing of the final report entailed submitting the chapters to the dissertation committee, making corrections in accordance with their suggestions, and revising each chapter. The findings of the study were presented and discussed, a conclusion was drawn, and recommendations for further studies were made. A summary, appendices, and references were included. An analysis of the findings of the investigation is presented in Chapter IV.

CHAPTER IV

PRESENTATION OF THE FINDINGS

The results of the statistical treatment of the data are presented in Chapter IV. The problem of this study was to determine if participation in the Chronologically Controlled Developmental Education (CCDE) Sensory-Motor Program would improve the motor performance and sensory integration of academically handicapped and normal first-grade children. Two experimental groups (normal and academically handicapped) participated in a sensory-motor program encompassing developmental exercises, crawling, and deep pressure tactile stimulation (Snapp, 1979) comprised of 30-minute sessions, 5 days a week, for 15 weeks. Two control groups (normal and academically handicapped) engaged in the regular physical education program during an equivalent period.

Quantitative measures of motor performance were attained from pre-, mid-, and posttest scores on the Bruininks-Oseretsky Test Short Form (BOT-SF) containing 14 subtests. Measures of sensory integration were derived from the Southern California Perceptual Motor Test (SCPMT) containing six subtests.

The findings of this study are arranged under the following principal headings: (a) Description of the Subjects, (b) Reliability and Objectivity Coefficients for the Data Collection Instruments, (c) Performance of the Groups on the Pre-, Mid-, and Posttests, (d) Examination of the Hypotheses, and (e) Summary.

Description of the Subjects

The subjects selected for this study were 30 academically handicapped and 30 normal first-grade children attending Crockett Elementary School, San Marcos, Texas, during the 1981-1982 academic year. All subjects were free from any physical impairment which would prevent active participation in the sensory-motor or regular physical education programs. Additionally, all subjects were certified by the school nurse as free from visual and hearing acuity problems. Demographic data of the subjects are presented in Table 1.

Inspection of Table 1 indicates that the distribution of boys and girls in each group was similar with the exception of the experimental normal group which had 11 boys and four girls. Most of the subjects in each group were of Hispanic origin. Children reading on grade level and below grade level were determined by an evaluation team

Table 1

Sex, Race, Reading Performance, and Age of Subjects

Variable	Experimental academically handicapped	Control academically handicapped	Experimental normal	Control normal
Sex				
Boys	7	7	11	8
Girls	8	8	4	7
Race				
Hispanic	11	14	8	9
White	2	1	7	6
Black	2	0	0	0
Reading performance				
On grade level	0	0	15	15
Below grade level	15	15	0	0
Age (months)				
M	85.47	83.67	82.40	82.93
SD	5.18	5.19	2.80	3.90

rather than through administration of a standardized test. This team included the principal, educational diagnostician, and classroom teacher. The ages of the subjects in all groups were similar.

Reliability and Objectivity Coefficients for the Data Collection Instruments

Reliability was determined by the intraclass reliability method (Safrit, 1976) which utilized the RELSF.FOR intraclass reliability computer program (Kelly, 1980) and the BMDP2V (Dixon & Brown, 1979) computer program. Reliability coefficients were calculated for the pretest scores of six subtests of the SCPMT and the composite score of the Bruininks-Oseretsky Test-Short Form. The reliability coefficients for the seven dependent variables in this study are presented in Table 2.

Objectivity coefficients for the BOT-SF were determined by the inter-rater reliability formula (Safrit, 1976) using the BMDP2V computer program (Dixon & Brown, 1979). Objectivity coefficients for the SCPMT were attained by computing Pearson product-moment correlations using the Interactive Statistical Packages program REGRES. The objectivity coefficients for both tests are presented also in Table 2.

Table 2

Reliability and Objectivity Coefficients for the Southern California Perceptual Motor Test and Bruininks-Oseretsky Test Short Form

Evaluation Instrument	Reliability Coefficient n = 60	Objectivity Coefficient n = 30
Bruininks-Oseretsky Test Short Form	.89	.99
Southern California Perceptual Motor Test		
Imitation of Postures	.96	.98
Crossing Midline	.98	.96
Bilateral Motor Coordination	.96	.95
Right-Left Discrimination	.98	.97
Standing Balance Eyes Open	.92	.99
Standing Balance Eyes Closed	.89	.94

Table 2 reveals that the reliability coefficient for the BOT-SF composite score was .89. This correlation coefficient was similar to the $\underline{r}$ = .87 obtained by Bruininks (1978). The reliability coefficients for the SCPMT subtests ranged from .89 to .98. The reliability coefficients computed on the SCPMT subtests in this study were higher than those obtained by Ayres (1968). The SCPMT was administered by two data collectors; however, the BOT-SF, comprised of 14 subtests, was administered by three data collectors. The objectivity coefficient for the three testers on the BOT-SF composite score was based on the pretest data with two groups of the sample (_n_ = 30). The resulting correlation was .99.

Performance of the Groups on Pre-, Mid-, and Posttests

Descriptive data for the academically handicapped and normal first-grade children on the Bruininks-Oseretsky Test Short Form (BOT-SF) and six subtests of the Southern California Perceptual Motor Test (SCPMT) are presented in Tables 3 and 4. The pre-, mid-, and posttest data for the four groups describe the performance over 15 weeks.

Visual inspection of Table 3 reveals that the mid- and posttest scores improved for all groups, although it is not known without a test of significance whether this occurred by chance. The standard deviations, which are measures of variability, ranged from 3.17 to 7.38.

Table 3

Performance of Groups on the Bruininks-Oseretsky Test Short Form

Groups	Pretest M	Pretest SD	Midtest M	Midtest SD	Posttest M	Posttest SD
EAH	33.00	5.54	36.13	7.38	43.67	7.23
CAH	33.60	5.40	40.00	6.61	44.80	4.44
EN	39.40	3.87	43.47	5.84	50.27	3.17
CN	39.33	6.32	46.60	5.64	50.60	6.60

Visual inspection of Table 4 reveals that the means for each subtest of the Southern California Perceptual Motor Test improved for most of the groups. It is not known, however, without a test of significance whether this occurred by chance. Mid- and posttest scores improved for all groups on the standing balance (eyes open) subtest; improved or remained the same for three of the four groups on the imitation of postures, right-left discrimination, and standing balance (eyes open) subtests; improved for two of the four groups on the bilateral motor coordination subtest; and improved for one of the four groups on the crossing the midline subtest. Declines in performance

Table 4

Performance of Groups on the Southern California Perceptual Motor Test

	Pretest		Midtest		Posttest	
Groups	M	SD	M	SD	M	SD
			Imitation of Postures			
EAH	10.87	2.92	14.93	2.76	14.53	2.59
CAH	12.13	4.36	13.73	3.33	14.40	2.41
EN	14.07	3.90	15.47	3.74	16.93	3.49
CN	12.87	5.19	15.47	3.52	15.60	4.29
			Crossing the Midline			
EAH	8.87	5.26	10.47	6.50	11.60	6.24
CAH	6.67	4.73	8.60	6.28	7.87	6.74
EN	13.60	3.00	14.40	3.79	12.80	4.33
CN	12.07	5.16	11.60	6.00	14.07	4.16
			Bilateral Motor Coordination			
EAH	8.53	4.41	7.47	4.27	8.40	4.27
CAH	6.40	3.81	7.53	4.14	7.93	4.06
EN	8.07	3.10	11.27	2.55	9.60	3.83
CN	10.60	3.06	10.93	3.59	11.00	3.46
			Right-Left Discrimination			
EAH	12.20	5.14	13.00	5.28	14.80	4.89
CAH	13.00	5.22	12.93	5.71	12.40	6.29
EN	14.33	4.45	15.93	3.49	16.93	3.10
CN	14.00	6.26	15.33	5.48	17.73	2.49
			Standing Balance Eyes Open			
EAH	20.47	14.30	23.27	7.97	51.67	34.77
CAH	46.40	44.17	49.27	38.29	64.93	52.22
EN	35.67	21.94	64.87	62.47	104.47	60.33
CN	53.40	43.73	78.60	42.33	92.80	54.94
			Standing Balance Eyes Closed			
EAH	10.07	5.54	12.60	7.06	12.60	6.29
CAH	7.60	4.42	9.60	4.58	9.80	4.62
EN	11.27	8.11	19.67	8.70	22.47	14.42
CN	8.53	5.73	11.07	6.99	9.47	4.90

were more common from mid- to posttest than pre- to midtest. More decrements in performance were noted among the control groups than the experimental groups. The standard deviations were similar with the exception of the standing balance (eyes open) subtest.

Examination of the Hypotheses

On the pages which follow the hypotheses of the study are examined. Results of the two-way analysis of variance and posteriori comparisons on the Bruininks-Oseretsky Test Short Form and six subtests of the Southern California Perceptual Motor Test are discussed.

In Table 5 the findings of the analysis of variance on the Bruininks-Oseretsky Test Short Form related to the following statistical hypotheses are presented: (a) There is no significant difference between the groups on the pre-, mid-, and posttest scores, (b) There is no significant difference between the pre-, mid-, and posttest trials, and (c) There is no significant interaction between groups and trials.

The F ratios of 8.46 for between groups and 151.08 for within groups were significant at the .001 level. These findings led to the rejection of the hypotheses relating to the significant difference between groups and

Table 5

Comparison of Groups, Trials, and Interaction
on the Bruininks-Oseretsky
Test Short Form

Source	_df_	_SS_	_MS_	_F_	_p_
Between					
Groups	3	1956.91	652.30	8.46*	.001
S(Groups)	56	4317.15	77.09		
Within					
Trials	2	3633.21	1816.61	151.08*	.001
Tr x Gr	6	98.74	16.45	1.37	.233
Tr x S (Gr)	112	1346.71	12.02		

*$p \leq .001$.

trials, respectively. Post hoc comparisons of mean differences (contrast values) were computed to determine where the differences occurred and are presented in Tables 6 and 7. All post hoc comparisons were calculated using the Tukey B procedure (Winer, 1971). The formula to determine the contrast ratios (_C_) appears in Appendix L.

Post hoc comparison of mean differences (contrast values) for the four groups on the BOT-SF indicated that the academically handicapped groups made significantly

Table 6

Comparison of the Four Groups on the Bruininks-Oseretsky Test Short Form Using the Tukey B Test

Contrast Groups	Contrast Values Pre	Mid	Post
EAH vs. CAH	.60	3.87	1.13
EAH vs. EN	6.40* EN[a]	7.34* EN[a]	6.60* EN[a]
EAH vs. CN	6.33* CN[a]	10.47* CN[a]	6.93* CN[a]
CAH vs. EN	5.80* EN[a]	3.47	5.47* EN[a]
CAH vs. CN	5.73* CN[a]	6.60* CN[a]	5.80* CN[a]
EN vs. CN	.07	3.13	.33

*$p < .01$.

[a] The significant difference favored this group.

lower ($p < .01$) scores than the normal groups. This finding was expected since several authorities have reported that academically handicapped have lower motor ability than normal children.

No significant differences were found between the academically handicapped experimental and control groups. This can be interpreted to mean that the CCDE Sensory-Motor

Program and the regular physical education program were equivalent in their ability to cause change in the 14 motor abilities measured by the Bruininks-Oseretsky Test Short Form.

A comparison of the three trials on the BOT-SF is presented in Table 7. Information relative to the hypothesis that there is no significant difference between pre-, mid-, and posttest trials is revealed.

Table 7

Comparison of the Three Trials on the Bruininks-Oseretsky Test Short Form Using the Tukey B Test

Contrast Groups	Contrast Values			
	EAH	CAH	EN	CN
Pre vs. Mid	3.13	6.40*	4.07	7.27*
Mid vs. Post	7.54*	4.80	6.80*	4.00
Pre vs. Post	10.67*	11.20*	10.87*	11.27*

*$p < .01$.

Significant improvement from the pre- to midtest was noted only for the academically handicapped and normal control groups. Apparently the CCDE Sensory-Motor Program takes at least 15 weeks before significant changes in motor performance will occur for both normal and academically handicapped children. Significant improvement from mid- to posttest was noted for the academically handicapped and normal experimental groups. Significant improvement from pre- to posttest was noted for all four groups. The null hypothesis that there is no significant difference between pre-, mid-, and posttest trials was rejected.

Included also in Table 7 is information for examination of the research hypothesis: The CCDE Sensory-Motor Program as measured by the Bruininks-Oseretsky Test Short Form will enhance the motor performance of academically handicapped and normal first-grade children. This enhancement will be documented by significant difference between pre- and midtests for the normal children and by signifiacant difference between pre- and posttests for the academically handicapped children. This hypothesis was rejected since only part of the groups exhibited the learning pattern expected from pre- to midtest and from mid- to posttests.

The findings of the analysis of variance on the six subtests of the Southern California Perceptual Motor Test related to the following null hypotheses are presented in Table 8: (a) There is no significant difference between

Table 8

Comparison of Groups, Trials, and Interaction on the Southern California Perceptual Motor Test

Source	df	SS	MS	F	p
Imitation of Postures					
Between					
Groups	3	136.11	45.37	2.01	.123
S(Gr)	56	1263.64	22.57		
Within					
Trials	2	287.43	143.72	16.98**	.001
Tr x (Gr)	6	36.88	6.15	.73	.630
Crossing the Midline					
Between					
Groups	3	923.88	307.96	6.66**	.001
S(Gr)	56	2591.33	46.27		
Within					
Trials	2	53.63	26.82	1.40	.251
Tr x (Gr)	6	102.23	17.04	0.89	.504
Bilateral Motor Coordination					
Between					
Groups	3	337.24	112.41	3.71*	.017
S(Gr)	56	1697.33	30.31		
Within					
Trials	2	30.18	15.09	2.51	.085
Tr x (Gr)	6	77.16	12.86	2.14	.054

*$p \leq .01$; **$p \leq .001$.

Table 8--Continued

Source	df	SS	MS	F	p
Right-Left Discrimination					
Between					
Groups	3	324.33	108.11	3.07	.035
S(Gr)	56	1968.89	35.15		
Within					
Trials	2	130.83	65.42	3.40	.037
Tr x (Gr)	6	84.59	14.10	0.73	.625
Standing Balance (Eyes Open)					
Between					
Groups	3	49365.75	16455.25	4.70*	.005
S(Gr)	56	196088.53	3501.58		
Within					
Trials	2	47661.03	23830.52	22.80**	.001
Tr x (Gr)	6	11980.30	1996.72	1.91	.085
Standing Balance (Eyes Closed)					
Between					
Groups	3	2161.17	720.39	8.79**	.001
S(Groups)	56	4589.16	81.95		
Within					
Trials	2	657.08	328.54	8.50**	.001
Tr x (Gr)	6	519.94	86.66	2.24	.044

*$p \leq .01$; **$p \leq .001$.

the groups on the pre-, mid-, and posttest scores, (b) There is no significant difference between the pre-, mid-, and posttest trials, and (c) There is no significant interaction between groups and trials.

In the section which follows these null hypotheses are discussed separately for each subtest. Tukey B post hoc comparisons are presented in Tables 9 to 15 in order to show specifically where significant differences lay. When appropriate, the research hypothesis pertaining to amount of time required for significant differences to occur is accepted or rejected at the end of the discussion of a subtest.

On the imitation of postures subtest a study of Table 8 reveals a significant difference ($F = 16.98$, $p < .001$) between the trials. The null hypothesis that there is no significant difference between the pre-, mid-, and posttest trials on the imitation of postures subtest is thus rejected. The findings of a post hoc comparison of mean differences to determine which trials were significantly different appear in Table 9. Only one significant difference is found in Table 9. The experimental academically handicapped group improved significantly from the pre- to midtest.

Table 9

Comparison of the Three Trials on the Imitation of Postures Subtest Using the Tukey B Test

Contrast Groups	EAH	Contrast Values CAH	EN	CN
Pre vs. Mid	4.06*	1.60	1.40	6.60
Mid vs. Post	-.40	.67	1.46	.13
Pre vs. Post	3.66	2.27	2.86	2.73

*p < .01.

In Table 9 information is presented also for the examination of the research hypothesis: The CCDE Sensory-Motor Program as measured by the Southern California Perceptual Motor Test will enhance the sensory integration of academically handicapped and normal first-grade children. This enhancement will be documented by significant difference between pre- and midtests for the normal children and by significant difference between pre- and posttests for the academically handicapped children. This hypothesis was rejected for the imitation of postures subtest.

The F ratio of 6.66 in Table 8 indicates a significant ($p < .001$) difference between groups on the crossing the midline subtest. This led to the rejection of the hypothesis that there is no significant difference between the groups on the pre-, mid-, and posttest scores of the crossing the midline subtest.

In Table 10 the post hoc comparisons of the mean differences on the crossing the midline subtest indicated significant differences only on the pretest between the control normal and academically handicapped groups, favoring the normal group. This revealed that these groups were significantly different (i.e., not equated) at the beginning of the 15-week experimental period.

Table 10

Comparison of the Four Groups on the Crossing the Midline Subtest Using the Tukey B Test

Contrast Groups	Contrast Values Pre	Mid	Post
EAH vs. CAH	-2.20	-1.87	-3.73
EAH vs. EN	4.73	3.93	1.20
EAH vs. CN	3.20	1.13	2.47
CAH vs. EN	6.93*EN[a]	5.80	4.93
CAH vs. CN	5.40	3.00	6.20
EN vs. CN	-1.53	-2.80	1.27

*$p < .01$.

[a] The significant difference favored this group.

On the bilateral motor coordination subtest an F ratio of 3.71 in Table 8 revealed a significant ($p < .01$) difference between groups. The post hoc comparison of mean differences is presented in Table 11.

Table 11

Comparison of the Four Groups on the Bilateral Motor Coordination Subtest Using the Tukey B Test

Contrast Groups	Contrast Values Pre	 Mid	 Post
EAH vs. CAH	-2.13	.06	-.47
EAH vs. EN	-.46	3.80*EN[a]	1.20
EAH vs. CN	2.07	3.46*CN[a]	2.60
CAH vs. EN	1.67	3.74*EN[a]	1.67
CAH vs. CN	4.20*CN[a]	3.40	3.07
EN vs. CN	2.53	-.34	1.40

*$p < .01$.

[a]The significant difference favored this group.

The post hoc comparisons for the four groups on the bilateral motor coordination subtest indicated that in three of four comparisons the normal groups made significantly higher ($p < .01$) scores than the academically handicapped groups on the midtest; however, this finding was not applicable to the posttest. No significant difference between groups on the posttest indicated that neither the sensory-motor or the regular physical education programs had lasting effects on the children in the improvement of bilateral motor coordination.

On the right-left discrimination subtest no significant differences ($p < .01$) were found in Table 8. It appears that neither the sensory motor program nor the regular physical education program contributed to the children's ability to distinguish between right and left. The hypotheses of no significant difference between groups and trials pertaining to the right-left discrimination subtest were accepted.

On the standing balance (eyes open) subtest a significant F ratio of 4.70 in Table 8 revealed a significant difference between groups. This finding led to the rejection of the null hypothesis that there is no significant difference between the groups on the standing balance (eyes open) subtest. The post hoc comparisons of mean differences were calculated to determine which means were significantly different.

Table 12

Comparison of the Four Groups on the Standing Balance Eyes Open Subtest Using the Tukey B Test

Contrast Groups	Contrast Values Pre	 Mid	 Post
EAH vs. CAH	25.93	26.00	13.26
EAH vs. EN	15.20	41.60	52.80*EN[a]
EAH vs. CN	32.93	55.33*CN[a]	41.13
CAH vs. EN	-10.73	15.60	39.54
CAH vs. CN	7.00	29.33	27.87
EN vs. CN	17.73	13.73	-11.67

$^{*}\underline{p} < .01.$

[a]Significant differences favored this group.

In Table 12 differences are noted between the academically handicapped experimental group and the normal control and normal experimental groups, in favor of the normal groups. This finding was expected as it is well substantiated in the literature that academically handicapped children have difficulty on balance items of motor fitness tests (Bruininks & Bruininks, 1977); however, in this study there were no significant differences in balance on the pretest. The significant difference on the posttest between the two experimental groups, in favor of the normal group, indicates that the CCDE Sensory-Motor Program may enhance the ability of normal children more than academically handicapped children during a 15-week program. This finding is unusual in that the CCDE Sensory-Motor Program was designed primarily to improve the motor performance of academically handicapped children.

A comparison of the three trials on the standing balance (eyes open) subtest is presented in Table 13.

Table 13

Comparison of the Three Trials on the Standing Balance Eyes Open Subtest Using the Tukey B Test

Contrast Groups	Contrast Values			
	EAH	CAH	EN	CN
Pre vs. Mid	2.80	2.87	29.20	25.20
Mid vs. Post	28.40	15.66	39.60	14.20
Pre vs. Post	31.20	18.53	68.80*	39.40

*$\underline{p} < .01$.

Comparison of the three trials in Table 13 revealed specifically where the significant differences between pre-, mid-, and posttest trials on the standing balance (eyes open) subtest occurred. The CCDE Sensory-Motor Program contributed to the improvement of balance from pre- to posttest for the normal but not for the academically handicapped group.

On the standing balance (eyes closed) subtest, there are two significant F ratios, 8.79 and 8.50 in Table 8. These indicate significant differences ($p < .001$) between the groups and the trials and led to the rejection of the null hypotheses. A comparison of the four groups on the standing balance (eyes closed) subtest is presented in Table 14.

Significant differences occurred only between the control academically handicapped group, the control normal group, and the experimental normal group. On the midtest significant differences occurred between the control academically handicapped and the experimental normal groups, favoring the children in the CCDE program.

On the posttest significant differences were found between the two normal groups, favoring the experimental normal group. This finding indicates that the CCDE Sensory-Motor Program may be more beneficial than regular physical education in the development of balance skills with eyes closed for normal children.

Table 14

Comparison of the Four Groups on the Standing Balance Eyes Closed Subtest Using the Tukey B Test

Contrast Groups	Contrast Values Pre	Mid	Post
EAH vs. CAH	-2.47	-3.00	-2.80
EAH vs. EN	1.20	7.07	9.87*EN[a]
EAH vs. CN	-1.54	-1.53	-3.13
CAH vs. EN	3.67	10.07*EN[a]	12.67*EN[a]
CAH vs. CN	.93	1.47	.33
EN vs. CN	-2.74	-8.60	-13.00*EN[a]

*$p < .01$.

[a] The significant difference favored this group.

Other significant differences on the posttest were noted between the academically handicapped and normal groups. Although no significant differences were noted on the pretest in this study, the literature indicates the superior motor performance of normal vs. academically handicapped children (Pyfer & Carlsen, 1972).

A comparison of the three trials on the standing balance (eyes closed) subtest is presented in Table 15. Only one significant difference is revealed in Table 15; it is for the experimental normal group from pre- to post-test. Apparently the CCDE Sensory-Motor Program takes at least 15 weeks before significant changes in balance (eyes closed) will occur for normal children. The time required for significant improvement in balance for academically handicapped children in the CCDE Sensory-Motor Program or regular physical education program was not determined in this investigation.

Table 15

Comparison of the Three Trials on the Standing Balance Eyes Closed Subtest Using the Tukey B Test

Contrast Groups	Contrast Values EAH	CAH	EN	CN
Pre vs. Mid	2.53	2.00	8.40	2.54
Mid vs. Post	.00	.20	2.80	-1.60
Pre vs. Post	2.53	2.20	11.20*	.94

*$\underline{p} < .01$.

Summary

Significant differences were found between groups and between trials on the Bruininks-Oseretsky Test Short Form and on four of the six subtests of the Southern California Perceptual Motor Test. Of the significant differences between groups, most indicated differences between the academically handicapped and normal groups. Only one significant difference was found between the experimental and control groups. This was on the standing balance (eyes closed) subtest of the SCPMT and favored the experimental normal group.

Significant differences between trials were found on the Bruininks-Oseretsky Test Short Form and three of the six subtests of the Southern California Perceptual Motor Test. Of these differences, the BOT-SF was the only test in which all groups improved significantly ($p < .01$) from pre- to posttest.

No significant ($p < .01$) interactions between groups and trials were noted on any of the dependent variables. In summary, the findings indicate that the CCDE Sensory-Motor Program and regular physical education are equally effective in the enhancement of motor performance as measured by the Bruininks-Oseretsky Test Short Form.

Neither program seems to enhance sensory integration as measured by the Southern California Perceptual Motor Test with one exception. The CCDE Sensory-Motor Program was better than the regular physical education program in the improvement of standing balance (eyes closed) for normal children.

In Chapter V, as summary of the study, a conclusion based on the findings, and recommendations for further studies will be presented.

CHAPTER V

SUMMARY, CONCLUSION, DISCUSSION, AND RECOMMENDATIONS

The problem of this study was to determine if participation in the Chronologically Controlled Developmental Education (CCDE) Sensory-Motor Program would improve the motor performance and sensory integration of academically handicapped and normal first-grade children. Two experimental groups participated in a sensory-motor program of developmental exercises, crawling patterns, and deep pressure tactile stimulation (Snapp, 1979) for 30 minutes a day, 5 days a week, for 15 weeks. During the same period, two control groups participated in a regular physical education program. The four groups, each comprised of 15 children, attended Crockett Elementary School, San Marcos, Texas, during the 1981-1982 academic year. Lesson plans for the experimental groups were constructed by the investigator and implemented by a graduate assistant in the physical education department of Southwest Texas State University. Both persons were certified CCDE teachers. Lesson plans for the control groups, designed to meet the same instructional objectives, were formulated and taught by the regular physical education teacher. Both programs were administered with a 1:15 teacher-student ratio.

Quantitative measures of motor performance were attained from pre-, mid-, and posttest scores on the Bruininks-Oseretsky Test Short Form (BOT-SF), containing 14 subtests. Measures of sensory integration were derived from the Southern California Perceptual Motor Test (SCPMT), containing six subtests. Data were collected by four trained assistants and the investigator. The scores were treated statistically by two-way analysis of variance with repeated measures on the Texas Woman's University DEC System 20 computer. The post hoc test used was the Tukey B. Findings were reported with respect to the efficacy of the CCDE Sensory-Motor Program proposed by Snapp for improving motor performance and sensory integration of academically handicapped and normal first-grade children.

Summary of Findings

Following is a summary of decisions to accept or reject the hypotheses of the study based upon statistical findings.

Statistical Hypotheses Pertaining to the Bruininks-Oseretsky Test Short Form

There is no significant difference between the groups on the pre-, mid-, and posttest scores of the Bruininks-Oseretsky Test Short Form. Rejected.

There is no significant difference between the groups on the pre-, mid-, and posttest trials on the Bruininks-Oseretsky Test Short Form. Rejected.

There is no significant interaction between groups and trials on the Bruininks-Oseretsky Test Short Form. Accepted.

Statistical Hypotheses Pertaining to the Southern California Perceptual Motor Test

The following hypothesis was tested separately for each of the six subtests: There is no significant difference between the groups on the pre-, mid-, and posttest scores.

Imitation of Postures subtest--Accepted.

Crossing the Midline subtest--Rejected.

Bilateral Motor Coordination subtest--Rejected.

Right-Left Discrimination subtest--Accepted.

Standing Balance (Eyes Open) subtest--Rejected.

Standing Balance (Eyes Closed) subtest--Rejected.

The following hypothesis was tested separately for each of the six subtests: There is no significant difference between the pre-, mid-, and posttest trials.

Imitation of Postures subtest--Rejected.

Crossing the Midline subtest--Accepted.

Bilateral Motor Coordination subtest--Accepted.

Right-Left Discrimination subtest--Accepted.

Standing Balance (Eyes Open) subtest--Rejected.

Standing Balance (Eyes Closed) subtest--Rejected.

The following hypothesis was tested separately for each of the six subtests: There is no significant interaction between groups and trials. Accepted for all six subtests.

Research Hypotheses

The following research hypotheses were examined.

1. The CCDE Sensory-Motor Program as measured by the Bruininks-Oseretsky Test Short Form (BOT-SF) will enhance the motor performance of academically handicapped and normal first-grade children. This enhancement will be documented by a significant difference between pre- and midtests for the normal children and by a significant difference between pre- and posttests for the academically handicapped children. The hypothesis was rejected since

only part of the groups exhibited the learning pattern expected from pre- to midtest and from mid- to posttests.

2. The CCDE Sensory-Motor Program as measured by each subtest of the Southern California Perceptual Motor Test (SCPMT) will enhance sensory integration of academically handicapped and normal first-grade children. This enhancement will be documented by a significant difference between pre- and midtests for the normal children and by a significant difference between pre- and posttests for the academically handicapped children. The hypothesis was rejected.

Conclusion

Within the limitations of this study, it was concluded that participation in the CCDE Sensory-Motor Program and regular physical education are equally effective in the enhancement of motor performance of first-grade academically handicapped and normal children. Neither program seems to enhance sensory integration with one exception. The CCDE Sensory-Motor Program is better than regular physical education in the improvement of standing balance (eyes closed) for normal children who score below average on Ayres' norms on this item.

Discussion

The results of this study indicated that there was a significant difference ($p < .01$) between academically handicapped and normal children in motor performance as measured by the BOT-SF (Bruininks, 1978). This finding was consistent with the research of Cruickshank (1967) and Bruininks and Bruininks (1977). Moreover, it should be noted that on the BOT-SF pretest, all groups were below the 50th percentile on the norms (Bruininks, 1978). Previous research by Lipton (1970), Walton (1974), and Lamport (1974) substantiated the fact that academically handicapped youth can improve motor performance as a result of participation in a carefully planned program of physical education. The results of this study were consistent with previous research. The results indicated also that a CCDE Sensory-Motor Program of at least 15 weeks duration could also improve motor performance of both normal and academically handicapped first-grade children.

Neither the CCDE Sensory-Motor Program or regular physical education seemed to enhance sensory integration as measured by the SCPMT (Ayres, 1968) with one exception. The CCDE Sensory-Motor Program was better than regular physical education in the improvement of standing balance (eyes closed) for normal children. One explanation for this may relate to the pretest means on the SCPMT. Compared with the norms (Ayres, 1980), all groups were average or above average on the subtests of the SCPMT except for standing balance (eyes closed) in which all groups were below average. This seems to imply that the groups may not have needed special training like the CCDE Sensory-Motor Program, which was directed toward sensory integration except for the remediation of their deficit.

Although Snapp (1979) recommends his program for all first-grade classes, this investigator, on the basis of the findings of this study, believes that the CCDE Sensory-Motor Program may not benefit all first-grade children. Specifically it does not seem to benefit children who score average or above on the SCPMT. Further research is necessary to determine the characteristics of children who would receive the greatest benefit from the program.

Several other factors may have contributed to the finding that academically handicapped and normal children exposed to the CCDE Sensory-Motor Program did not differ significantly at the end of the experimental period from their respective control groups. The random assignment of subjects to groups in this study failed to result in equality with respect to racial background, reading performance, and sex. This problem could have been averted through the use of a randomized block design.

Most of the subjects in the academically handicapped groups were Hispanic. It is possible, therefore, that their classification as academically handicapped, which was based on their below average reading performance, may not have been a valid indicator of neurological dysfunction. Their failure to read at grade level may have reflected cultural rather than neurological differences. It should be noted, however, that the difference between the number of Hispanic children in the experimental and control groups was not statistically different. It should be noted, also, that the percentage of Hispanic, White, and Black individuals in the sample were representative of the total school population which was 65% Hispanic, 31% White, and 4% Black.

Another factor which may have weakened the effectiveness of the CCDE Sensory-Motor Program was the delimitation established in Chapter I that the program would be conducted in an educational setting where strict environment controls could not be enforced. According to Snapp (1979), the CCDE Program should not be implemented without strict environmental controls. Because the sensory-motor classes were held immediately after lunch on the stage area adjacent to the cafeteria, difficulties were encounted because of inadequate space, inability to darken the area, and extraneous noise. Modification of the program was necessary in the public school setting.

Additionally, because of decisions to examine the hypothesis related to the midtest, a CO-ANOVA could not be used. The analysis of variance with repeated measured did not control for lack of equality of the groups at the beginning of the study on the BOT-SF and two subtests of the SCPMT. The multivariate CO-ANOVA could not be used because of its lack in identifying pre-, mid-, and posttest differences. Therefore, limitations imposed by the statistical design itself, failing to control for the inequality of the groups on the pretest, may have affected the results of the study.

Recommendations for Further Studies

Recommendations for future research are based on the findings of this study. Similar investigations should be conducted:

1. Utilizing different data collection instruments.

2. Selecting subjects drawn from other specific educational classifications such as mild mentally retarded, Down's syndrome, and minimal brain injured populations.

3. Examining different age levels, particularly younger children. The literature recommends that changes

in motor proficiency as a result of participation in sensory-motor programs are more likely to occur with younger children because of the greater plasticity of the nervous system.

4. Administering the program with a smaller (1:1 or 1:5) teacher-student ratio, particularly for severely or profoundly retarded individuals.

5. Comparing the CCDE Sensory-Motor Program with other programs which purport to improve sensory integration.

APPENDIX A

PERMISSION FORM AND INFORMATIVE LETTER

San Marcos Consolidated Independent School District

ADMINISTRATIVE OFFICES
501 South L.B.J. Drive • P. O. Box 1087
San Marcos, Texas 78666
512/392-8141

December 18, 1981

Mrs. Dawn A. White
P.O. Box 44
San Marcos, Texas 78666

Dear Mrs. White:

Your request to conduct a research project concerning the effectiveness of a Sensory Motor Physical Education Program has been approved.

It is understood that the project will be conducted at Crockett Elementary School, under the guidelines established by the principal, Dr. LaRue Miller.

We would be most pleased to receive a copy of the results.

Sincerely,

Don Williams

Don Williams
Assistant Superintendent
for Personnel and Administration

DW/nm

January 5, 1982

Dear Parents:

As a part of the regular physical education program, we will be providing additional and specialized physical education activities. The purpose of these activities is to find out how physical education can help students learn better in school.

Your child has been selected to participate in this program. The activities will be conducted as a part of your child's regular physical education class. The teacher will be Mrs. Dawn Logan.

If you have any questions, please feel free to contact me.

Sincerely,

LaRue Miller

Dr. LaRue Miller, Principal
Crockett Elementary School
1300 Girard Street
San Marcos, Texas 78666

LRM:kes

APPENDIX B

DIRECTIONS FOR THE BRUININKS-OSERETSKY TEST SHORT FORM

Directions for the Administration of the
Bruininks-Oseretsky Test Short Form

The following test directions are paraphrased from the Bruininks-Oseretsky Test Manual (Bruininks, 1978). Directions for the 14 subtests on the Short Form are included in Appendix B .

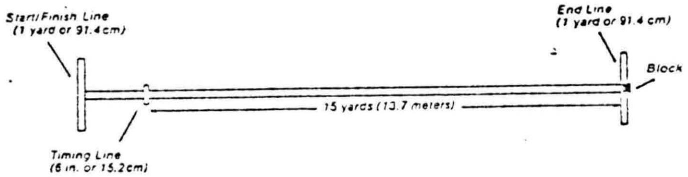
SUBTEST 1: Running Speed and Agility

GENERAL DIRECTIONS

1. Require the subject to wear tennis or crepe-soled shoes.
2. Administer the subtest in a large area that is free of obstacles and hazards and that has a nonslippery surface. A wooden floor is preferable. If a wooden floor is not available, a concrete or asphalt floor may be used. Reduce any slipperiness by sweeping the surface.
3. Prepare the running course as shown in Figure 1. The lines to be marked on the running course are labeled on the tape measure.
   a. Place a 1-yard piece of masking tape on the floor to mark the start-finish line.
   b. Tape the metal pull of the tape measure to the center of the start/finish line. Pull the tape measure out to the timing line and place a 6-inch piece of masking tape on the floor.
   c. Tape the metal pull of the tape measure to the center of the timing line and pull the tape measure out to

the end line. Place a 1-yard piece of masking tape on the floor.

d. Place the block on the end line.



Layout of running course Subtest 1
Figure 1

Running Speed and Agility

The subject runs to the end line, picks up the block, and runs back across the start/finish line. The subject is timed between the first and last crossings of the timing line.

Trials: 2

Administering and Recording

Stand beside the timing line and have the subject stand behind the start/finish line. Say: "When I say 'On your mark, get set, go,' run as fast as you can to the block, pick it up, and bring it back across this line. Don't slow down; run fast across this line. "On your mark, get set, go!"

Start the watch when the subject crosses the timing line and stop the watch when the subject crosses the timing line with the block. If the subject slows down as she or he approaches the timing line, remind the subject to continue to run fast across the start/finish line. Start the trial over if the subject: (a) stumbles or falls, (b) fails to pick up the block, or (c) drops the block before crossing the timing line. On the second trial, encourage the subject to run faster. Record the time to the nearest 0.2 second in the appropriate space on the Individual Record Form. If the hand of the stopwatch is between two numbers, record the higher number.

SUBTEST 2: Balance

GENERAL DIRECTIONS

1. Require the subject to wear tennis or crepe-soled shoes.
2. Prepare the target and balance beam as shown in Figure 2.
   a. Fasten the target to the wall with masking tape so that the lowest point on the circumference is at the subject's eye level.
   b. Place balance beam in front of the target about 10 feet from the wall. The balance beam should be as straight as possible.
3. For all items, stand next to the subject to observe performance most efficiently.

4. For all items, administer a second trial only if the subject does not achieve a maximum score on the first trial. When a second trial is necessary, the subject's errors should be pointed out before the second trial is administered.

Standing on Preferred Leg on Balance Beam

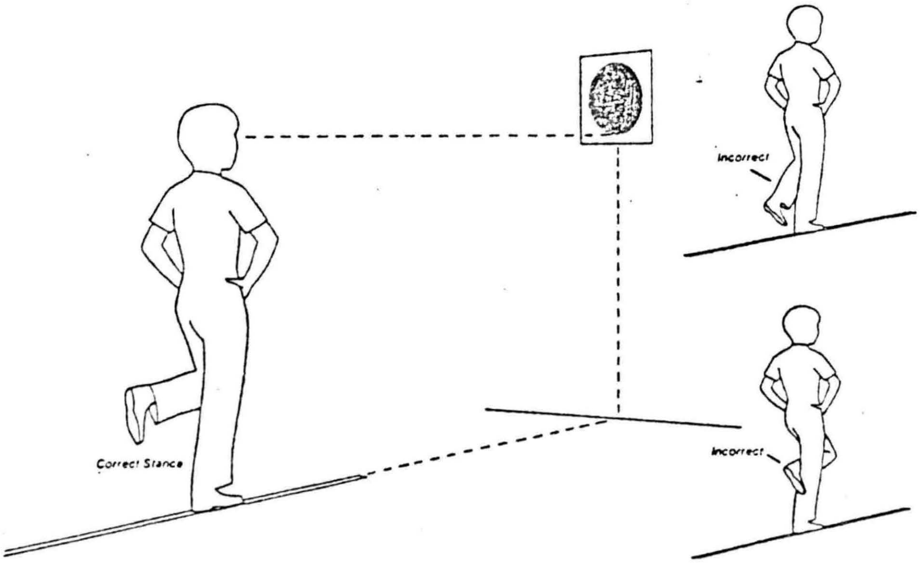
The subject stands on preferred leg on the balance beam, looking at the target with hands on hips, and with other leg bent so that it is parallel to the floor. The subject must maintain the position for 10 seconds to achieve a maximum score.

Trials: 2 Administer a second trial only if the subject does not achieve a maximum score on the first trial.

Administering and Recording

Place the balance beam over the walking line. Say: "Stand on the beam on your (right/left) leg and raise your other leg like this (demonstrate). Place your hands on your hips and look at the target. Stand like this until I tell you to stop." If necessary, help subject achieve the correct position. Begin timing as soon as position is achieved and remind subject as needed to keep hands on hips and to look at target. Slight swaying is acceptable. Allow only one warning to keep the raised leg parallel to the floor (or above a 45 angle).

After 10 seconds, tell the subject to stop. Stop the trial and record the time before 10 seconds if the subject: (a) drops the raised leg so that it touches the floor, (b) drops the raised leg below a 45 angle after one warning, (c) hooks the raised leg behind the supporting leg, or (d) shifts the supporting foot out of place. On the Individual Record Form, record to the nearest second the time that the subject maintains the correct position.



Standing on preferred leg on walking line or balance beam
Subtest 2:

Figure 2

Walking Forward Heel-to-Toe on Balance Beam

The subject walks forward on the balance beam heel-to-toe, with hands on hips. The subject must make 6 consecutive steps correctly to achieve a maximum score.

Trials: 2 Administer a second trial only if the subject does not achieve a maximum score on the first trial.

Administering and Recording

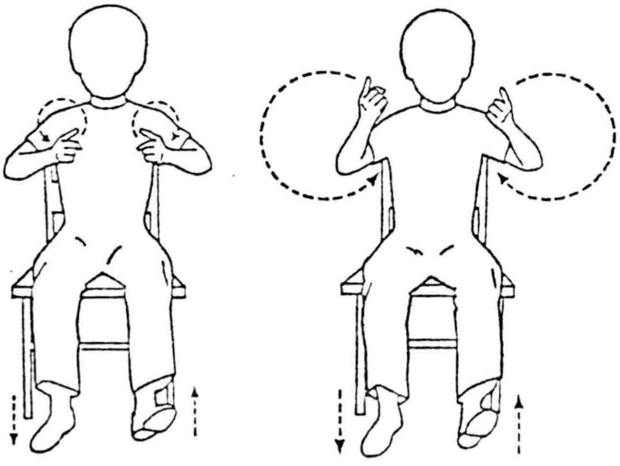
Place the balance beam in the designated position. Have the subject stand at one end of the beam. Say: "Place your feet on the beam like this (demonstrate a heel-to-toe stance). Place your hands on your hips. When you walk down the beam, hit the toe of your back foot with the heel of your front foot (demonstrate). Walk to the end of the beam. Remember, keep your feet on the beam and your hands on your hips as you walk. Ready, begin." Stand at one side of the beam and count the subject's steps, keeping track of both correct and incorrect steps. A step is incorrect if the subject: (a) does not touch the heel of the front foot to the toe of the back foot, or (b) moves the back foot forward to touch the heel of the front foot. Remind the subject as needed to walk heel-to-toe and to keep hands on hips. After six steps have been taken, tell the subject to stop. If the subject places one or both feet completely off the beam before taking six steps, stop the trial and record the number of steps taken on the beam. On the Individual Record Form, record the number of correct and incorrect steps. Use "1" for correct steps and "0" for incorrect steps.

SUBTEST 3: Bilateral Coordination

Tapping Feet Alternately While Making Circles with Fingers

The subject taps feet alternately while making circles with index fingers, as shown in Figure 3. The subject is given 90 seconds to complete 10 consecutive foot taps correctly. The score is recorded as a pass or a fail.

Trials: 1



Correct

Incorrect

Tapping feet alternately while making circles with fingers
Subtest 3

Figure 3

Administering and Recording

Place two chairs facing each other; have the subject sit facing you. The subject's arms are held at, or slightly below shoulder height with elbows bent and index fingers pointing toward the examiner. One index finger is to move clockwise and the other counterclockwise. Say: "First tap one foot and then the other like this (demonstrate). At the same time you tap your feet, hold your arms in front of you and close your hands, pointing your first (index) fingers to me like this (demonstrate). Make circles with just your fingers; try not to move your hands, wrists, or arms (demonstrate). Keep tapping your feet and making circles with your fingers until I tell you to stop. Ready, begin." The subject may tap toes with heels resting on floor, tap with the entire foot, or tap heels with toes resting on floor, as long as the tapping rhythm is consistent. Begin timing. If necessary, provide additional instruction. Start counting taps as soon as the subject establishes a consistent tapping rhythm. During the trial, correct the subject and start counting over if he or she: (a) does not maintain a consistent tapping rhythm, (b) fails to alternate feet, (c) fails to make circles simultaneously with both fingers, (d) uses wrists and forearms in making circles, or (e) fails to make complete circles. Wiggling fingers is incorrect.). Allow no more than 90 seconds.

including time needed for additional instruction, for the subject to complete 10 consecutive foot taps correctly. After 90 seconds, tell the subject to stop. On the Individual Record Form, record pass or fail.

Jumping Up and Clapping Hands

The subject jumps as high as possible, clapping hands in front of fact as many times as possible before landing. The subject must clap 5 times to achieve a maximum score. Trials: 2 Administer a second trial only if the subject does not achieve a maximum score on the first trial.

Administering and Recording

Stand facing the subject. Say "When I tell you to begin, jump straight up as high as you can. As you jump, clap your hands in front of your face as many times as you can before you land (demonstrate). Ready, begin. Count claps as subject jumps. Do not count claps that are made while the subject's feet are on the floor or claps that are made below chest level. Mark the trial "0" if the subject loses balance and touches the floor with one or both hands when landing. On the Individual Record Form, record the number of claps made correctly.

SUBTEST 4: Strength

GENERAL DIRECTIONS

1. If the subject appears tired, administer this subtest a after a rest period or on another day.

2. Prepare the jumping area in the following manner: (a) fasten a 2-foot strip of masking tape to the floor to mark the starting line, and (b) tape the metal pull of the tape measure to the floor perpendicular to the starting line and pull the tape measure out until the number series 16 appears. Fasten the tape measure to the floor at the line following the last 16.

Standing Broad Jump

The subject jumps forward as far as possible, starting from a bent-knee position. The distance of each jump is recorded.

Trials: 3

Administering and Recording

Have the subject jump up and down a few times before starting. Then say: "Stand behind this line with your feet spread about as far apart as your shoulders (demonstrate). Bend your knees, lean forward, and swing your arms at your sides a few times. When I say go, put your arms back and jump forward as far as you can, letting your arms swing forward, and land on both feet (demonstrate). Remember, bend your knees, swing your arms back, and jump as far as you can. When you jump, let your arms swing forward and try to land on both feet. If you lose your balance, try to fall forward. Ready, go." Between trials repeat instructions as necessary. Correct the subject and readminister the trial if the subject shuffles over the starting line before jumping or if the subject jumps up instead of forward. On the Individual Record Form, record the distance jumped on each trial by noting the number that is nearest the point where the back of the subject's heels land. If one foot lands behind the other, measure to the heel that is nearest the starting line. If the subject loses balance and falls backward, measure to the point where the subject's hands (or other part of the body nearest the starting line) touch the floor.

SUBTEST 5: Upper-Limb Coordination

GENERAL DIRECTIONS

1. Place the standing mat, rough-side down, on the floor so that the mat will not move. Fasten a small strip of masking tape to the floor 10 feet from the standing mat.
2. Tape the target to the wall so that the lowest point on the circumference is at the subject's eye level. Fasten a 3-foot strip of masking tape to the floor 5 feet in front of the 9 3/4 inch diameter target.

<u>Catching a Tossed Ball with Both Hands</u>

The subject stands on the standing mat, and with both hands, catches a tennis ball tossed underhand from a distance of 10 feet. The number of correct catches is recorded.

Trials 1 practice, 5 recorded

Administering and Recording

Say: "Stand on the mat and catch this ball with both hands when I throw it to you." Give the subject one practice trial. Stand behind the strip of masking tape and slowly toss the ball underhand in a slight arc so that it comes down between the subject's shoulders and waist. Then say: "Catch the ball with both hands each time I throw it to you. Count the number of correct catches made in 5 trials. A catch is incorrect if the subject: (a) misses the ball or traps it against the body, (b) steps off the mat, or (c) catches the ball with one hand. It the subject misses the ball because it is thrown above the shoulders, below the knees, or outside the subject's reach, readminister that trial. On the Individual Record Form, record the number of correct catches.

Throwing a Ball at a Target with Preferred Hand

With the preferred hand, the subject throws a tennis ball overhand at the target from a distance of 5 feet. The subject receives a point each time the ball is correctly thrown and hits the 9 3/4 inch target. See Figure 4.

Trials: 1 practice, 5 recorded

Administering and Recording

Say "Stand behind this line. You are to throw the ball overhand at the bull's-eye (demonstrate). Throw from behind this line. Give the subject one practice trial.

The subject may throw overhand in a modified sidearm motion with both feet stationary, or may take one step forward toward the target while throwing. Then say: "Ready, begin." Stand behind the subject and count the number of correct throws in 5 trials. A throw is incorrect if the subject: (a) misses the target (Hitting the black perimeter of the target is acceptable.), (b) throws underhand, or (c) steps over the line. After 5 trials, tell the subject to stop. On the Individual Record Form, record a "1" for each correct throw and a "0" for each incorrect throw.

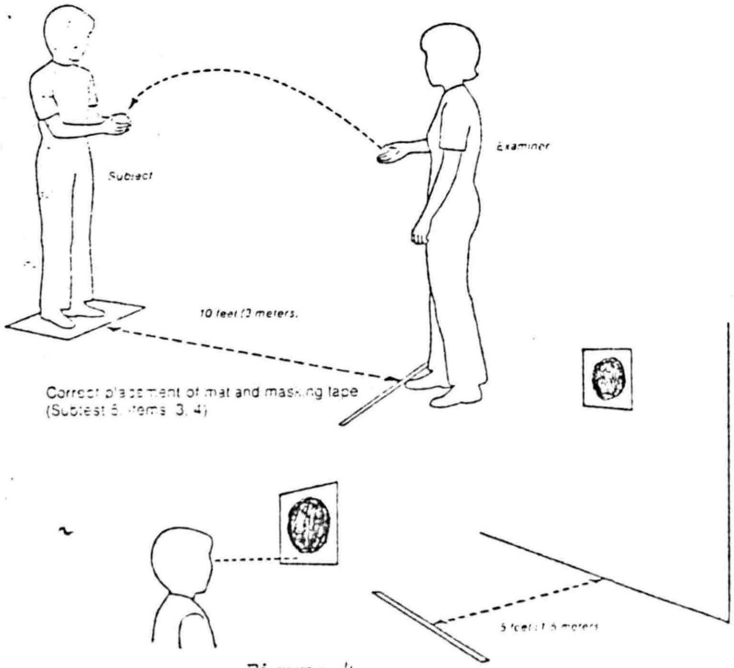


Figure 4

SUBTEST 6 Response Speed

GENERAL DIRECTIONS

Fasten a 1-foot strip of masking tape to the wall. The tape strip should be slightly below the subject's shoulders when the subject is seated and far enough off the floor so that the entire response speed stick is below the tape line when the stick is resting perpendicular to the floor. The subject must be seated high enough so that both of these requirements are met.

Response Speed

The subject places the preferred hand flat on the wall, next to the response speed stick. The examiner holds the stick vertically against the wall and then drops the stick. The subject uses the thumb of the preferred hand to stop the stick as it drops. The response speed stick number that is at or just above the tape strip when the stick is stopped is the trial score. The point score is derived from the trial scores.

Trials: 2 practice, 7 recorded.

Administering and Recording

Sit beside the subject, facing the wall; the subject should be seated with his or her preferred arm away from you. Say: "We are going to find out how fast you can stop a falling stick." Place the response speed stick flat against the wall in front of the subject so that the starting line on the stick is even with the top edge of the tape. Then say: "Let me show you what to do. Put your (right/left) hand against the wall next to the red line on the stick." Help the subject place the preferred hand against the wall with the thumb about 1/2 to 1 inch away from the stick, spreading the fingers in a comfortable, fan-like position. The thumb should be over, but not on, the stick; no part of the subject's hand should touch the stick before it is dropped. Say "Watch the red line on the stick. When the red line moves, stop the stick as fast as you can with your thumb (demonstrate by placing the subject's thumb against the stick). Just before I let the stick fall, I will say "Get set" Then, when you see the red line move, stop the stick with your thumb as fast as you can. Give the subject 2 practice trials. For each trial, say "Get set" slowly and deliberately and then wait the number of seconds shown on the table below before releasing the stick. Count the seconds silently--one thousand one; one thousand two, etc. Keep the stick perpendicular to the tape strip and make certain that the subject is observing the red line before you release the stick.

	Trial	Seconds
Practice	1	1
Practice	2	3
	1	2
	2	3
	3	1
	4	3
	5	2
	6	1
	7	1

Administer 7 trials. Repeat instructions and readminister a test trial if the subject: (a) fails to look at the stick when it is dropped, or (b) touches the stick before or just as it is released. On the Individual Record Form, record the response speed stick number that is at, or just above the tape strip when the subject stops the stick. This is the trial score. Record "0" for a trial if the subject does not stop the stick before it hits the floor. To obtain the point score for this subtest, rank the scores for the 7 trials from highest to lowest. The median (middle) score is the point score.

SUBTEST 7: Visual-Motor Control

GENERAL DIRECTIONS

1. Administer the test with the subject seated next to you at a table.
2. Do not count errors or score until all testing has been completed.

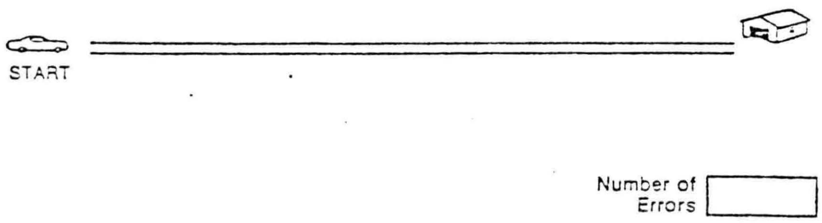
Drawing a Line Through a Straight Path with Preferred Hand

The subject uses the preferred hand to draw a pencil line through a path. The number of errors made is recorded.

Trials: 1

Administering and Recording

Clip the Student Booklet to the clipboard and have red pencils ready to use. While holding one corner of the clipboard say: "This is a road (Point to path shown in Figure 4). Take the red pencil and draw a line from the car to the end of the road. Stay inside the lines; try not to go off the road. Take as much time as you need. Ready, begin." Allow as much time as necessary. Keep your hand on the clipboard and do not allow the subject to rotate the test page more than 45 degrees while drawing. Record the number of errors made, up to a maximum of 7 errors. An error is made each time the line goes outside the boundary lines. Count an additional error for each one-half inch the line remains outside the boundary lines. Record the score in the Individual Record Form.



Drawing a Line Through a Straight Path with Preferred Hand

Figure 5

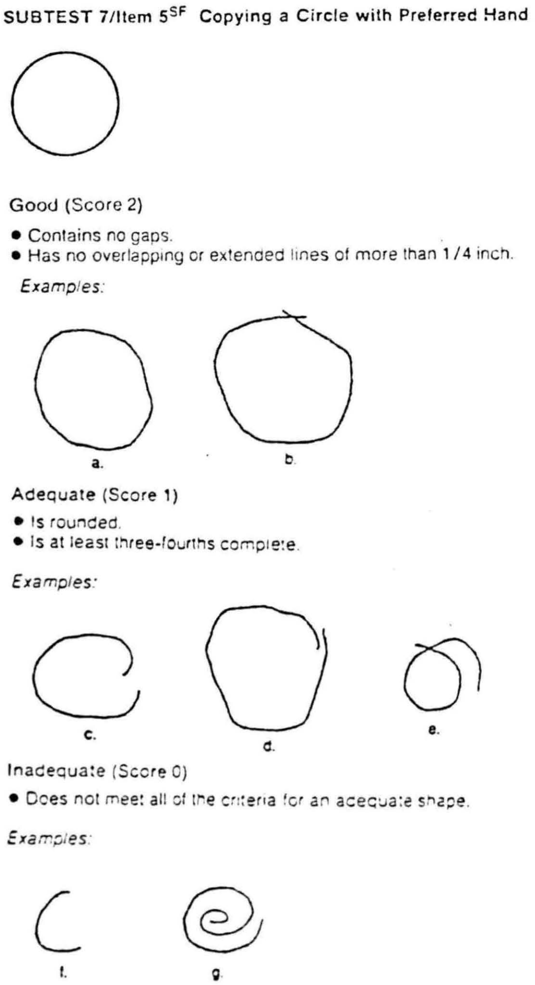
Copying a Circle with Preferred Hand

The subject uses the preferred hand to copy a circle. The accuracy of the drawing is evaluated and scored.

Trials: 1

Administering and Recording

Clip the Student Booklet to the clipboard and have black pencils ready to use. Say: "Look at the circle in this box. With your (right/left) hand make one just like it in the empty box below. Take as much time as you need. Ready begin." Erasing is permitted. Keep your hand on the clipboard and do not allow the subject to rotate the test page more than 45 degrees while drawing. Refer to the scoring directions in Figure 5. Record the score in the Individual Record Form.



SUBTEST 7/Item 5^{SF} Copying a Circle with Preferred Hand

Good (Score 2)

- Contains no gaps.
- Has no overlapping or extended lines of more than 1/4 inch.

Examples:

Adequate (Score 1)

- Is rounded.
- Is at least three-fourths complete.

Examples:

Inadequate (Score 0)

- Does not meet all of the criteria for an adequate shape.

Examples:

Figure 6

Copying Overlapping Pencils with Preferred Hand

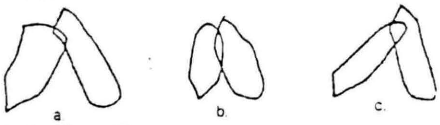
Use same directions as for the Copying a Circle with Preferred Hand item. Refer to the scoring directions in Figure 7. Record the score in the Individual Record Form.

SUBTEST 7: Item 8^{SF} Copying Overlapping Pencils with Preferred Hand

Good (Score 2)

- Shows two overlapping pencils, each longer than it is wide, each with relatively straight and parallel sides, each with one pointed end and one rounded end.
- Shows the left-hand pencil pointed downward and to the left, and the right-hand pencil pointed upward.
- Shows the rounded end of the left-hand pencil overlapping the pointed end of the right-hand pencil. (The overlap must not be extreme.)
- Contains no corner gaps greater than 1/8 inch.
- Has no overlapping or extended lines of more than 1/4 inch.

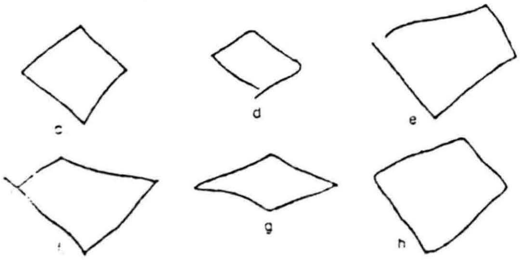
Examples:



Adequate (Score 1)

- Has four relatively straight sides.
- Has four definite corners. (Corners may be slightly rounded as shown in Example d.)
- Contains no more than one corner gap greater than 1/8 inch.
- Has no more than one overlapping or extended line of more than 1/4 inch.

Examples:



Inadequate (Score 0)

- Does not meet all of the criteria for an adequate shape.

Examples:

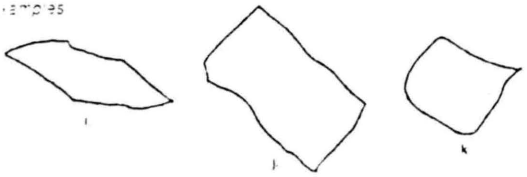


Figure 7

SUBTEST 8: Upper-Limb Speed and Dexterity

GENERAL DIRECTIONS

1. Administer this subtest with the subject seated across the table from you.
2. If the subject misunderstands a task or stops performing, repeat the instructions and start over.

Sorting Shape Cards with Preferred Hand

With the preferred hand, the subject sorts a mixed deck of red and blue cards into piles, separating them by color. The number of cards correctly sorted in 15 seconds is recorded.

Trials: 1 practice, 1 recorded

Administering and Recording

Place one red card and one blue card on the testing pad in front of the subject. Shuffle the remaining cards. Say "When I say go, put all the red cards here (point to the red card) and all the blue cards here (point to the blue card). Use your (right/left) hand to sort the cards one at a time as fast as you can (demonstrate). Hold the cards in your other hand. Now you try it. As a practice trial, have the subject sort five cards. Reshuffle the cards, leaving one red card and one blue card on the testing pad as sorting guides. Place the deck on the testing pad. Then say: "Keep sorting the cards with your (right/left) hand until I tell you to stop. Ready, go!" Begin timing when the subject touches the cards. Count the number of cards the subject sorts correctly; do not count the guide cards. If the subject sorts mare than one card at a time, give credit for only one card. If the subject changes hands, readminister the trial. After 15 seconds tell the subject to stop. On the Individual Record Form, record the number of cards sorted correctly.

Making Dots in Circles with Preferred Hand

The subject makes a pencil dot inside each of a series of circles. The number of circles dotted correctly in 15 seconds is recorded.

Trials: 1 practice, 1 recorded

Administering and Recording

Clip the Student Booklet to the clipboard and have red pencils ready to use. Say: "When I say go, take the red pencil in your (right/left) hand and make one dot in each circle as fast as you can." Demonstrate by tapping with the eraser end of the pencil in a left-to-right progression in the practice circles. Then say: "Now you try it here:" Have the subject make one dot in each of the practice circles. It is not necessary for the subject to make dots from left to right. Then say: "Make one dot in each of these circles. Put a dot in as many circles as you can as fast as you can. Ready, Go!" Begin timing when the subject touches the pencil to the paper. After 15 seconds, tell the subject to stop. On the Individual Record Form record the number of separate dots.

BRUININKS-OSERETSKY TEST
OF MOTOR PROFICIENCY
Robert H. Bruininks, Ph.D.

STUDENT BOOKLET

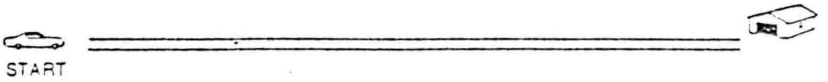
NAME ____________________________________

EXAMINER __________________ DATE ____________

AGS **American Guidance Service**
Circle Pines, Minnesota 55014

SUBTEST 7: Visual-Motor Control

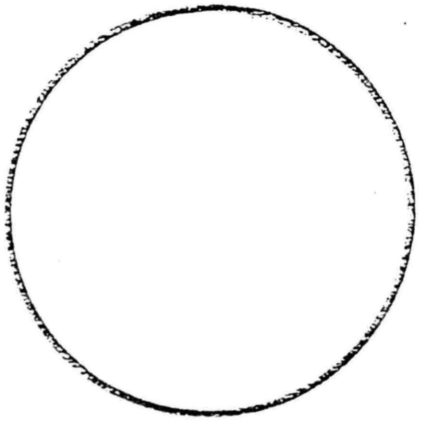
Item 3^{SF} / Drawing a Line Through a Straight Path with Preferred Hand



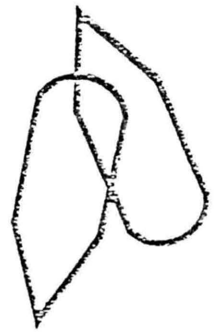
Number of Errors ☐

SUBTEST 7: Visual-Motor Control

Item 5^{SF} / Copying a Circle
with Preferred Hand



Item 8^{SF} / Copying Overlapping Pencils
with Preferred Hand



Score

Score

SUBTEST 8: Upper-Limb Speed and Dexterity

Item 7^{SF} / Making Dots in Circles with Preferred Hand

Practice: ○ ○ ○ ○ ○

○ ○ ○ ○ ○ ○ ○ ○ ○ ○
○ ○ ○ ○ ○ ○ ○ ○ ○ ○
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Number Correct ☐

APPENDIX C

DIRECTIONS FOR THE SOUTHERN CALIFORNIA PERCEPTUAL MOTOR TEST

Directions for the Administration of the Southern California Perceptual Motor Test

The following test directions are found in the Southern California Sensory Integration Tests Manual (Ayres, 1980).

Directions for the Administration of the Southern California Perceptual Motor Test

Imitation of Postures

Materials. None other than protocol booklet.

Procedure. The examiner and child sit opposite each other in chairs without arms. The protocol booklet rests on a table to the side of the examiner. The examiner says:

> *You make your arms and hands do the same thing as mine do. See how fast you can do it.*

The examiner then assumes the mirror image of the trial posture, i.e., his or her hands are over the left ear and not the right as appears in the protocol booklet. If the child does not imitate the examiner, the child is again asked to do what the examiner has done. Regardless of whether or not the child imitates the posture correctly, the examiner says, gesturing appropriately and/or touching the child's hands:

> *This hand is over my ear, this hand is on top of it, and I'm leaning to the side. It's as though you were looking in a mirror.*

The examiner helps the child if the child's posture is not correct, placing the child in the correct position. Emphasis is placed on an exact mirror imitation of the examiner. Since the examiner has assumed the mirror image of the picture in the protocol booklet, the child's mirror image of the examiner should look exactly like the picture. After the child has demonstrated the trial posture, the examiner says:

> *Now do this one. Do it quickly.*

The examiner then *quickly* assumes and holds posture in Item 1 for either 10 seconds or until the child has assumed the correct posture, whichever occurs first. It is essential that the examiner assume the posture so quickly that the child cannot follow the movements of the examiner as they are made but must plan his or her movements based on the observed posture of the examiner. The examiner records the score and gives the rest of the items in sequence. No corrections of the child are made after the trial item, but if necessary the child is admonished to move quickly and to be sure that he or she looks exactly like the examiner. A suggested comment is:

> *Watch my hands carefully and make yours do exactly the same thing.*

After either 10 seconds or the child's correct response, the examiner releases the posture and records the score before assuming the next posture. The examiner then begins posture from a neutral position, hands resting in lap. The child will usually imitate the examiner, bringing his or her hands back to the lap. In case the child fails to do so, the examiner asks the child to put his or her hands in the lap. The examiner always assumes a mirror image of the diagram in the protocol booklet and the child usually automatically assumes a mirror image of the examiner without directions to do so. However, if the child should assume correct nonmirror image posture, the response is accepted as correct, but the child is told to give a mirror imitation thereafter. If necessary the child's attention can be obtained before each item with a comment such as:

> *Now watch this one.*

Scoring. Two points are given for each one of the 12 postures imitated correctly in three seconds after the examiner has assumed the posture. One point is given if the child imitates the posture correctly in 4 to 10 seconds. If the posture is close but not exactly correct and is assumed in 10 seconds, 1 point is given. Criteria for scoring are given below. No points are given if the correct posture is assumed after 10 seconds or if it does not meet the criteria for a score of 1 or 2. Since the examiner's hands are involved in the test procedure and the examiner must watch the child closely, the examiner is not free to use a stopwatch. The examiner times the child by counting 1001, 1002, etc., inaudibly to himself or herself, beginning the counting the instant the examiner has finished assuming the position. If the child's response is not clearly a 1- or 2-credit response, the examiner is advised to draw the child's response on the protocol booklet and score it later. On items where arms are crossed (1, 3, 4, and 7), it does not matter which arm is in front of the other. For example, if, on Item 7, the child places left hand in front of right instead of right hand in front of left and the position is otherwise correctly assumed in three seconds, the score is 2.

Item-by-Item Scoring.

Item 1: Score 2 if hands cover knees and arms are crossed within 3 seconds.
Score 1 if above position is obtained in 4 to 10 seconds.
Score 1 if arms are crossed and hands are placed on distal half of thigh within 10 seconds.
Score 0 if arms are not crossed.
Score 0 if hands are at mid-point or proximal aspect of thigh.

Item 2: Score 2 if grasping hand is behind back and grasps (in any manner) elbow, lower half of humerus, or upper half of forearm within 3 seconds.

5 6 7 8 9
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Score 1 if above position is obtained in 4 to 10 seconds.

Score 1 if grasping arm is behind back and grasps other arm at upper half of humerus or lower half of forearm within 10 seconds.

Score 1 if grasping arm is behind back and touches but does not grasp other arm between shoulder and wrist, but exclusive of them.

Score 0 if grasping arm grasps wrist or hand.

Score 0 if grasping arm is behind back but fails to touch other arm.

Item 3: Score 2 if elbows are cupped in opposite hands within 3 seconds.

Score 1 if above position is assumed in 4 to 10 seconds.

Score 1 if one or both hands or parts of both hands touch but do not cup elbow within 10 seconds. Elbow is defined as area within ½ inch of tip of ulna (olecranon process).

Score 0 if one or both hands touch arms in any place other than elbow.

Score 0 if one hand touches elbow and other hand does not.

Item 4: Score 2 if arms are crossed and both palms are placed on cheeks someplace between chin and ear within 3 seconds.

Score 1 if above position is assumed in 4 to 10 seconds.

Score 1 if arms are crossed and palms are on face or someplace other than on cheek, such as chin.

Score 1 if arms are crossed and only finger tips touch cheeks within 10 seconds.

Score 1 if arms are crossed and palmar surface of only one or two fingers of one or both hands are on cheeks.

Score 0 if arms are crossed and dorsum of one or both hands is on cheeks.

Score 0 if arms are not crossed and palms are on cheeks.

Item 5: Score 2 if palm or fingers cover ear on side to which body is leaning to any degree and other palm or fingers are placed on hip or waist within 3 seconds.

Score 1 if above position is assumed in 4 to 10 seconds.

Score 1 if head but not trunk is laterally flexed and hands are in correct position within 10 seconds.

Score 1 if palm or fingers touch side of face but do not cover ear within 10 seconds.

Score 1 if hand is not on hip or waist but on thigh or buttock.

Score 1 if all three of the immediately above conditions prevail.

Score 0 if neither head nor trunk is laterally flexed.

Score 0 if one hand is not on hip, waist, buttock, or thigh.

Score 0 if one hand is not covering some part of face.

Item 6: Score 2 if grasping arm is behind one leg and grasps (in any manner) other leg between ankle and knee in 3 seconds. Alternate arm is in lap but its position does not enter into the scoring. It should be placed in lap inconspicuously before starting posture so the child will not spend time in moving inactive arm.

Score 1 if above position is assumed in 4 to 10 seconds.

Score 0 if arm is not placed behind leg.

Score 0 if hand merely touches, instead of grasps, other leg.

Item 7: Score 2 if wrists are crossed and touch and palmar surface of at least two fingers (exclusive of thumb) of each hand touch each other. Position of shoulder does not enter into scoring.

Score 1 if above position is assumed in 4 to 10 seconds.

Score 1 if wrists are crossed and only one finger (exclusive of thumb) of either hand touches the fingers of other hand within 10 seconds.

Score 0 if wrists are crossed but fingers do not touch each other.

Score 0 if wrists do not touch.

Item 8: Score 2 if palm or fingers of one hand are on opposite cheek and other hand covers opposite knee within 3 seconds.

Score 1 if above position is assumed in 4 to 10 seconds.

Score 1 if arms cross body and one or both hands are slightly misplaced, e.g. hand on ear instead of cheek and/or hand on distal aspect of thigh.

Score 0 if either arm does not cross body or hands are not on locations given for a score of 2 or 1.

Item 9: Score 2 if grasping arm touches head above hair line and grasps (in any manner) other forearm any place between elbow and wrist within 3 seconds.

Score 1 if above position is assumed in 4 to 10 seconds.

Score 1 if grasping arm touches forehead.

Score 1 if grasping arm grasps other arm at elbow, wrist, or arm above elbow.

Score 0 if grasping arm does not touch head.

Score 0 if grasping hand or wrist, as opposed to arm, touches head.

Score 0 if grasping arm touches, instead of grasps, alternate arm.

Score 0 if grasping arm is placed behind head and does not touch it.

Item 10: Score 2 if thumb of one hand and fifth finger of other hand are hooked and fingers point in opposite directions within 3 seconds. Both thumb and fifth finger must be slightly flexed.

Score 1 if above position is assumed in 4 to 10 seconds.

Score 1 if fingers are hooked correctly but palms of hands face the same direction within 10 seconds.

Score 1 if only one finger is flexed.

Score 0 if any finger other than thumb of one hand and fifth finger of other hand is used.

Item 11: Score 2 if index finger of one hand is placed between ring and middle finger of the other hand within 3 seconds, approaching it from palmar surface.

Score 1 if above position is assumed in 4 to 10 seconds.

Score 1 if index finger is placed between any two fingers other than the correct ones with a palmar approach within 10 seconds.

Score 1 if any finger other than or in addition to index is placed between middle and ring finger of opposite hand, palmar approach.

Score 0 if approach is from dorsal rather than from palmar surface.

Score 0 if any arrangement of fingers is used other than those described above.

Item 12: Score 2 if thumb of one hand touches tip of index finger of other hand and other thumb touches tip of other index finger within 3 seconds.

Score 1 if above position is obtained within 4 to 10 seconds.

Score 0 for any other positions.

Score for the test is the total number of points for the 12 items. The standard deviations for the raw scores (the standard scores) are found in Tables 40 through 44.

M. Crossing Mid-Line of Body

Materials. None other than protocol booklet.

Procedure. The examiner and child sit facing each other. The examiner says:

> ***I am going to point to either my eye or my ear. You do the same thing I do. If I touch this ear*** (touch own right ear with own right hand) ***you touch this ear*** (touch child's left ear). ***If I point to this eye*** (touch own face just below right eye) ***you point to this eye*** (touch child's face just below left eye). ***If I touch this ear*** (touch own left ear with own left hand) ***you touch this ear*** (touch child's right ear). ***If I point to this eye*** (touch own face just below left eye) ***you point to this eye*** (touch child's face just below right eye). ***If I use this hand*** (hold up own right hand) ***you use this one*** (touch child's left hand). ***If I use this hand*** (hold up own left hand) ***you use this one*** (touch child's right hand). ***We will practice first for you to learn how.***

As practice, the examiner points quickly to ear or eye in sequence of the first four items in the protocol booklet, i.e., right hand touches right ear; right hand touches left eye; left hand touches right eye; left hand touches left ear. Each position is held until the child makes his or her response, then the examiner's hand is brought back to his or her lap. During the trial items the examiner helps the child imitate the examiner, explaining and moving child's hand appropriately if the child needs assistance. Since this test follows *Imitation of Postures*, children usually have little difficulty in grasping the idea that they are to continue imitating the position of the examiner's hands. Since this test measures a tendency rather than ability, it is important that the child not know that he or she is being tested for the inclination to avoid crossing the mid-line of his or her body. Such knowledge would invalidate the test response. A limitation of this test lies in the opportunity for a sophisticated child to perform cognitively rather than perceptually, thus scoring higher than his or her actual functioning warrants. After the trial items, no further help is given the child except to remind the child to put his or her hand in the child's lap after each item. The items are arranged in a pattern to help the examiner to remember how to execute the movements without constant referral to the protocol booklet. One complete pattern consists of eight items. This pattern is repeated twice. After going through one pattern of four items as a trial, the examiner says:

Now let's see how quickly you can do it.

The examiner points quickly to his or her own ear or eye in the sequence given. The child is given no further help in executing items except to be reminded, if necessary, to put his or her hand in the child's lap after each item. It is essential that the examiner assume positions rapidly enough to encourage the child to do so. Positions are held by the examiner until the child completes his or her response.

Scoring. If the child touches the correct side of his or her face with the correct hand, 2 points are given. The place on the side of his or her face that he or she touches is not important, as this is not a test of praxis but of crossing the mid-line of the body with the hand. If the child starts to use the incorrect hand but changes to the correct hand before the incorrect one touches his or her face, 1 point is given. If the child uses the correct hand and starts to point to the wrong side of his or her face but changes to the correct side before touching his or her face on the wrong side, 1 point is given. If the child uses the wrong hand to touch the correct side of his or her face or touches the wrong side of his or her face with the correct hand, even though the child may immediately correct himself or herself, 0 points are given. The difference between a response deserving of 1 point versus 0 points is that, in the former instance, the error is corrected before the hand touches the face; in the latter case, the hand touches the face, even though momentarily. Occasionally a child will make a slight movement of one hand as preparation to move it to his or her face. If the hand does not leave the lap during this movement it is not considered to have initiated a response. An incorrect hand must be raised from the lap but not touch the face before being corrected for a score of 1

Half of the items involve crossing the mid-line to touch the contralateral side of the face and half involve touching the ipsilateral side of the face. All items, regardless of whether crossing the body's mid-line is involved, are scored 2 for a correct, 1 for a wrong but corrected response, and 0 for incorrect responses. Occasionally a child will give an exact rather than a mirror image response. For example, he or she will point to his or her left eye or ear with his or her left hand in response to the examiner's pointing to his or her left eye or ear with his or her left hand. If the response was initiated by the child's left hand the score is 2, for the child was correct in his or her response of not crossing the mid-line. If the child had started with his or her right hand and then changed to the left hand before touching his or her face, the score would be 1, for the child started incorrectly but then corrected to a non-crossed response. Similarly, if the child points to his or her right ear or eye with his or her left hand in response to the examiner's pointing to his or her right ear or eye with his or her left hand, the score would be 2, for, again, it is the crossing or not crossing the mid-line that is under test. If the child does use the wrong hand but is correct on his or her crossing response, a note should be made to that effect and left and right scores not computed, for they are invalidated.

The objective in scoring is to give credit for crossing the mid-line without penalizing for poor motor planning. To do this requires giving credit for crossing the mid-line in an incorrect response. This is accomplished through the method of totaling the scores. All ipsilateral item scores are put in ovals in the protocol booklet; all contralateral scores are recorded in rectangles. The total of all points in the ovals is subtracted from 24 and the remainder added to the total of scores placed in rectangles. The result is the score for the test. For example, if the child twice failed to cross the mid-line when expected to do so and in addition corrected one response that started as incorrect, but responded correctly on all other contralateral items, his or her total score in the rectangles would be 19. If the child performed all ipsilateral responses correctly, excepting once when he or she crossed when not expected to do so and once when he or she started to cross but corrected himself or herself, the child's score in the ovals would be 21. Subtracting 21 from 24 leaves 3, which, when added to 19, results in 22, the child's total score for the test. Complete failure to cross the mid-line results in a score of 0. Random movements, crossing or not crossing regardless of the item, may also result in a score of 24, suggesting that the child does not avoid crossing the mid-line but has difficulty in imitating the motion. Any score above 24 should be recorded as 24. If the child uses only one hand to do all pointing, his or her score would be 24, but in this case the CMLX score (that score which appears in the rectangle in the protocol booklet) would give a more accurate indication of his or her tendency to cross the mid-line, for he or she would definitely be avoiding crossing with one hand. In inspecting the child's responses in the protocol booklet, the examiner must remember that when he or she points his or her right hand to his or her right ear, the child is expected to point his or her left hand to his or her left ear. Standard scores are found in Tables 40 through 44.

To compute a raw score and a standard deviation score for the right hand only on CML, all responses (of which there are 12) on Items 3, 4, 5, and 6 are totaled. These items constitute the subtest CML.R. Similarly, all responses on Items 1, 2, 7, and 8 are totaled to make subtest CML.L. The examiner is reminded that when using his or her right hand, the child uses his or her left hand, and vice versa. The highest possible score of

CML:R or CML:L is 24. Standard scores for raw scores on these tests are found in Tables 45 through 49.

Since it is not yet known when scores on crossed items only are preferred to scores on crossed and uncrossed items combined, normative data for crossed items only are also given. The frequency with which the right hand crosses the mid-line when expected to do so is expressed in subtest CMLX:R, the raw score for which is the total (six responses) of Items 3 and 5. Total of Items 2 and 8 constitutes the score for subtest CMLX:L, or the left hand's performance on crossed items only. Standard scores for these raw scores are in Tables 45 through 49.

Bilateral Motor Coordination

Materials. None other than protocol booklet.

Procedure. For administration of this test the examiner faces the child, who is expected to imitate the movements of the examiner after they have been demonstrated. Since this test follows two tests that also require that the child imitate the examiner in either movement or posture, children usually have no difficulty in grasping the essential nature of the task. The main difference between this test and the former two tests, as far as the child's grasping the meaning of the test is concerned, is that the child is not to imitate the examiner until after the examiner has completed the demonstration of the item. Unlike the two previous tests, the behavioral dimension under evaluation is the ability of the two upper extremities to move together in a smoothly integrated pattern.

All items involve touching the palms of the hands to the thigh in a quick, light slap which makes an audible but not loud sound. After each slap or touching of the thigh, the hand is raised about eight inches from the thigh. The examiner starts each item with hands pronated and held eight inches above thighs. The examiner tries to be as rhythmical as possible in his or her demonstration, emphasizing the kind of reciprocal action of the hands that is being evaluated. A disconnected demonstration will yield a segmented response. Coordination ability is judged largely on timing and smoothness of the interaction of the two hands in relation to each other. Each item consists of a type of motor pattern that is repeated one or two times. Each motor pattern or unit of action should take one second. Thus a slap and a pause occupy one second, two quick slaps or claps and a pause before repeating a movement pattern also require one second to execute. The examiner's execution of Items 1 through 5 (as well as the trial item) requires four seconds for each item, with a fraction of a second left over, which would be the pause before another replication of the movement, were it to be given. Items 6 through 8 require three seconds each to execute.

To initiate the test, one trial item is given. The examiner says:

Watch my hands. Then you do the same thing.

The examiner moves his or her hands in a smooth, rhythmic, reciprocal motion, gently touching the left palm to left thigh, then, as it raises, touching the right palm to right thigh. This pattern of motion is repeated once. The examiner then adds, holding up his or her left hand:

I began with this hand, so you begin with this (touch child's right hand) *hand.*

If the child performs the trial item (L R L R) incorrectly, he or she is corrected by the examiner taking the child's hands and moving them through the motions. If and when the child performs the trial item as well as he or she seems to be able to, the examiner says:

When I begin with this hand (hold up right hand) *you begin with this one* (touch child's left hand). *When I begin with this one* (hold up left hand) *you begin with this one* (touch child's right hand). *Watch me do another one.*

The examiner gives the items as described below, repeating directions only as necessary.

Item 1: Examiner moves his or her hands in reciprocal motion, gently slapping right palm to right thigh, then, as it raises, slapping left palm to left thigh. Motion is repeated once. If the child does not automatically repeat the examiner's movements, the examiner says:

You do it.

If the child starts his or her motions before the examiner has completed the pattern, the examiner says:

Wait until I finish, then you do it.

An item interrupted in the above manner should be redemonstrated. If the child begins motions with the incorrect hand the response is considered incorrect, and the child is corrected, with the examiner saying, while pointing out appropriately:

I began with this hand; you begin with this one.

If the child then executes the motions correctly, beginning with the correct hand, he or she is given a score of 1 in accordance with the scoring procedures explained below. If he or she repeats the motions again with the incorrect hand, the child is scored 0 for that item.

If the child imitates the motions accurately he or she is scored 2 for the item and the examiner proceeds to the next item, but if the child's movements are jerky, disconnected, or inaccurate, the examiner says:

Watch me again.

The examiner demonstrates the item again and the child attempts the item a second time. If a second attempt is successful, the child is scored 1 for the first item; if the second attempt is still inaccurate or arhythmical, the item is scored 0. No further attempts are allowed. Subsequent items are administered in a similar manner.

Item 2: Left palm slaps left thigh and, after a pause, right palm slaps right thigh quickly twice. Motion is repeated. The number of times a pattern is given is indicated on the protocol booklet as two times or three times. One repetition makes a total of two presentations.

Item 3: Same as Item 2, but reversing hands.

Item 4: Both hands are used symmetrically. Palms slap ipsilateral thighs simultaneously, then, after a pause, clap (in typical palms together position) twice. Pattern is repeated once.

Item 5: Both hands are used symmetrically. Palms slap ipsilateral thighs simultaneously; after a pause they slap same thighs twice quickly. Pattern is repeated once.

Item 6: Left palm slaps left thigh, immediately followed by right palm slapping right thigh. After a pause, the motions are repeated twice, making a total of three executions of the pattern.

Item 7: Same as Item 6, but reversing hands.

Item 8: Same as Item 6, but right arm is crossed over the left arm and the left palm slaps the right thigh, followed by right palm slapping the left thigh. Item is repeated twice, making a total of three executions.

Scoring. If the child imitates the examiner correctly after the first demonstration with good bilateral integration, the score is 2 points. If an accurate and rhythmical response is not made after the first demonstration but is made after the second demonstration, 1 point is given. If the second attempt is poorly executed, 0 points are given for that item. Smoothness of execution and interaction of the hands are aspects under consideration. Jerky or disconnected movements constitute an error. The child must execute the motion pattern of each item at least as many times as the examiner does. If the child should stop after an insufficient number of executions, the examiner advises the child to do it again and the child is not penalized. If the child repeats the pattern more frequently than is required, the child is not penalized. If the child executes the pattern slightly faster or more slowly than did the examiner, the child is not penalized but his or her actions are judged on the basis of degree of coordination shown. The total score is the total number of points for the eight items. The standard deviations or standard scores for the raw scores are found in Tables 40 through 44.

Right-Left Discrimination

Materials. Pencil with eraser and protocol booklet.

Procedure. The child and examiner sit in chairs facing each other. After gaining the child's attention, the examiner says:

Show me your right hand (emphasis on "right").

Immediately upon completion of the command, the examiner starts counting seconds (1001, 1002, etc.) inaudibly to himself or herself which watching the child's response. If the child holds up, presents, or in any other way indicates his or her right hand within three seconds after the command is made, the child is scored 2. If the child indicates the right hand after three seconds, but before 10 seconds, the child is scored 1. If the child first indicates the left hand but then changes it to the right hand, the score is based on the time when the right hand was indicated. Usually changes from the incorrect to the correct hand are not made within three seconds, but should it occur, the score for the item is 2. If the change is made from the incorrect to the correct choice after three seconds but before 10 seconds, the score is 1. The remainder of the items are scored accordingly. When presenting Items 3 and 9, the examiner holds one pencil in both of his or her hands, which rest on his or her knees. Enough of the eraser end of the pencil extends for easy grasp by the child. When Items 4 and 10 are given, the examiner holds both hands on knees with palms up to receive pencil. When administering Item 5, the examiner holds the pencil with his or her right hand, at a distance of one foot in front of the tip of the child's left shoulder. For Item 8, the examiner holds the pencil with his or her left hand in front of the child's right shoulder. The child should not touch the pencil. The examiner should avoid letting the child see his or her score or otherwise learn whether his or her response is correct or not. If the command must be repeated, the score for the item cannot exceed 1. Timing for the item is from the end of the first command. If the child says he or she does not know the answer, the child is requested to guess.

Scoring. Items are scored 2, 1, or 0 according to accuracy and quickness of response. The test score is the total points for the 10 items. Standard scores are found in Tables 40 through 44.

P. Standing Balance: Eyes Open

Materials. Stopwatch and protocol booklet.

Procedure. The child is asked to stand so that he or she is not close to walls or furniture that might encourage the child's use of them to maintain balance. The child is asked to stand with arms folded, elbows flexed, and hands tucked in and held near chest. Touching the child's left leg near the foot, the examiner says:

Lift this foot. Don't hop or move around.

Stopwatch is started as soon as one foot is lifted and time noted when that foot is placed on the floor again, even momentarily, or hand is extended to gain balance, or child hops or moves foot on which he or she is standing in order not to lose balance. If the child immediately loses his or her balance, apparently because of not getting balance first before lifting the foot, the test is repeated with the reminder to the child that he or she should get his or her balance first, before lifting the foot. It is important that a child be given a second chance if the first measurement was not an accurate indication of his or her standing balance. When the child has stood for 180 seconds on a foot, the test is stopped for that foot.

Balancing ability on the left leg is tested in the same manner, with the examiner saying:

Now lift the other foot.

Scoring. The number of seconds recorded for SBO right foot is the SBO:R score and that recorded for the left is the SBO:L score. The total of the two scores is the SBO score. The maximal SBO raw score is 360. These raw scores can be converted into standard scores by either the conventional method or through use of a logarithmic conversion. Standard scores computed in the standard manner are found in Table 50 for scores of both feet combined or Tables 51 and 52 for either foot alone.

The failure of the normative sample raw scores to assume a Gaussian distribution led to seeking other methods of scoring standing balance. The alternate method developed involves use of a logarithmic conversion scale. The scale, shown in Table 53, gives a converted number or score for the number of seconds, or raw score. The conversion scale was prepared by placing various linear scales or rulers against a logarithmic scale, finding each child's raw SBO or SBC score on the logarithmic scale, and recording the linear equivalent measurement or conversion score. Different conversion scales were tried until the SBO scores for the 5.6- to 5.11-year normative sample and the SBC:L for the 8.0- to 8.5-year normative sample reached an optimally bell-shaped curve. It is this scale that is reported and which has been used to compute converted means, standard deviations, and the standard scores in Tables 53 through 57. There are no data regarding the effectiveness of use of the conversion score relative to the standard method, but its use over the standard method is preferred. It can be applied to any SBO or SBC score, total, right, or left.

Q. Standing Balance: Eyes Closed

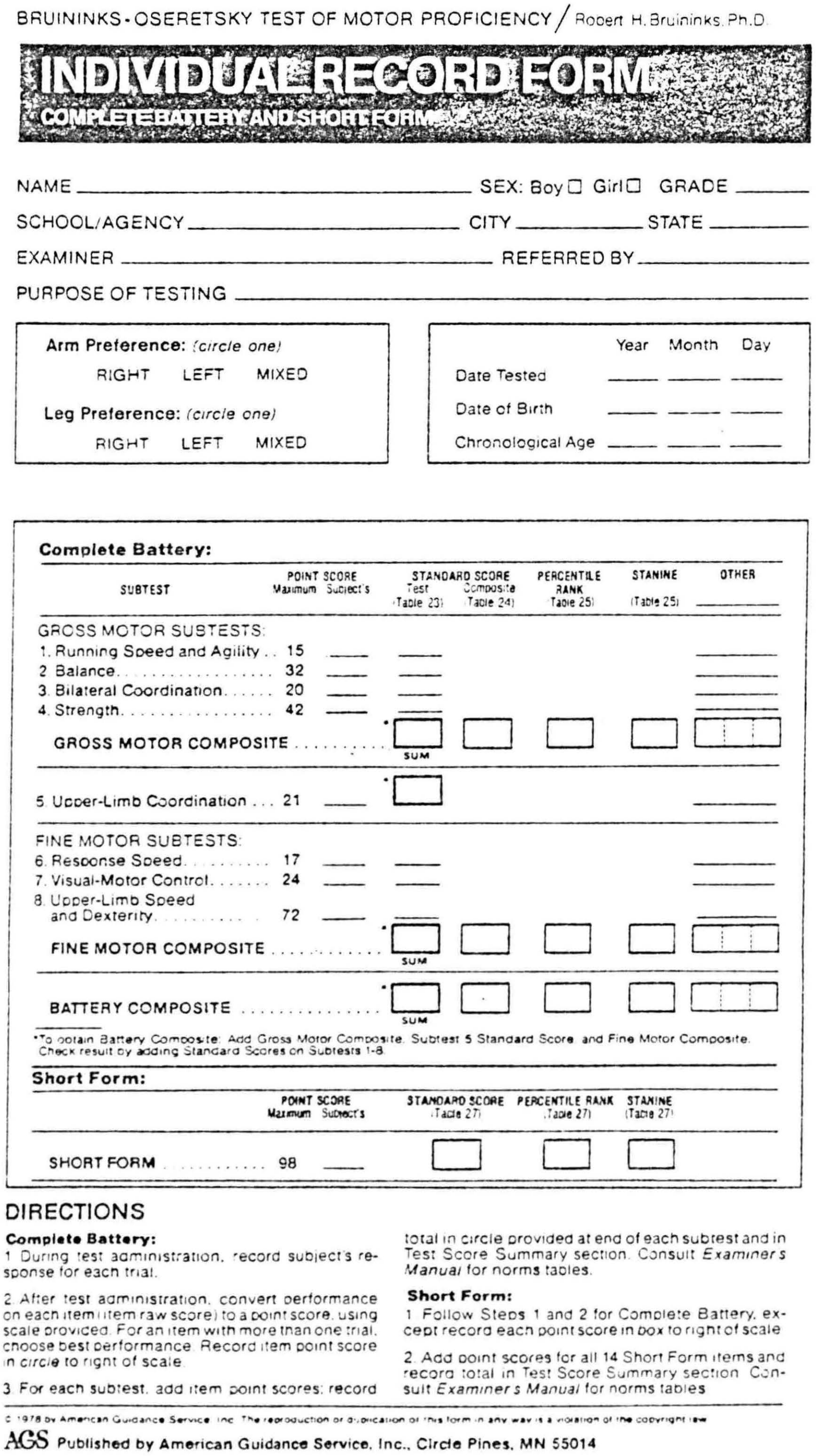
Materials. Stopwatch and protocol booklet.

Procedure. The procedure and scoring for this test are identical to that for *Standing Balance: Eyes Open*, with the exception that the child is required to keep his or her eyes closed while balancing on one foot. If the child is unable to keep his or her eyes closed, a shield should be placed before the child's eyes to prevent any visual stimuli from assisting the child in his or her balance. It is often advisable to let the child know that balancing with the eyes closed is much more difficult for all people. As in SBO, this test is terminated when the child has stood 180 seconds on either foot, making the maximal possible score 360. It is unlikely that any child will reach the maximal score.

Scoring. Scoring SBC is handled similarly to that for SBO and the same procedure regarding use of a conventional method of computing standard scores or use of a logarithmic conversion scale applies. Appropriate standard scores are found in Tables 40 through 44 and 53 through 57. Standard scores computed in the standard manner for either foot alone are found in Tables 45 through 49.

APPENDIX D

INDIVIDUAL RECORD FORM FOR THE BRUININKS-OSERETSKY TEST SHORT FORM



BRUININKS-OSERETSKY TEST OF MOTOR PROFICIENCY / Robert H. Bruininks, Ph.D.

INDIVIDUAL RECORD FORM

COMPLETE BATTERY AND SHORT FORM

NAME ______________ SEX: Boy ☐ Girl ☐ GRADE ______

SCHOOL/AGENCY ______________ CITY ________ STATE ______

EXAMINER ______________ REFERRED BY ______________

PURPOSE OF TESTING ______________

Arm Preference: *(circle one)*

RIGHT LEFT MIXED

Leg Preference: *(circle one)*

RIGHT LEFT MIXED

	Year	Month	Day
Date Tested	____	____	____
Date of Birth	____	____	____
Chronological Age	____	____	____

Complete Battery:

SUBTEST	POINT SCORE Maximum	POINT SCORE Subject's	STANDARD SCORE Test (Table 23)	STANDARD SCORE Composite (Table 24)	PERCENTILE RANK (Table 25)	STANINE (Table 25)	OTHER ______
GROSS MOTOR SUBTESTS:							
1. Running Speed and Agility . .	15	____	____				______
2. Balance	32	____	____				______
3. Bilateral Coordination	20	____	____				______
4. Strength	42	____	____				______
GROSS MOTOR COMPOSITE			*☐ SUM	☐	☐	☐	☐
5. Upper-Limb Coordination . . .	21	____	*☐				______
FINE MOTOR SUBTESTS:							
6. Response Speed	17	____	____				______
7. Visual-Motor Control	24	____	____				______
8. Upper-Limb Speed and Dexterity	72	____	____				______
FINE MOTOR COMPOSITE			*☐ SUM	☐	☐	☐	☐
BATTERY COMPOSITE			*☐ SUM	☐	☐	☐	☐

*To obtain Battery Composite: Add Gross Motor Composite, Subtest 5 Standard Score, and Fine Motor Composite. Check result by adding Standard Scores on Subtests 1-8.

Short Form:

	POINT SCORE Maximum	POINT SCORE Subject's	STANDARD SCORE (Table 27)	PERCENTILE RANK (Table 27)	STANINE (Table 27)
SHORT FORM	98	____	☐	☐	☐

DIRECTIONS

Complete Battery:

1. During test administration, record subject's response for each trial.

2. After test administration, convert performance on each item (item raw score) to a point score, using scale provided. For an item with more than one trial, choose best performance. Record item point score in *circle* to right of scale.

3. For each subtest, add item point scores; record total in circle provided at end of each subtest and in Test Score Summary section. Consult *Examiner's Manual* for norms tables.

Short Form:

1. Follow Steps 1 and 2 for Complete Battery, except record each point score in *box* to right of scale.

2. Add point scores for all 14 Short Form items and record total in Test Score Summary section. Consult *Examiner's Manual* for norms tables.

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RECORD POINT SCORES FOR COMPLETE BATTERY

RECORD POINT SCORES FOR SHORT FORM

SUBTEST 1: Running Speed and Agility

☐ **1. Running Speed and Agility**[SF]*

TRIAL 1 _______ seconds TRIAL 2 _______ seconds

Raw Score	Above 11.0	10.9-11.0	10.5-10.8	9.9-10.4	9.5-9.8	8.9-9.4	8.5-8.8	7.9-8.4	7.5-7.8	6.9-7.4	6.7-6.8	6.3-6.6	6.1-6.2	5.7-6.0	5.5-5.6	Below 5.5
Point Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

○ ☐

POINT SCORE SUBTEST 1 (Max: 15)

SUBTEST 2: Balance

1. Standing on Preferred Leg on Floor *(10 seconds maximum per trial)*

TRIAL 1: _______ seconds TRIAL 2: _______ seconds

Raw Score	0	1-3	4-5	6-8	9-10
Point Score	0	1	2	3	4

○

☐ **2. Standing on Preferred Leg on Balance Beam**[SF] *(10 seconds maximum per trial)*

TRIAL 1 _______ seconds TRIAL 2: _______ seconds

Raw Score	0	1-2	3-4	5-6	7-8	9	10
Point Score	0	1	2	3	4	5	6

○ ☐

3. Standing on Preferred Leg on Balance Beam—Eyes Closed *(10 seconds maximum per trial)*

TRIAL 1: _______ seconds TRIAL 2: _______ seconds

Raw Score	0	1-3	4-5	6	7	8	9	10
Point Score	0	1	2	3	4	5	6	7

○

4. Walking Forward on Walking Line *(6 steps maximum per trial)*

TRIAL 1: _______ steps TRIAL 2: _______ steps

Raw Score	0	1-3	4-5	6
Point Score	0	1	2	3

○

5. Walking Forward on Balance Beam *(6 steps maximum per trial)*

TRIAL 1: _______ steps TRIAL 2: _______ steps

Raw Score	0	1-3	4	5	6
Point Score	0	1	2	3	4

○

6. Walking Forward Heel-to-Toe on Walking Line *(6 steps maximum per trial)*

TRIAL 1 ☐☐☐☐☐☐ = _______ steps TRIAL 2 ☐☐☐☐☐☐ = _______ steps

Raw Score	0	1-3	4-5	6
Point Score	0	1	2	3

○

☐ **7. Walking Forward Heel-to-Toe on Balance Beam**[SF] *(6 steps maximum per trial)*

TRIAL 1 ☐☐☐☐☐☐ = _______ steps TRIAL 2 ☐☐☐☐☐☐ = _______ steps

Raw Score	0	1-3	4	5	6
Point Score	0	1	2	3	4

○ ☐

8. Stepping Over Response Speed Stick on Balance Beam

TRIAL 1: Fail Pass TRIAL 2: Fail Pass

Raw Score	Fail	Pass
Point Score	0	1

○

○

POINT SCORE SUBTEST 2* (Max: 32)

---

*SF and the box in left-hand margin indicate Short Form items

RECORD POINT SCORES FOR COMPLETE BATTERY ▼

RECORD POINT SCORES FOR SHORT FORM ▼

SUBTEST 3: Bilateral Coordination

1. **Tapping Feet Alternately While Making Circles with Fingers**[SF] *(90 seconds maximum)*

* Raw Score	Fail	Pass
☐ Point Score	0	1

○ ☐

2. **Tapping—Foot and Finger on Same Side Synchronized** *(90 seconds maximum)*

* Raw Score	Fail	Pass
Point Score	0	1

○

3. **Tapping—Foot and Finger on Opposite Side Synchronized** *(90 seconds maximum)*

* Raw Score	Fail	Pass
Point Score	0	1

○

4. **Jumping in Place—Leg and Arm on Same Side Synchronized** *(90 seconds maximum)*

* Raw Score	Fail	Pass
Point Score	0	1

○

5. **Jumping in Place—Leg and Arm on Opposite Side Synchronized** *(90 seconds maximum)*

* Raw Score	Fail	Pass
Point Score	0	1

○

6. **Jumping Up and Clapping Hands**[SF]

TRIAL 1 ______ claps TRIAL 2 ______ claps

Raw Score	0	1	2	3	4	Above 4
☐ Point Score	0	1	2	3	4	5

○ ☐

7. **Jumping Up and Touching Heels with Hands**

TRIAL 1: Fail Pass TRIAL 2: Fail Pass

Raw Score	Fail	Pass
Point Score	0	1

○

8. **Drawing Lines and Crosses Simultaneously** *(15 seconds)*

NUMBER OF PAIRS CORRECT ______

Raw Score	0	1	2-3	4-5	6-7	8-9	10-11	12-14	15-17	Above 17
Point Score	0	1	2	3	4	5	6	7	8	9

○

○ POINT SCORE SUBTEST 3 (Max. 20)

SUBTEST 4: Strength

1. **Standing Broad Jump**[SF] *(record number from tape measure)*

TRIAL 1: ______ TRIAL 2: ______ TRIAL 3: ______

Raw Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
☐ Point Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

○ ☐

2. **Sit-ups** *(20 seconds)*

NUMBER ______

Raw Score	0	1-2	3-4	5-6	7-8	9-10	11-12	13-15	16-18	19-20	Above 20
Point Score	0	1	2	3	4	5	6	7	8	9	10

○

3a. **Knee Push-ups** (For Boys Under Age 8 and All Girls) *(20 seconds)*

NUMBER ______

Raw Score	0	1-2	3-5	6-7	8-9	–	–	10-12	–	–	13-15	–	16-18	–	–	19-20	Above 20
Point Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

○

3b. **Full Push-ups** (For Boys Age 8 and Older) *(20 seconds)*

NUMBER ______

Raw Score	0	–	–	–	–	1-5	6-9	–	10-11	12-13	–	14-15	–	16-17	18-20	–	Above 20
Point Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

○

○ POINT SCORE SUBTEST 4 (Max. 42)

---

*For Subtest 3, circle pass or fail in items 1-5.

RECORD POINT SCORES FOR COMPLETE BATTERY ▼

RECORD POINT SCORES FOR SHORT FORM ▼

SUBTEST 5: Upper-Limb Coordination

1. Bouncing a Ball and Catching It with Both Hands *(5 trials)*

NUMBER OF CATCHES: ______

Raw Score	0	1-2	3-4	5	
Point Score	0	1	2	3	○

2. Bouncing a Ball and Catching It with Preferred Hand *(5 trials)*

NUMBER OF CATCHES: ______

Raw Score	0	1-2	3-4	5	
Point Score	0	1	2	3	○

3. Catching a Tossed Ball with Both Hands[SF] *(5 trials)*

NUMBER OF CATCHES: ______

Raw Score	0	1-2	3-4	5		
☐ Point Score	0	1	2	3	○	☐

4. Catching a Tossed Ball with Preferred Hand *(5 trials)*

NUMBER OF CATCHES: ______

Raw Score	0	1-2	3-4	5	
Point Score	0	1	2	3	○

5. Throwing a Ball at a Target with Preferred Hand[SF] *(5 trials)*

______ = HITS

Raw Score	0	1-2	3-4	5		
☐ Point Score	0	1	2	3	○	☐

6. Touching a Swinging Ball with Preferred Hand *(5 trials)*

NUMBER OF HITS: ______

Raw Score	0	1-2	3-4	5	
Point Score	0	1	2	3	○

7. Touching Nose with Index Fingers—Eyes Closed *(90 seconds maximum)*

* Raw Score	Fail	Pass	
Point Score	0	1	○

8. Touching Thumb to Fingertips—Eyes Closed *(90 seconds maximum)*

* Raw Score	Fail	Pass	
Point Score	0	1	○

9. Pivoting Thumb and Index Finger *(90 seconds maximum)*

* Raw Score	Fail	Pass	
Point Score	0	1	○

○ POINT SCORE SUBTEST 5 (Max: 21)

SUBTEST 6: Response Speed

1. Response Speed[SF]

TRIAL	SECONDS TO WAIT	SCORE[1]	RANKED TRIAL SCORES[2]
Practice 1	1	XXXX	
Practice 2	3	XXXX	
1	2	______	HIGHEST ☐
2.	3	______	☐
3	1	______	☐
4	3	______	MEDIAN — ☐ →
5	2	______	☐
6	1	______	☐
7	1	______	LOWEST ☐

☐ ○ ☐ POINT SCORE SUBTEST 6 (Max: 17)

[1] Record number from response speed stick in this column

[2] Rank all seven trial scores, highest to lowest, in boxes provided. The point score for Subtest 6 is the median (middle), or fourth, score from the top

---

*For Subtest 5, circle pass or fail in items 7-9

SUBTEST 7: Visual-Motor Control

RECORD POINT SCORES FOR COMPLETE BATTERY

RECORD POINT SCORES FOR SHORT FORM

1. Cutting Out a Circle with Preferred Hand

NUMBER OF ERRORS ______

Raw Score	Above 10	10	8-9	3-7	0-2		
Point Score	⓪	①	②	③	④	○	

2. Drawing a Line Through a Crooked Path with Preferred Hand

NUMBER OF ERRORS ______

Raw Score	Above 6	5	2-5	1	0		
Point Score	⓪	①	②	③	④	○	

3. Drawing a Line Through a Straight Path with Preferred Hand^{SF}

NUMBER OF ERRORS ______

	Raw Score	Above 6	5	2-5	1	0		
☐	Point Score	⓪	①	②	③	④	○	☐

4. Drawing a Line Through a Curved Path with Preferred Hand

NUMBER OF ERRORS ______

Raw Score	Above 5	6	2-5	1	0		
Point Score	⓪	①	②	③	④	○	

5. Copying a Circle with Preferred Hand^{SF}

SCORE ______

	* Raw Score	0	1	2		
☐	Point Score	⓪	①	②	○	☐

6. Copying a Triangle with Preferred Hand

SCORE ______

* Raw Score	0	1	2	
Point Score	⓪	①	②	○

7. Copying a Horizontal Diamond with Preferred Hand

SCORE ______

* Raw Score	0	1	2	
Point Score	⓪	①	②	○

8. Copying Overlapping Pencils with Preferred Hand^{SF}

SCORE ______

	* Raw Score	0	1	2		
☐	Point Score	⓪	①	②	○	☐

○

POINT SCORE SUBTEST 7 (Max. 24)

---

*See scoring criteria for Items 5-8 in Appendix A of *Examiner's Manual.*

SUBTEST 8: Upper-Limb Speed and Dexterity

RECORD POINT SCORES FOR COMPLETE BATTERY

RECORD POINT SCORES FOR SHORT FORM

1. **Placing Pennies in a Box with Preferred Hand** *(15 seconds)*

NUMBER OF PENNIES ______

Raw Score	0-5	6-10	11-13	14-15	16-17	18-19	20-21	22-23	24
Point Score	0	1	2	3	4	5	6	7	8

○

2. **Placing Pennies in Two Boxes with Both Hands** *(50 seconds maximum for seven correct pairs)*

PAIRS CORRECT: ☐☐☐☐☐☐☐☐☐☐☐☐ TIME IN SECONDS: ______

Raw Score	Above 49	41-49	31-40	26-30	21-25	18-20	16-17	14-15	12-13	10-11	Below 10
Point Score	0	1	2	3	4	5	6	7	8	9	10

○

3. **Sorting Shape Cards with Preferred Hand**^{SF} *(15 seconds)*

NUMBER OF CARDS ______

Raw Score	0	1-8	9-12	13-16	17-20	21-25	26-29	30-33	34-37	38-41	Above 41
Point Score	0	1	2	3	4	5	6	7	8	9	10

☐ ○ ☐

4. **Stringing Beads with Preferred Hand** *(15 seconds)*

NUMBER OF BEADS ______

Raw Score	0-1	2-4	5	6	7	8	9	Above 9
Point Score	0	1	2	3	4	5	6	7

○

5. **Displacing Pegs with Preferred Hand** *(15 seconds)*

NUMBER OF PEGS ______

Raw Score	0	1-5	6-7	8-9	10-11	12-13	14-15	16-18	19-20
Point Score	0	1	2	3	4	5	6	7	8

○

6. **Drawing Vertical Lines with Preferred Hand** *(15 seconds)*

NUMBER OF LINES ______

Raw Score	0	1-3	4-6	7-9	10-12	13-16	17-20	21-24	25-35	Above 35
Point Score	0	1	2	3	4	5	6	7	8	9

○

7. **Making Dots in Circles with Preferred Hand**^{SF} *(15 seconds)*

NUMBER OF CIRCLES WITH DOTS ______

Raw Score	0	1-10	11-15	16-20	21-25	26-30	31-35	36-40	41-50	51-60	Above 60
Point Score	0	1	2	3	4	5	6	7	8	9	10

☐ ○ ☐

8. **Making Dots with Preferred Hand** *(15 seconds)*

NUMBER OF DOTS ______

Raw Score	Below 10	10-25	26-35	36-45	46-55	56-65	66-75	76-85	86-95	96-105	Above 105
Point Score	0	1	2	3	4	5	6	7	8	9	10

○

○

POINT SCORE SUBTEST 8 (Max: 72)

NOTES/OBSERVATIONS

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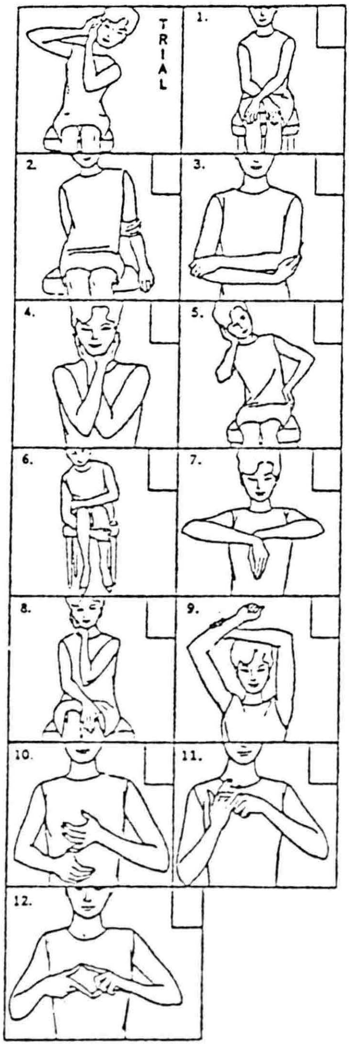
APPENDIX E

SCORE SHEET FOR THE SOUTHERN CALIFORNIA PERCEPTUAL MOTOR TEST

IMITATION OF POSTURES

No special materials needed
Score 2, 1, or 0



IP Raw Score ______
IP Standard Score ______

CROSSING MID-LINE OF BODY

No special materials needed
Trial: Items 1 thru 4 (Then repeat Items 1 thru 4 as test items)
Score 2, 1, or 0

(L)	1. R hand to R ear	○	○	○
(LX)	2. R hand to L eye	☐	☐	☐
(RX)	3. L hand to R eye	☐	☐	☐
(R)	4. L hand to L ear	○	○	○
(RX)	5. L hand to R ear	☐	☐	☐
(R)	6. L hand to L eye	○	○	○
(L)	7. R hand to R eye	○	○	○
(LX)	8. R hand to L ear	☐	☐	☐

(total in ovals) − ______
CMLX Raw Score + ______
(total in rectangles)
CML Raw Score ______
CMLX Standard Score ______
CML Standard Score ______

CML:R (3+4+5+6) **Raw Score** ______ **Standard Score** ______
CML:L (1+2+7+8) **Raw Score** ______ **Standard Score** ______
CMLX:R (3+5) **Raw Score** ______ **Standard Score** ______
CMLX:L (2 8) **Raw Score** ______ **Standard Score** ______

BILATERAL MOTOR COORDINATION

No special materials needed
Trial: L R L R (reciprocal)
Score 2, 1, or 0

1. R L R L (reciprocal) .... ______
2. L, pause, R R quickly (2 times) .... ______
3. R, pause, L L quickly (2 times) .... ______
4. Both, pause, clap, clap (2 times) .... ______
5. Both, pause, both both quickly (2 times) .. ______
6. L R quickly (3 times) .... ______
7. R L quickly (3 times) .... ______
8. Crossed L R quickly (3 times) .... ______

BMC Raw Score ______
BMC Standard Score ______

RIGHT-LEFT DISCRIMINATION

Use pencil with eraser
Score 2 (3 seconds), 1 (10 seconds), or 0

1. Show me your R hand .... ______
2. Touch your L ear .... ______
3. Take this pencil with your R hand .... ______
4. Now put it in my R hand .... ______
5. Is this pencil on your R side or your L side (L)? .. ______
6. Touch your R eye .... ______
7. Show me your L foot .... ______
8. Is this pencil on your R side or your L side (R)? .. ______
9. Take this pencil with your L hand .... ______
10. Now put it in my L hand .... ______

RLD Raw Score ______
RLD Standard Score ______

STANDING BALANCE (EYES OPEN AND EYES CLOSED)

Use stopwatch
Arms folded against chest
Score is the number of seconds

	R	L	Raw Score (R + L)	Standard Score
Eyes open (SBO)	______	______	______	______
Eyes closed (SBC)	______	______	______	______

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APPENDIX F

PRETEST RAW DATA

Table A

Bruininks-Oseretsky Pretest Data for Computing Reliability

Experimental Academically Handicapped (EAH Group

Subjects	Shuttle run		Balance beam pose		Balance beam walk		Bilateral coordination		Jump & clap	
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	Test	Retest
01	10.0	9.8	1	1	1	2	0	0	2	3
02	8.5	8.5	8	10	6	4	0	0	3	3
03	9.4	9.6	10	10	5	6	0	0	2	3
04	10.9	10.0	5	6	4	5	1	1	2	2
05	10.1	9.8	4	3	6	6	0	0	1	1
06	10.9	10.8	8	10	6	3	0	0	2	3
07	8.6	8.6	2	3	1	3	0	0	0	1
08	8.1	8.0	10	10	6	6	0	0	2	2

Note. Maximum composite point score = 98.

Table A --Continued

Experimental Academically Handicapped (EAH) Group

Subjects	Shuttle run		Balance beam pose		Balance beam walk		Bilateral coordination		Jump & clap	
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	Test	Retest
09	9.9	9.5	5	4	6	5	0	0	3	3
10	9.2	9.5	10	10	6	6	0	0	1	1
11	9.4	9.2	0	3	2	4	0	0	2	2
12	8.6	8.4	5	5	5	3	1	1	2	2
13	10.8	10.2	5	6	3	6	0	0	2	2
14	8.8	8.7	0	3	0	1	0	0	2	2
15	8.7	8.7	10	3	0	0	0	0	2	2
Control Academically Handicapped (CAH) Group										
01	9.3	9.4	8	10	3	6	0	0	1	1
02	8.1	8.0	8	9	4	6	0	0	2	2
03	12.0	8.1	8	10	0	6	1	1	2	2
04	8.4	9.0	10	10	5	6	1	1	1	1

Table A--Continued

Control Academically Handicapped Group--Continued												
Subjects	Shuttle run		Balance beam pose		Balance beam walk		Bilateral coordination		Jump & clap	
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	Test	Retest
05	8.5	9.0	10	1	5	4	1	1	2	2
06	8.8	9.8	6	6	2	3	0	0	1	1
07	9.1	8.9	10	3	4	6	1	1	2	2
08	9.4	9.8	10	10	6	2	0	0	1	1
09	8.5	8.6	10	10	6	6	1	1	3	3
10	8.7	8.2	10	10	4	2	0	0	2	2
11	8.2	8.3	10	10	3	5	0	0	2	2
12	8.5	9.2	3	5	3	4	0	0	1	1
13	9.2	9.2	2	3	0	0	0	0	2	2
14	8.4	8.5	10	10	4	6	0	0	2	2
15	8.2	9.5	6	10	4	5	0	0	2	2

Table A--Continued

Subjects	Shuttle run		Balance beam pose		Balance beam walk		Bilateral coordination		Jump & clap	
	Experimental Normal (EN) Group									
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	Test	Retest
01	8.5	8.6	5	5	3	4	1	1	1	1
02	8.2	8.8	3	0	2	3	1	1	3	4
03	7.8	8.6	10	10	4	6	1	1	2	2
04	8.6	8.7	9	10	5	6	0	0	2	2
05	7.9	8.3	6	7	5	6	1	1	2	2
06	7.7	7.6	10	10	5	5	0	0	2	2
07	8.8	8.5	10	8	4	5	1	1	1	1
08	8.4	8.6	5	8	5	6	1	1	3	3
09	7.7	7.7	3	4	4	3	0	0	2	2
10	8.7	8.6	10	10	6	6	0	0	2	2
11	8.5	8.4	0	0	1	3	1	1	3	3
12	8.7	8.3	8	6	6	5	1	1	2	2
13	10.0	10.2	10	3	5	4	1	1	2	2
14	9.6	10.5	10	10	3	3	0	0	1	1
15	8.8	8.6	10	8	5	6	1	1	2	2

Table A--Continued

Control Normal (CN) Group												
Subjects	Shuttle run		Balance beam pose		Balance beam walk		Bilateral coordination		Jump & clap	
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	Test	Retest
01	8.5	8.6	10	10	6	6	1	1	2	2
02	8.3	8.2	10	5	3	3	0	0	2	2
03	8.6	9.6	10	8	3	2	0	0	2	3
04	9.3	9.9	4	5	3	4	1	1	2	2
05	7.9	8.0	10	7	4	6	1	1	2	3
06	8.2	8.4	10	10	6	6	1	1	2	2
07	8.2	8.6	10	8	5	6	1	1	2	2
08	8.5	8.3	10	4	4	6	1	1	2	2
09	8.4	9.2	6	10	0	5	0	0	2	2
10	9.3	9.9	5	2	0	6	0	0	1	1
11	7.7	7.7	10	10	5	6	1	1	2	3
12	8.6	8.2	5	6	2	2	0	0	2	2
13	8.4	7.7	10	10	4	6	1	1	2	3
14	9.4	8.7	10	10	3	6	0	00	2	2
15	8.4	8.3	9	10	6	4	1	1	2	2

Table A--Continued

Subjects	Long jump Test	Long jump Retest	Catching tennis ball Test	Catching tennis ball Retest	Throwing tennis ball Test	Throwing tennis ball Retest	Response speed Test	Response speed Retest	Drawing line Test	Drawing line Retest
Experimental Academically Handicapped (EAH) Group										
01	4	5	2	3	3	1	0	0	1	1
02	5	5	2	4	0	0	3	1	3	3
03	5	5	2	2	3	4	2	0	3	2
04	5	5	3	3	4	3	1	4	0	0
05	4	4	1	0	3	2	3	3	0	0
06	3	3	2	0	3	0	2	0	1	1
07	5	5	3	4	4	3	3	4	2	2
08	7	7	4	5	3	4	2	4	0	0
09	5	6	3	4	3	2	2	3	1	1
10	6	6	4	5	2	1	4	3	3	2
11	5	5	4	4	4	4	2	2	2	2
12	6	6	4	5	2	3	2	3	1	1
13	2	2	2	3	2	1	0	0	0	0
14	5	5	3	3	3	1	2	1	0	0
15	6	6	2	3	3	4	6	7	2	2

Table A--Continued

Subjects	Long jump		Catching tennis ball		Throwing tennis ball		Response speed		Drawing line	
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	Test	Retest
Control Academically Handicapped (CAH) Group										
01	3	6	0	2	2	1	0	1	3	3
02	5	4	1	2	3	3	0	1	0	0
03	7	7	2	1	2	1	0	0	2	1
04	3	3	4	4	3	4	2	3	0	0
05	4	5	1	2	3	2	2	2	0	6
06	6	7	5	5	4	3	3	2	0	0
07	4	6	2	2	1	2	0	1	3	3
08	3	3	0	1	1	0	1	0	0	1
09	5	5	2	4	1	0	3	4	1	0
10	6	6	2	3	2	2	2	3	0	0
11	5	6	3	4	3	4	1	1	1	0
12	4	4	1	2	0	0	2	2	0	0
13	3	3	4	4	4	5	4	4	1	0
14	1	3	2	2	1	2	3	3	1	1
15	6	6	1	0	1	2	2	2	1	1

Table A--Continued

Subjects	Long jump		Catching tennis ball		Throwing tennis ball		Response speed		Drawing line	
	Experimental Normal (EN) Group									
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	Test	Retest
01	8	9	0	0	2	3	3	3	0	0
02	6	6	2	1	1	2	3	2	2	1
03	5	5	4	4	5	4	4	3	0	0
04	7	8	5	5	3	3	3	3	2	2
05	6	7	4	3	2	3	1	2	0	0
06	5	5	3	3	4	3	3	2	0	0
07	6	6	4	3	3	1	3	3	1	0
08	5	5	2	1	2	2	0	0	0	0
09	5	5	4	4	4	4	2	2	5	3
10	7	7	2	2	1	2	3	4	0	0
11	7	8	3	3	4	3	4	3	0	0
12	5	6	4	4	1	2	2	2	0	0
13	5	5	1	1	2	0	3	3	1	0
14	5	5	0	1	3	2	3	4	0	0
15	6	6	3	3	1	0	1	0	0	0

Table A--Continued

Control Normal (CN) Group

Subjects	Long jump		Catching tennis ball		Throwing tennis ball		Response speed		Drawing line	
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	Test	Retest
01	6	7	2	3	5	5	2	3	0	0
02	6	5	5	5	3	2	1	3	1	1
03	7	7	4	5	5	5	1	1	4	3
04	5	5	3	2	1	3	2	2	0	0
05	8	8	1	0	3	4	3	4	1	1
06	5	6	3	2	1	3	2	2	0	0
07	4	5	2	4	1	0	1	2	3	3
08	5	6	4	5	2	1	2	2	1	1
09	6	5	5	4	2	4	3	3	4	3
10	4	4	4	5	3	1	2	2	0	0
11	5	5	4	5	4	4	5	7	0	0
12	4	3	3	4	0	1	0	0	4	3

Table A--Continued

Control Normal (CN) Group--Continued

Subjects	Long jump		Catching tennis ball		Throwing tennis ball		Response speed		Drawing line	
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	Test	Retest
13	7	8	2	3	4	3	4	6	1	0
14	2	3	1	2	3	1	2	2	3	3
15	6	6	4	5	3	4	1	1	0	0

Table A--Continued

Experimental Academically Handicapped (EAH) Group										
Subjects	Copying circle		Overlapping pencils		Card sorting		Dots in circles		Composite point score
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	
01	1	1	1	1	18	21	22	20	45
02	1	0	1	1	12	10	22	25	41
03	0	1	1	1	17	18	20	23	44
04	0	0	0	0	12	15	26	20	37
05	1	0	1	1	17	20	25	28	40
06	2	2	1	0	9	12	12	17	34
07	1	1	0	0	10	13	11	14	40
08	2	2	1	0	26	25	12	15	45
09	2	2	0	0	17	18	20	22	42
10	2	2	1	1	16	16	23	26	34
11	0	0	1	0	14	16	22	19	33
12	2	2	1	0	26	23	20	17	39
13	2	2	0	0	20	22	16	17	27
14	0	0	0	0	15	18	16	17	30
15	2	1	0	0	17	18	19	16	37

Note. The composite point score represents the mean of the raw scores on the pretests.

Table A--Continued

Control Academically Handicapped (CAH) Group

Subjects	Copying circle		Overlapping pencils		Card sorting		Dots in circles		Composite point score
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	
01	0	0	1	1	14	16	16	19	30
02	2	1	1	2	14	13	19	16	39
03	0	0	0	0	13	14	18	15	29
04	1	1	0	0	12	12	15	18	37
05	0	0	0	0	10	13	29	20	29
06	1	0	0	1	10	13	19	21	34
07	1	0	0	1	20	21	21	25	34
08	2	1	0	0	8	9	14	15	27
09	2	1	1	1	14	16	25	25	45
10	1	1	0	0	22	15	17	18	38
11	1	1	2	1	15	18	12	16	39
12	0	0	0	0	13	11	12	15	25
13	2	1	0	0	14	16	15	20	30
14	2	1	0	0	20	22	16	20	35
15	1	0	0	0	10	12	19	16	33

Table A--Continued

Subjects	Copying circle		Overlapping pencils		Card sorting		Dots in circles		Composite point score
Experimental Normal (EN) Group									
	Test	Retest	Test	Retest	Test	Retest	Test	Retest	
01	2	2	1	1	15	12	10	13	37
02	1	1	1	1	30	25	30	26	38
03	1	1	2	2	13	12	17	20	44
04	1	1	1	1	18	21	22	20	45
05	1	0	1	1	12	10	22	25	41
06	0	1	1	1	17	18	20	23	44
07	0	0	0	0	12	15	26	20	37
08	1	0	1	1	17	20	25	28	40
09	2	2	1	0	9	12	12	17	34
10	1	1	0	0	10	13	11	14	40
11	2	2	1	0	26	25	12	15	43
12	2	2	0	0	17	18	20	22	42
13	2	2	1	1	16	16	23	26	34
14	0	0	1	0	14	16	22	19	33
15	2	2	1	0	26	23	20	17	39

Table A--Continued

Control Normal (CN) Group										
Subjects	Copying circle 1	Copying circle 2	Overlapping pencils 1	Overlapping pencils 2	Card sorting 1	Card sorting 2	Dots in circles 1	Dots in circles 2	Composite point score
01	1	1	1	0	14	13	16	20	44
02	0	0	1	1	14	16	17	20	36
03	1	0	0	0	9	11	30	20	35
04	2	2	2	2	15	13	28	31	36
05	1	1	2	2	20	25	19	23	45
06	1	1	2	2	10	13	25	28	45
07	1	1	1	1	20	25	28	29	42
08	1	1	1	0	15	14	20	21	39
09	2	1	1	1	10	14	21	25	36
10	1	1	1	1	12	11	20	15	28
11	2	2	2	2	12	11	21	21	50
12	1	1	1	0	12	13	20	22	30

Table A--Continued

Control Normal (CN) Group--Continued									
Subjects	Copying circle		Overlapping pencils		Card sorting		Dots in circles		Composite point score
	1	2	1	2	1	2	1	2	
13	1	1	1	1	16	18	17	20	47
14	1	1	1	0	20	22	23	25	35
15	1	1	1	0	14	13	23	25	42

Table B

Southern California Perceptual Motor Pretest Data for Computing Reliability

Experimental Academically Handicapped (EAH) Group

Subjects	IP		CML		BMC		RLD		SBO		SBC	
	1	2	1	2	1	2	1	2	1	2	1	2
01	11	11	10	9	10	9	14	13	5	7	6	5
02	9	9	7	7	2	3	9	7	14	16	7	8
03	5	9	6	7	12	12	4	4	11	13	18	15
04	13	11	12	11	6	4	8	8	31	91	3	6
05	7	8	15	12	13	14	16	15	20	18	8	11

Note. Table is read as follows: IP-Imitation of Postures Subtest; CML-Crossing Midline of Body Subtest; BMC-Bilater Motor Coordination Subtest; RLD-Right-Left Discrimination Subtest; SBO-Standing Balance Eyes Open Subtest; SBC-Standing Balance Eyes Closed Subtest.

[a] The symbol 1 indicates the results of the initial pretest.

[b] The symbol 2 indicates the results of the retest completed 1 week following the initial pretest.

Table B--<u>Continued</u>

Subjects	IP		CML		BMC		RLD		SBO		SBC	
	1	2	1	2	1	2	1	2	1	2	1	2
Experimental Academically Handicapped (EAH) Group--Continued												
06	11	8	0	1	5	6	10	10	5	4	4	0
07	9	9	14	11	4	3	16	16	20	40	0	0
08	8	7	16	16	12	12	16	16	25	21	21	11
09	16	14	13	12	11	13	18	17	15	17	16	18
10	14	13	14	14	14	13	16	16	12	13	13	10
11	10	9	11	10	14	10	18	16	12	8	10	10
12	16	14	14	16	8	10	16	15	30	32	7	6
13	15	16	3	2	12	10	4	2	35	32	10	18
14	12	10	2	1	5	2	6	6	18	21	15	12
15	7	10	12	10	3	2	16	14	15	14	17	14
Control Academically Handicapped (CAH) Group												
01	12	13	2	2	9	8	4	5	19	24	13	10

Table B--Continued

Control Academically Handicapped (CAH) Group--Continued

Subjects	IP		CML		BMC		RLD		SBO		SBC	
	1	2	1	2	1	2	1	2	1	2	1	2
02	19	17	7	9	7	6	18	17	25	20	3	5
03	8	9	5	4	2	3	16	16	10	14	4	4
04	21	20	4	5	6	5	16	18	90	145	5	23
05	10	9	4	6	10	10	14	13	7	14	0	3
06	6	7	7	7	2	1	16	15	19	21	5	10
07	9	10	14	16	9	8	20	20	38	72	11	7
08	13	14	6	7	10	11	8	9	14	25	4	3
09	14	13	0	0	15	13	6	5	140	180	8	12
10	15	17	12	13	4	6	16	16	28	35	3	11
11	17	18	12	11	10	12	16	16	14	23	12	8
12	10	12	15	14	5	4	16	16	22	28	1	3
13	7	8	0	1	0	0	4	4	50	53	7	6
14	6	5	6	5	6	6	14	13	90	104	15	19

Table B--Continued

Subjects	IP		CML		BMC		RLD		SBO		SBC	
	1	2	1	2	1	2	1	2	1	2	1	2
Control Academically Handicapped (CAH) Group--Continued												
15	10	9	2	4	4	3	10	9	35	33	4	6
Experimental Normal (EN) Group												
01	18	16	14	12	9	5	16	16	47	62	8	9
02	16	16	7	7	7	8	6	6	13	9	12	11
03	12	12	15	12	10	9	16	16	8	7	11	12
04	18	16	16	16	12	9	18	17	42	103	6	9
05	19	15	14	13	16	12	16	14	15	16	7	7
06	18	15	14	12	6	5	16	16	40	54	36	32
07	19	12	13	10	10	9	16	16	30	53	8	10
08	11	10	16	16	6	5	16	16	65	68	20	19
09	19	17	16	16	11	10	16	16	10	11	6	7
10	17	14	8	7	4	3	4	4	16	15	12	10

Table B--Continued

Subjects	IP		CML		BMC		RLD		SBO		SBC	
	1	2	1	2	1	2	1	2	1	2	1	2
Experimental Normal (EN) Group--Continued												
11	12	12	13	13	8	6	20	20	25	27	5	4
12	20	20	16	16	9	8	18	16	55	90	22	22
13	5	5	12	10	12	12	12	6	33	29	8	6
14	12	12	16	16	3	4	19	14	23	34	6	9
15	10	11	16	16	3	3	18	15	25	27	5	10
Control Normal (CN) Group												
01	16	17	16	16	12	12	16	16	35	65	13	21
02	5	4	0	0	16	15	0	0	42	51	5	11
03	10	9	8	7	7	7	16	16	10	11	0	3
04	21	19	15	14	9	10	16	16	38	43	5	6
05	18	18	14	16	10	12	18	16	36	37	8	9
06	21	20	16	15	16	16	17	18	111	170	5	5

Table B--Continued

Control Normal (CN) Group--Continued

Subjects	IP		CML		BMC		RLD		SBO		SBC	
	1	2	1	2	1	2	1	2	1	2	1	2
07	18	17	12	11	12	12	15	14	25	50	12	12
08	8	9	2	3	8	6	4	6	13	10	12	11
09	11	12	13	13	11	12	20	18	43	45	3	3
10	11	10	12	14	5	6	20	18	28	32	1	2
11	12	13	8	10	10	8	10	11	70	56	13	15
12	7	8	15	14	10	10	4	4	1	7	2	2
13	11	10	16	16	12	13	17	18	52	60	18	22
14	19	19	16	16	12	13	18	17	140	180	10	15
15	8	9	16	16	7	7	20	20	58	87	3	7

APPENDIX G

MIDTEST RAW DATA

Table C

Bruininks-Oseretsky Short Form Midtest Data

	Experimental Academically Handicapped (EAH) Group													
Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
01	9.2	5	4	1	2	5	1	3	1	4	0	0	16	22
02	8.8	8	5	0	1	4	5	3	1	3	0	0	13	10
03	9.3	10	6	0	3	5	4	3	3	2	2	2	17	13
04	8.7	10	6	0	2	5	3	5	3	0	1	0	15	25
05	9.4	10	5	1	2	5	3	2	2	3	2	1	13	25
06	9.6	5	6	0	1	4	0	0	1	2	1	0	16	23
07	9.0	2	1	0	1	6	1	4	3	3	0	0	18	20

Note. Table is read as follows: SR-Shuttle Run; SBP-Standing Balance Pose; BW-Beam Walking; FTFC-Feet Tapping Fingers Circling; JC-Jump & Clap; SLJ-Standing Long Jump; C-Catching; T-Throwing; RS-Response Speed; DR-Drawing a Line; CC-Copying a Circle; OP-Overlapping Pencils; SC-Sorting Cards; and DC-Dots in Circles.

Table C--Continued

Experimental Academically Handicapped (EAH) Group--Continued

	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
08	8.0	8	6	0	2	8	4	3	4	1	2	1	20	17
09	10.3	7	4	0	3	5	2	3	5	3	1	0	14	24
10	8.9	10	5	1	2	4	4	2	1	4	0	0	23	24
11	9.9	6	4	1	2	5	2	1	3	3	2	1	13	18
12	8.5	10	5	1	2	7	5	3	5	2	1	2	15	17
13	11.1	8	5	1	1	2	3	3	0	2	2	1	17	14
14	9.8	5	2	0	1	5	3	3	2	1	1	1	14	22
15	8.5	10	6	1	2	6	2	3	5	3	1	0	22	23
Control Academically Handicapped (CAH) Group														
01	9.1	6	5	1	1	4	1	2	1	0	1	1	13	20
02	7.7	10	6	0	2	6	0	2	3	0	2	2	22	22

Table C--Continued

Control Academically Handicapped (CAH) Group--Continued

Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
03	9.8	4	5	0	2	8	3	3	0	5	0	1	18	14
04	9.2	4	6	0	1	4	3	1	2	1	1	0	12	18
05	8.6	2	2	1	2	6	5	4	2	2	2	0	15	15
06	8.1	6	6	0	2	6	1	4	2	7	2	1	12	17
07	8.5	10	6	1	2	6	2	1	3	0	2	1	19	21
08	8.8	10	6	0	1	4	1	2	4	1	1	0	20	20
09	8.0	10	6	1	2	7	3	5	3	2	2	1	24	23
10	7.4	10	6	1	2	6	3	3	3	3	2	1	17	25
11	8.9	10	5	1	2	5	3	3	8	0	2	2	15	14
12	8.9	6	6	1	2	4	5	2	3	2	2	2	13	15
13	9.6	8	6	0	2	4	2	2	7	0	1	0	22	28
14	9.5	10	6	0	2	3	1	2	3	1	2	0	24	27

Table C--Continued

Control Academically Handicapped (CAH) Group--Continued

Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
15	7.5	6	6	0	2	7	1	2	3	0	2	1	25	23
Experimental Normal (EN) Group														
01	8.9	10	5	0	3	7	3	3	5	7	1	1	14	13
02	9.5	3	2	1	2	7	2	1	2	0	2	2	26	38
03	7.8	10	4	0	2	7	3	4	7	0	1	2	9	25
04	7.8	10	6	1	3	7	5	5	2	1	2	2	21	8
05	7.7	5	4	1	4	8	4	4	3	4	2	2	13	33
06	8.1	10	6	0	2	6	5	3	6	4	2	2	16	19
07	8.7	10	5	0	2	8	3	1	5	4	2	1	20	26
08	8.5	6	4	1	2	3	3	2	3	0	2	1	26	16
09	8.2	3	3	0	2	6	2	0	4	1	1	1	12	15

Table C--Continued

Experimental Normal (EN) Group--Continued

Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
10	8.6	10	6	0	2	7	1	2	3	3	2	1	17	17
11	7.8	1	5	0	3	9	4	2	4	3	1	1	25	23
12	8.2	9	6	1	2	6	4	3	3	1	2	2	21	30
13	9.6	2	5	1	1	6	2	3	4	1	2	1	17	15
14	9.2	6	6	0	2	7	2	2	4	3	1	2	14	20
15	9.0	10	6	1	2	6	1	3	2	0	2	1	25	18
Control Normal (CN) Group														
01	8.1	10	5	1	2	7	2	4	2	0	0	1	21	28
02	8.4	9	6	0	2	6	2	3	4	2	2	1	14	26
03	8.7	8	6	0	2	8	4	3	4	4	0	0	17	25
04	9.3	10	6	1	1	5	1	4	4	0	1	2	18	30

Table C-- Continued

Control Normal (CN) Group--Continued

Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
05	7.4	10	6	1	3	9	4	3	4	3	2	2	23	24
06	7.2	7	5	1	2	5	3	1	2	0	2	2	14	26
07	8.3	10	6	0	2	6	3	2	3	2	1	1	23	28
08	7.7	6	6	0	2	5	2	1	3	1	2	0	18	28
09	8.7	10	6	0	2	6	2	4	3	2	0	1	14	24
10	8.2	6	5	0	2	5	2	2	2	1	2	2	20	35
11	7.2	10	6	1	2	8	5	5	6	0	2	2	12	25
12	8.5	8	4	1	2	6	3	1	3	0	0	0	16	26
13	7.9	10	6	1	3	8	5	4	6	0	2	1	18	19
14	8.2	10	6	1	2	4	2	1	2	0	2	2	22	22
15	8.4	10	6	0	2	7	3	5	7	1	2	2	19	28

Table D

Southern California Perceptual Motor Midtest Scores

	Experimental Academically Handicapped (EAH) Group--*Continued*					
	IP	CML	BMC	RLD	SBO	SBC
01	14	16	7	16	27	6
02	11	6	0	10	28	20
03	14	4	9	10	17	15
04	17	14	4	16	27	6
05	12	15	10	16	25	18
06	18	0	6	4	14	8
07	17	11	3	14	27	9
08	17	16	13	16	26	17
09	19	15	13	20	25	14

Note. Table is read as follows: IP-Imitation of Postures Subtest; CML-Crossing Midline of Body Subtest; BMC-Bilateral Motor Coordination Subtest; RLD-Right-left Discrimination Subtest; SBO-Standing Balance Eyes Open Subtest; and SBC-Standing Balance Eyes Closed Subtest.

Table D--Continued

Subjects	IP	CML	BMC	RLD	SBO	SBC
Experimental Academically Handicapped (EAH) Group--Continued						
10	12	0	12	4	15	9
11	17	16	13	16	9	3
12	10	14	4	16	32	28
13	14	16	9	16	37	21
14	15	0	2	4	28	7
15	17	14	7	17	12	8
Control Academically Handicapped (CAH) Group						
01	18	6	11	16	18	11
02	15	0	8	2	25	4
03	8	2	2	14	13	8
04	14	0	1	14	118	18
05	12	4	13	4	7	5
06	14	6	2	15	23	10

Table D--Continued

Subjects	IP	CML	BMC	RLD	SBO	SBC
Control Academically Handicapped (CAH) Group--Continued						
07	12	12	6	20	70	14
08	14	2	8	10	52	6
09	20	16	10	16	100	4
10	18	16	10	16	73	10
11	9	16	12	16	20	10
12	15	14	9	17	19	13
13	10	6	1	2	20	7
14	14	15	11	16	111	18
15	13	14	9	16	70	6
Experimental Normal (EN) Group						
01	14	16	15	11	15	9
02	17	10	14	12	33	11
03	12	16	7	16	170	20

Table D--Continued

Experimental Normal (EN) Group--Continued						
Subjects	IP	CML	BMC	RLD	SBO	SBC
04	22	16	10	16	38	25
05	16	14	15	20	130	22
06	19	16	9	15	31	20
07	12	16	11	16	17	15
08	9	16	9	16	40	20
09	18	16	12	16	10	11
10	10	16	14	20	35	19
11	14	16	10	20	38	16
12	20	16	13	20	170	45
13	14	2	12	8	26	17
14	17	16	10	16	40	17
15	18	14	8	17	180	28

Table D--Continued

Control Normal (CN) Group

Subjects	IP	CML	BMC	RLD	SBO	SBC
01	18	16	11	20	61	8
02	14	16	11	16	45	18
03	12	5	3	16	47	4
04	14	16	13	20	89	8
05	18	13	13	20	144	6
06	21	8	15	14	150	6
07	18	2	9	12	41	14
08	12	0	16	0	49	10
09	16	16	14	16	43	2
10	12	16	8	20	25	6
11	18	16	9	14	70	16
12	8	4	10	8	119	5
13	18	16	15	18	62	17

Table D--Continued

Control Normal (CN) Group--Continued

Subjects	IP	CML	BMC	RLD	SBO	SBC
14	19	14	11	16	147	26
15	14	16	6	20	87	20

APPENDIX H

POSTTEST RAW DATA

Table E

Bruininks-Oseretsky Test Short Form Posttest Data

Experimental Academically Handicapped (EAH) Group														
Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
01	8.2	6	6	0	1	5	4	2	3	2	1	2	21	18
02	8.7	8	3	0	1	6	3	5	2	4	1	1	20	20
03	8.1	10	6	0	3	7	3	2	4	0	2	2	19	18
04	8.1	10	6	0	2	6	3	5	4	15	1	2	24	23
05	10.4	10	6	1	2	7	2	3	3	3	2	1	14	25
06	7.3	10	6	0	1	5	4	2	4	2	2	2	18	22
07	8.5	8	3	0	1	5	5	5	2	12	1	0	19	25

Note. Table is read as follows: SR-Shuttle Run; SBP-Standing Balance Pose; BW-Beam Walking; FTFC-Feet Tapping Fingers Circling; JC-Jump & Clap; SLJ-Standing Long Jump; C-Catching; T-Throwing; RS-Response Speed; DR-Drawing a Line; CC-Copying a Circle; OP-Overlapping Pencils; SC-Sorting Cards; and DC-Dots in Circles.

Table E--Continued

Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
Experimental Academically Handicapped (EAH) Group--Continued														
08	7.8	10	6	1	2	8	5	3	6	0	1	2	17	26
09	7.9	5	4	0	4	5	5	2	8	0	2	1	22	22
10	8.1	10	6	0	2	6	5	2	4	0	1	0	21	28
11	8.3	6	6	1	2	5	3	3	2	0	2	1	14	21
12	7.9	10	6	0	2	8	5	1	6	0	0	2	18	23
13	10.3	3	3	1	1	3	4	3	1	0	1	0	21	18
14	8.8	10	4	0	2	5	5	3	2	0	1	2	12	20
15	8.0	10	6	0	1	6	4	1	4	0	2	2	20	24
Control Academically Handicapped (CAH) Group														
01	9.4	8	6	1	1	7	1	1	4	0	2	2	13	22
02	8.8	9	6	0	2	7	2	2	3	1	2	2	25	29
03	8.9	9	6	0	1	7	3	2	2	2	1	1	19	23

Table E--Continued

Control Academically Handicapped (CAH) Group--Continued

Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
04	8.2	10	6	0	2	6	4	3	5	2	2	1	17	26
05	8.2	4	6	0	1	7	4	4	2	6	1	2	18	26
06	8.5	6	6	0	2	7	3	4	5	2	1	1	13	19
07	8.3	10	6	1	2	7	1	2	4	0	1	2	18	28
08	9.2	10	4	0	1	5	1	1	2	2	2	1	23	21
09	8.0	10	6	1	2	6	5	5	4	4	1	1	25	26
10	7.8	10	6	0	2	6	3	3	4	0	2	1	21	26
11	8.2	10	6	1	1	5	2	4	3	0	1	2	16	15
12	8.5	9	6	0	2	4	5	2	4	4	1	1	15	20
13	8.5	10	6	0	2	5	4	2	4	0	1	1	23	27
14	8.1	10	6	1	2	7	2	3	3	0	2	0	27	30
15	7.6	10	6	0	2	7	3	2	4	1	0	1	21	26

Table E--Continued

Experimental Normal (EN) Group													
Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
01	8.0	10	6	0	3	7	4	4	7	4	1	2	17	19
02	7.3	10	6	0	2	9	2	1	4	0	1	2	31	47
03	8.0	10	4	1	2	7	4	3	5	2	2	2	14	16
04	7.9	10	6	1	3	8	4	5	4	1	2	2	21	23
05	7.8	10	6	1	3	9	4	4	2	0	2	2	16	28
06	7.2	10	6	0	2	7	4	3	4	1	1	2	14	15
07	8.4	10	6	0	2	8	5	4	6	1	1	1	17	24
08	8.2	10	6	1	3	5	5	1	4	3	1	1	23	32
09	7.1	8	6	0	2	7	5	2	4	0	2	2	19	19
10	8.1	10	6	0	2	7	5	4	6	0	2	2	18	25
11	7.7	10	6	0	2	8	3	0	5	2	2	2	24	27

Table E--Continued

Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
Experimental Normal (EN) Group--Continued														
12	7.1	10	6	0	2	5	4	5	3	0	2	1	17	21
13	9.5	10	6	1	2	6	5	1	4	0	1	2	23	23
14	8.0	10	6	1	2	6	5	1	5	0	2	1	12	24
15	8.0	10	6	0	2	7	5	3	3	0	2	1	32	18
Control Normal (CN) Group														
01	7.7	10	6	1	2	8	3	4	6	0	2	2	22	32
02	8.5	8	6	0	2	7	4	4	9	1	3	1	14	23
03	8.6	10	6	0	2	9	5	4	4	0	0	0	17	26
04	8.8	10	6	1	2	6	3	3	3	0	2	2	28	30
05	7.8	10	5	1	3	8	5	4	5	0	2	2	22	28
06	7.6	10	6	1	3	7	4	2	6	0	1	2	16	28

Table E--Continued

Control Normal (CN) Group--Continued

Subjects	SR	SBP	BW	FTFC	JC	SLJ	C	T	RS	DR	CC	OP	SC	DC
07	8.3	10	6	1	2	6	3	2	3	0	2	2	25	35
08	8.1	10	6	1	2	6	2	0	2	2	2	1	21	26
09	8.6	10	6	0	2	6	3	3	4	5	1	0	15	26
10	8.8	10	4	0	2	5	1	2	3	0	2	2	22	25
11	7.8	10	6	1	2	8	5	5	12	0	2	2	19	30
12	8.3	10	6	0	2	6	2	1	2	5	1	1	17	24
13	8.1	10	6	1	3	9	5	4	7	0	2	1	19	26
14	7.7	10	6	1	2	4	2	1	2	0	2	2	25	32
15	8.2	10	6	1	2	5	5	4	4	4	2	2	16	26

Table F

Southern California Perceptual Motor Posttest Scores

	Experimental Academically Handicapped (EAH) Group					
	IP	CML	BMC	RLD	SBO	SBC
01	14	13	10	16	29	6
02	16	10	1	16	27	10
03	10	0	12	12	71	8
04	20	16	8	16	132	21
05	14	16	13	16	42	21
06	16	0	6	4	41	23
07	13	15	5	16	29	6
08	14	12	14	14	95	19
09	16	16	11	20	22	17

Note. Table is read as follows: IP-Imitation of Postures Subtest; CML-Crossing Midline of Body Subtest; BMC-Bilateral Motor Coordination Subtest; RLD-Right-left Discrimination Subtest; SBO-Standing Balance Eyes Open Subtest; and SBC-Standing Balance Eyes Closed Subtest.

Table F --Continued

	Experimental Academically Handicapped (EAH) Group--Continued					
Subjects	IP	CML	BMC	RLD	SBO	SBC
10	16	0	14	4	44	8
11	18	15	10	16	34	7
12	14	16	5	20	27	8
13	14	14	10	16	32	13
14	11	16	1	20	36	16
15	12	15	6	16	114	6
	Control Academically Handicapped (CAH) Group					
01	18	0	14	4	14	8
02	16	12	10	20	20	6
03	12	2	9	4	35	9
04	12	12	2	12	125	15
05	14	12	9	4	88	16

Table F--Continued

Control Academically Handicapped (CAH) Group--Continued						
Subjects	IP	CML	BMC	RLD	SBO	SBC
06	14	4	6	14	32	9
07	16	0	11	4	78	15
08	14	2	6	14	45	4
09	16	16	12	16	156	10
10	14	16	6	20	59	12
11	14	0	16	6	47	15
12	16	0	4	16	16	0
13	16	12	4	16	14	6
14	16	16	6	16	180	13
15	8	14	4	20	65	9
Experimental Normal (EN) Group						
01	12	7	6	18	116	36
02	15	10	14	16	110	14

Table F--*Continued*

Experimental Normal (EN) Group--*Continued*						
Subjects	IP	CML	BMC	RLD	SBO	SBC
03	14	14	4	16	89	11
04	20	11	4	16	106	21
05	16	16	10	20	160	25
06	14	8	9	20	39	9
07	23	16	13	16	165	27
08	16	16	15	16	104	59
09	18	16	8	16	25	7
10	16	16	11	20	186	35
11	19	16	9	20	30	6
12	22	16	11	20	188	34
13	18	13	16	16	164	26
14	20	15	5	16	18	15
15	11	2	9	8	129	12

Table F--Continued

Control Normal (CN) Group

Subject	IP	CML	BMC	RLD	SBO	SBC
01	20	16	6	20	180	11
02	6	16	10	16	114	5
03	14	15	9	16	27	3
04	16	16	12	20	70	10
05	16	16	13	18	48	8
06	20	16	18	16	145	15
07	18	12	12	16	34	12
08	10	12	8	20	132	11
09	18	16	9	16	40	0
10	16	13	14	20	9	4
11	16	15	7	20	80	12
12	14	0	11	12	70	6
13	22	16	16	20	145	15

Table F--<u>Continued</u>

Control Normal (CN) Group--Continued						
Subjects	IP	CML	BMC	RLD	SBO	SBC
14	18	16	13	16	156	15
15	10	16	7	20	142	15

APPENDIX I

INSTRUCTIONAL OBJECTIVES FOR THE EXPERIMENTAL AND CONTROL GROUPS

Table G

Instructional Objectives for the Experimental Group

	Objectives									
Date	Static & dynamic balance	Bilateral coordination	Hand-eye/upper body coordination	Fine motor coordination	Motor planning	R/L discrimination	Reaction/movement time	Upper limb speed/dexterity	Abdominal strength	Leg strength & power
Mon., Jan. 11	x		x				x			x
Tue., Jan. 12	x	x	x		x			x		
Mon., Jan. 18			x		x			x		x
Wed., Jan. 20			x	x	x		x	x		
Th., Jan. 21		x	x	x			x	x	x	
Fri., Jan. 22	x					x				x
Mon., Jan. 25	x		x				x			x
Tue., Jan. 26	x	x	x		x			x		
Wed., Jan. 27			x		x			x		x
Th., Jan. 28			x	x	x		x	x		
Fri., Jan. 29		x	x	x			x	x	x	
Mon., Feb. 1	x				x	x				
Tue., Feb. 2					x	x	x		x	
Wed., Feb. 3					x	x	x		x	
Th., Feb. 4					x	x	x		x	
Mon., Feb. 8					x	x	x		x	x
Tue., Feb. 9		x			x	x	x		x	x
Wed., Feb. 10		x			x	x	x		x	x
Th., Feb. 11		x			x	x	x		x	x
Mon., Feb. 15					x		x		x	x
Wed., Feb. 17		x			x	x	x		x	
Th., Feb. 18		x			x		x		x	

Table G--Continued

	Objectives									
Date	Static & dynamic balance	Bilateral coordination	Hand-eye/upper body coordination	Fine motor coordination	Motor planning	R/L discrimination	Reaction/movement time	Upper limb speed/dexterity	Abdominal strength	Leg strength & power
Fri., Feb. 19		x			x	x				x
Mon., Feb. 22		x			x	x	x		x	x
Tue., Feb. 23		x			x		x		x	x
Wed., Feb. 24		x			x		x		x	x
Th., Feb. 25		x			x		x		x	x
Fri., Feb. 26		x			x				x	x
Mon., Mar. 1					x		x		x	x
Tue., Mar. 2		x			x		x		x	x
Wed., Mar. 3		x			x		x		x	x
Th., Mar. 4		x			x		x		x	
Fri., Mar. 5		x			x					x
Mon., Mar. 8	x		x				x			x
Tue., Mar. 9	x	x	x		x			x		
Th., Mar. 11		x	x		x		x			
Fri., Mar. 12			x	x			x	x	x	
Mon., Mar. 22	x					x				
Tue., Mar. 23					x		x		x	x
Wed., Mar. 24		x			x	x				x
Th., Mar. 25		x	x		x		x		x	x
Fri., Mar. 26		x	x		x					x
Mon., Mar. 29		x			x		x		x	x
Tue., Mar. 30		x	x		x					x
Wed., Mar. 31					x		x		x	x
Th., Apr. 1		x			x		x		x	x
Fri., Apr. 2		x			x		x		x	x

Table G--<u>Continued</u>

	Objectives									
Date	Static & dynamic balance	Bilateral coordination	Hand-eye/upper body coordination	Fine motor coordination	Motor planning	R/L discrimination	Reaction/movement time	Upper limb speed/dexterity	Abdominal strength	Leg strength & power
Mon., Apr. 5		x			x		x		x	x
Tue., Apr. 6			x		x		x		x	x
Wed., Apr. 7		x			x		x		x	x
Tue., Apr. 13					x		x		x	x
Wed., Apr. 14					x		x		x	x
Th., Apr. 15			x		x		x		x	x
Fri., Apr. 16			x		x		x		x	x
Mon. Apr. 19		x	x		x		x		x	x
Tue., Apr. 20			x		x		x		x	x
Wed., Apr. 21		x			x		x		x	x
Th., Apr. 22		x			x		x		x	x
Fri., Apr. 23		x	x		x		x		x	x
Mon., Apr. 26		x	x		x		x		x	x
Tue., Apr. 27		x	x		x		x		x	x
Wed., Apr. 28							x		x	x
Th., Apr. 29		x	x		x					x
Fri., Apr. 30		x	x		x					x
Mon., May 3					x		x		x	x
Tue., May 4		x	x		x		x		x	x
Wed., May 5		x			x		x		x	x
Th., May 6							x		x	x
Fri., May 7		x	x		x		x		x	x
Mon., May 10	x						x			x
Tue., May 11	x	x	x							
Wed., May 12			x		x					x
Th., May 13			x		x		x	x		
Fri., May 14			x	x			x	x		
Mon., May 17		x	x	x				x	x	
Tue., May 18	x					x				

Table H

Instructional Objectives for the Control Group

	Objectives									
Dates	Static & dynamic balance	Bilateral coordination	Hand-eye/upper body coordination	Fine motor coordination	Motor planning	R/L discrimination	Reaction/movement time	Upper limb speed/dexterity	Abdominal strength	Leg strength & power
Mon., Jan. 11		x	x		x			x		
Tue., Jan. 12	x	x			x				x	x
Mon., Jan. 18	x						x			x
Wed., Jan. 20	x	x	x		x					
Th., Jan. 21			x		x			x		
Fri., Jan. 22			x	x	x		x	x		
Mon., Jan. 25	x		x	x	x	x		x	x	
Tue., Jan. 26	x						x			x
Wed., Jan. 27	x	x	x		x					
Th., Jan. 28			x					x		x
Fri., Jan. 29			x	x			x	x		
Mon., Feb. 1				x			x	x	x	
Tue., Feb. 2					x					x
Wed., Feb. 3		x	x		x		x		x	x
Th., Feb. 4	x				x				x	x
Mon., Feb. 8	x				x				x	x
Tue., Feb. 9			x						x	x
Wed., Feb. 10		x	x		x				x	x
Th., Feb. 11		x	x		x					
Mon., Feb. 15					x				x	x
Wed., Feb. 17		x	x		x					
Th., Feb. 18	x				x				x	x
Fri., Feb. 19					x				x	x
Mon., Feb. 22		x	x		x			x	x	
Tue., Feb. 23		x	x		x				x	x
Wed., Feb. 24		x			x	x	x		x	x

Table H--Continued

Date	Objectives	Static & dynamic balance	Bilateral coordination	Hand-eye/upper body coordination	Fine motor coordination	Motor planning	R/L discrimination	Reaction/movement time	Upper limb speed/dexterity	Abdominal strength	Leg strength & power
Th., Feb. 25				x		x		x			x
Fri., Feb. 26			x			x		x			x
Mon., Mar. 1			x			x		x	x		x
Tue., Mar. 2						x	x	x		x	x
Wed., Mar. 3		x		x		x			x	x	x
Th., Mar. 4		x		x		x				x	x
Fri., Mar. 5						x	x	x		x	x
Mon., Mar. 8		x	x	x		x		x		x	x
Tue., Mar. 9		x		x		x		x		x	x
Th., Mar. 11						x		x		x	x
Fri., Mar. 12			x	x		x	x	x	x	x	x
Mon., Mar. 22		x				x		x			x
Tue., Mar. 23			x	x		x					x
Wed., Mar. 24				x		x		x	x		
Th., Mar. 25					x				x	x	
Fri., Mar. 26		x					x				
Mon., Mar. 29				x	x	x				x	x
Tue., Mar. 30				x	x	x				x	x
Wed., Mar. 31				x	x	x				x	x
Th., Apr. 1			x			x				x	x
Fri., Apr. 2			x			x				x	x
Mon., Apr. 5			x			x				x	x
Tue., Apr. 6			x			x		x		x	x
Wed., Apr. 7			x	x	x	x		x		x	x
Tue., Apr. 13		x		x	x			x		x	
Wed., Apr. 14				x	x	x				x	x
Th., Apr. 15		x	x	x		x				x	x
Fri., Apr. 16		x	x		x					x	x

Table H--Continued

	Objectives									
Date	Static & dynamic balance	Bilateral coordination	Hand-eye/upper body coordination	Fine motor coordination	Motor planning	R/L discrimination	Reaction/movement time	Upper limb speed/dexterity	Abdominal strength	Leg strength & power
Mon. Apr. 19		x	x		x		x		x	x
Tue., Apr. 20			x		x		x		x	x
Wed., Apr. 21		x			x		x		x	x
Th., Apr. 22		x			x		x		x	x
Fri., Apr. 23		x	x		x		x		x	x
Mon., Apr. 26		x	x		x		x		x	x
Tue., Apr. 27		x	x		x		x		x	x
Wed., Apr. 28							x		x	x
Th., Apr. 29		x	x		x					x
Fri., Apr. 30		x	x		x					x
Mon., May 3					x		x		x	x
Tue., May 4		x	x		x		x		x	x
Wed., May 5		x			x		x		x	x
Th., May 6							x		x	x
Fri., May 7		x	x		x		x		x	x
Mon., May 10	x						x			x
Tue., May 11	x	x	x							
Wed., May 12			x		x					x
Th., May 13			x		x		x	x		
Fri., May 14			x	x			x	x		
Mon., May 17		x	x	x				x	x	
Tue., May 18	x					x				

APPENDIX J

DESCRIPTION OF THE CCDE SENSORY-MOTOR PROGRAM AND LESSON PLANS FOR THE EXPERIMENTAL GROUPS

Description of the CCDE Sensory-Motor Program and Lesson Plans for the Experimental Groups

The lesson plans for the experimental groups consisted of deep pressure tactile stimulation, developmental exercises, and crawling patterns. These lessons were designed to meet specific objectives--to improve static and dynamic balance, bilateral coordination, hand-eye upper body coordination, motor planning, right-left discrimination, reaction/movement time, upper limb speed/dexterity, abdominal strength and power, which were identical to the objectives of the control groups. The experimental groups' classes were held for 30 minutes at the same class period as that of the control groups. A description of the CCDE Sensory-Motor Program utilized in this study as well as sample lesson plans for the experimental groups are presented in Appendix J.

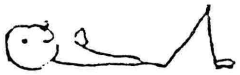
Developmental Exercises

The developmental exercises were presented in the following sequence with a different number of repetitions of each exercise, depending on the attention span and fatigue level of the children as well as their mastery of the exercises. The developmental exercise segment of the sensory-motor program comprised approximately 10 minutes of the 30-minute physical education class. The children, dressed in regular school clothes, entered the stage area which was enclosed by two folding partitions. Shoes, socks, and belts with large buckles were removed during each lesson.

The following exercises were performed in sequence beginning in supine hook-lying position with the hands fisted, arms inwardly rotated, elbows flexed and held tightly against the ribs. Blindfolds were used on some days as indicated in the individual lesson plans. The exercises were cued in response to a startle sound made by blocks accompanied by loud, verbal commands.

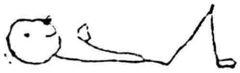
1. Tuck

   Supine hook-lying position with arms diagonally across chest. Bring the head and knees to the midline of the body with the hands fisted and arms adducted tightly on the chest. Flex feet and curl toes downward. Eyes gaze downward. Hold 5 seconds. Cue: Tuck, Relax.



2. Prenatal Release

Supine hook-lying position with arms diagonally across chest
Rub the arms gently across the upper chest and diagonally from the chest to the abdomen. Rub one arm at a time then both together. Rub legs gently together while arms move slowly in an up and down motion. Eyes gaze straight forward. Continue 60 seconds.
Cue: Legs together, Right arm, Left arm, Both arms, Relax.

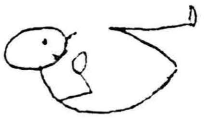


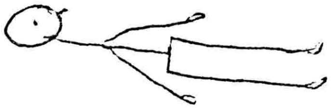
3. Tuck, Push, Point Toes

Supine hook-lying position with arms diagonally across chest
Tuck (Follow directions for Tuck exercise). Push (Partially extend the legs to a 45 degree angle). Toes (Point toes downward). Flex and inwardly rotate shoulders; lift head off the floor during the entire exercise. Hold each position 5 seconds.
Cue: Tuck, Push, Toes, Relax.

4. Tuck and Extend

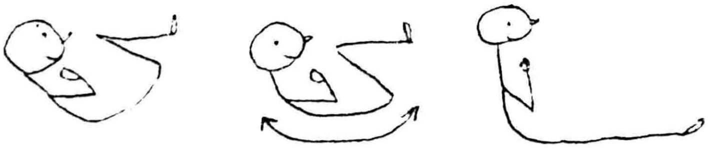
Supine hook-lying position with arms diagonally across chest. Tuck (Follow directions for the Tuck exercise). Extend (Extend the legs 180 degrees, pointing the toes and lifting them slightly off the floor). Extend the arms parallel to the legs. Lift head off the floor. Assume hook-lying position ready for the next repetition. Hold each position 5 seconds. Cue: Tuck, Extend, Relax.





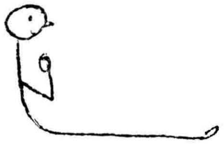
5. Tuck, Rock, and Sit

Supine hook-lying position with arms diagonally across chest. Tuck (Follow directions for the Tuck exercise). Rock (Remain in tuck position and rock back and forth). Sit (Extend legs, kicking to a sitting position). Keep arms on chest. Hold each position 5 seconds. Cue: Tuck, Rock, Sit, Relax.



6. Tuck and Sit

Supine hook-lying position with arms diagonally across chest. Tuck (Follow directions for Tuck exercise). Sit (Extend legs, kicking to a sitting position). Keep arms on chest. Hold each position 5 seconds. Cue: Tuck, Sit, Relax.



7. Prone Extension

Prone-lying position (on the abdomen) with arms adducted, hands in a fist, elbows flexed and held tightly against the ribs. Extend the neck, trunk, and legs with the toes pointed. Outwardly rotate shoulders with fists held shoulder height. Keep elbows close to the trunk. Eyes gaze upward, if not using a blindfold. Keep feet 1 inch from the floor. Hold 5 seconds. Cue: Up, Hold, Relax.

Crawling Patterns

Three specific crawling patterns: (a) basic, (b) homolateral, and (c) cross-pattern, were introduced in the sensory-motor program. These crawling patterns were presented for approximately 10 minutes at each session. All crawling patterns were done in prone position with all body parts on the floor. The basic crawl was done for the first 7 weeks of the experimental period. The homolateral crawl was done from the eighth to the eleventh week of the 15-week experimental period. The cross-pattern crawl was done from the twelfth through the fifteenth week. The children crawled in the school cafeteria on a hard, smooth, linoleum surface which provided the essential tactile sensations recommended by Snapp (1979). Other environmental controls included the overhead lights turned off and window shades drawn.

The basic crawling pattern, which is detailed in the next section, was taught in a specific sequence. After the children performed the pattern correctly, they crawled independently while wearing blindfolds. Thus, visual stimuli was not used to guide or structure the crawling patterns. Children crawled continuously at their own pace back and forth across the large room. Boundary cones were used to enclose the area and provide tactile cues for changing directions when children were blindfolded. The distance crawled each day varied with the functional ability of the students. Distance goals were set at each sesson and appear in the individual lesson plans; however, students crawled the specified time allocated for crawling even if the daily goal was exceeded.

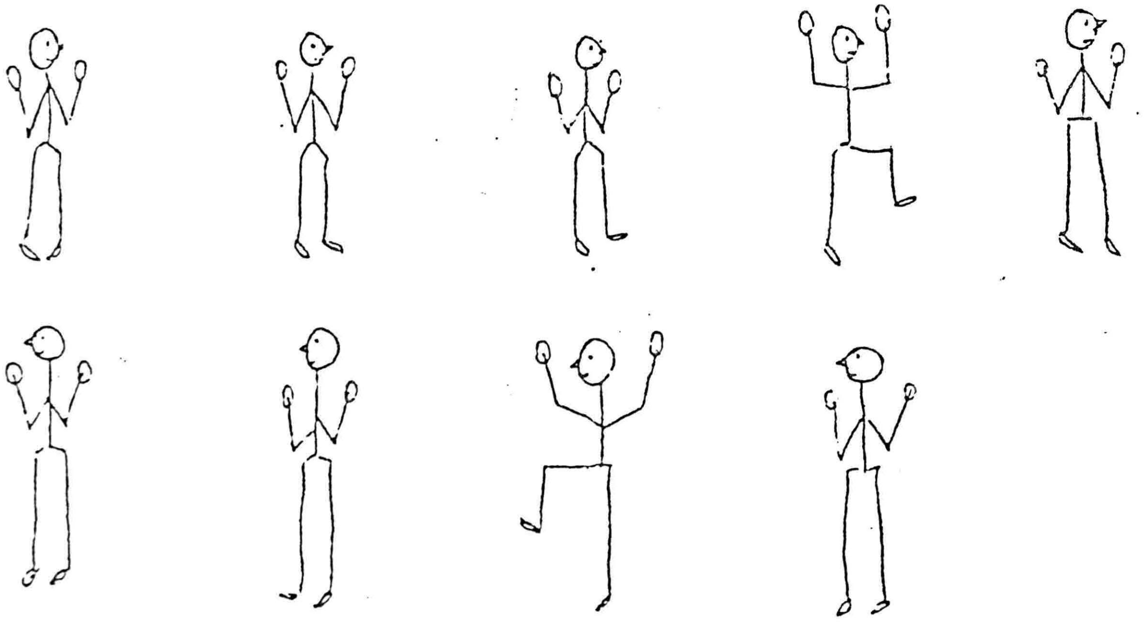
Teaching the Basic Crawl

The basic crawl was taught by a patterning technique which required sequential component movements to be practiced by visual, auditory, tactile, and kinesthetic cues. The first phase included visual and verbal cues given by the instructor (demonstration). The second phase comprised manual guidance of the lower extremities done one at a time by a student partner while the instructor gave the following verbal cues: (a) Turn it out, (b) Flex, (c) Pull it up, (d) Push, and (e) Touch toes. The patterning cues for the upper extremities were done one arm at a time by the student. The instructor gave the following verbal cues: (a) Turn it out, (b) Reach up, (c) Pull, and (d) Put it away. The third phase included verbal cues given by the instructor while the students were blindfolded. The basic crawl, using this technique, required approximately 4 weeks of instruction. Thereafter, the students crawled independently with occasional manual guidance given by the instructor for students who were not performing the pattern correctly.

Patterning of the lower extremities, done one leg at a time, was executed from a prone-lying position with the toes touching and arms flexed and under the trunk. Patterning the basic crawl included the following movements of the lower extremities: (a) outward rotation of the leg at the hip, (b) flexion of the ankle, (c) flexion of the knee and hip keeping the hip, leg, and foot on the floor, (d) extension of the leg at the hip, and (e) inward rotation of the hip to the initial position with the toes touching. The arms were patterned, one at a time, with the following movements as the face turned toward the advancing extremity: (a) outward rotation of the shoulder, (b) upward extension of the arm, (c) downward pull until the hand reaches the shoulder, and (d) inward rotation of the shoulder placing the fist against the chest under the shoulder. Following mastery of patterning one extremity, both arms were used simultaneously.

The basic crawl involves a bilateral pull with the upper extremities on each alternating flexion (push) of the lower extremity. The face is turned toward the direction of the flexed lower leg with visual tracking of the extended hand.

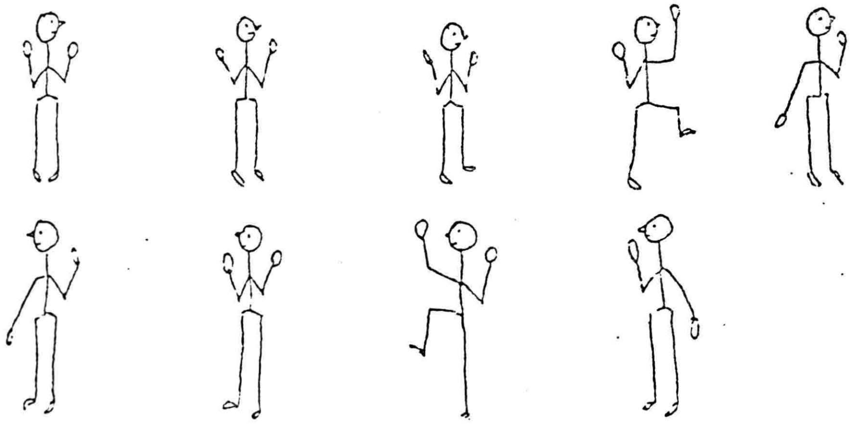
Basic Crawl



Homolateral Crawl

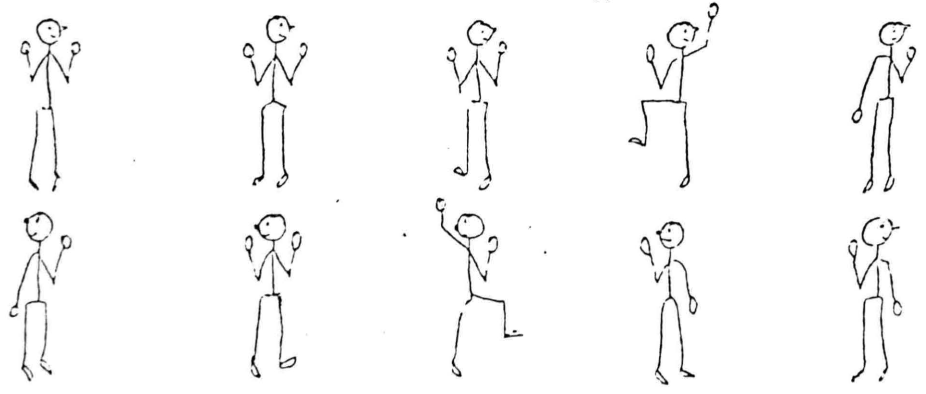
The homolateral crawl was presented following the basic crawl for 4 weeks near the midpoint of the experimental period. The homolateral crawl was taught by demonstration without individual patterning of the limbs as used for the basic crawl. The students practpracticed the homolateral crawl while wearing blindfolds, and later with vision toward the extended upper extremity. In the homolateral crawl the right arm and right leg move simultaneously, and the left arm and left leg move simultaneously. The face is turned toward the direction of the advanced upper extremity. The head moves from side to side as each arm is used. Students practiced the homolateral crawl while wearing a blindfold, and later visually tracked the extended hand on each side. The body remained horizontal on the crawling surface.

Homolateral Crawl



Cross-Pattern Crawl

The cross-pattern crawl was presented following the homolateral crawl during the last 4 weeks of the experimental period. The cross-pattern crawl was taught by demonstration without sequential patterning of the limbs. The students practiced the pattern while wearing blindfolds, and later with vision toward the extended upper extremity. In the cross-pattern crawl the left arm and right move simultaneously. The face is turned in the direction of the arm executing the pull. The eyes track the extended hand as the body advances. A pushing-pulling movement is done with the right arm and left leg simultaneously. All body parts remain in contact with the floor.



Deep Pressure Tactile Stimulation

Deep pressure tactile stimulation of 8 to 10 pounds intensity was applied with the thumb, knuckle, or several fingers held closely together pressing downward as a unit on specific areas of the body. Each application of pressure was sustained at least 3 seconds in duration. There was no massage or circular movement associated with pressure. This portion sensory-motor program comprised approximately 10 minutes of the 30-minute class. Pressure was administered by the instructor to each child during this 10-minute period. Concurrently, pressure was administered by a student partner or by the child himself as the instructor verbally cued the different body parts to receive pressure. Pressure was administered by different student partners each day. The children creceived pressure while in prone-lying position and while sitting "Indian" style.

The following areas were stimulated, one at a time, in the following order: (a) on the back, 1 inch laterally from the spinal column from the cervical to the lumbar vertebrae, (b) on the palms of the hands, (c) on the volar or palmar and dorsal surfaces of the forearms, (d) on the anterior, posterior, and lateral portions of the thighs, and (e) on the sole, heel, and medial arches of the feet. Each area of the body to receive pressure was cued verbally by the instructor.

The children received deep pressure tactile stimulation by a partner or self-pressure and pressure by the teacher in each specified area during this segment of the sensory-motor program.

Experimental Group Lesson Plan

Concept: Deep pressure tactile stimulation
Developmental exercises
Patterning basic crawl

Objectives: Demonstrate understanding of pressure by being able to relax when pressure is administered.
Perform developmental esercise: Tuck on cue. Understand verbal cues "Turn it out", "Flex", and "Pull it up" in patterning the lower extremities on the basic crawl.

Procedures:

Children enter room and sit against the wall "Indian" style behind a carpet square. Remove shoes, socks, sweaters, coats, jackets, and large belts. Check roll.

Lesson:

10 minutes Pressure by instructor; children lie in prone position with arms at sides. Pressure is given to the following areas: back, and posterior surface of the legs. Students are to keep eyes closed during pressure.

5 minutes Developmental exercises
Tuck- 10 repetitions.
Stress lifting the head to touch the knees. Manual guidance is provided for those who have difficulty.

10 minutes Patterning basic crawl
Teach the patterning cue "Pull it up". Pattern the lower extremities with the cues: "Turn it out",' Flex", "Pull it up". 15 repetitions.

Materials & Equipment Blocks, carpet squares.

Date: Wednesday, February 3, 1982

Experimental Group Lesson Plan

Concept: Deep pressure tactile stimulation
Developmental exercises

Objectives: Demonstrate knowledge of pressure by exerting the correct amount of force in appropriate areas on a partner.
Perform exercises cued by a tape with a smooth transition between exercises.

Procedures: Select proper name tag. Remove shoes and socks. Lie in prone position awaiting pressure with music accompaniment from "Lullaby from the Womb." Stickers are awarded to children who perform developmental exercises correctly with a fast reaction time.

Lesson:

14 minutes Pressure by instructor on posterior body surfaces with children in prone position.
Pressure by student partner on posterior body surfaces with children in prone position.
Self pressure on hands, feet, and upper legs.

5 minutes Developmental exercises: Tuck, Tuck & Extend, Tuck Rock & Sit, Tuck & Sit, and Prone Extension cued by a tape recording. 4 repetitions. Instructor enhances auditory cues with blocks.

6 minutes Basic crawl with blindfold.
Children crawl independently over a distance of 20 feet.

Materials & Equipment Blocks, tape recorder, tapes, blindfolds, boundary cones.

Date: Wednesday, March 3, 1982

Experimental Group Lesson Plan

Concept: Deep pressure tactile stimulation
Developmental exercises

Objectives: Perform pressure on partner in the appropriate areas with the aid of the back strip. Improve endurance and muscular strength by increasing the repetitions of each developmental exercise.

Procedures: As each child enters, he is given a back strip (piece of cloth 3 inches wide with a string around the neck). Shoes and socks are removed and the student lies quietly in prone position with eyes closed. Stickers are awarded for the students who excel in the developmental exercises. Check roll.

Lesson:

15 minutes As instructor applies pressure to the back the back strip is adjusted to the center of the back.
Pressure on back by partner using the back strips as guides to the correct placement of the thumbs. Instructor gives verbal direction directions in the use of the backstrip.
Pressure on hands, feet, and legs by partner.

7 minutes Developmental exercises with blindfolds. Tuck, Tuck & Extend (pushing from the wall), Tuck Rock & Sit, Tuck & Sit, and Prone Extension. 7 repetitions.

3 minutes Self pressure on hands, feet, arms and legs. Self pressure is accompanied by tape: "Lullaby from the Womb."

Materials & Equipment Blindfolds, back strips, tape recorder, tape, blocks.

Date: Monday, March 29, 1982

Experimental Group Lesson Plan

Concept:
Deep pressure tactile stimulation
Developmental exercises
Homolateral crawl

Objectives:
Administer pressure in the correct areas using the back strips.
Increase the speed of reaction time on the developmental exercises.
Perform the homolateral crawl correctly.

Procedures: Children sit by the stage area and remove shoes and socks. When entering the stage area each child receives a back strip. Children find partners and await the verbal cue of the instructor to begin pressure. Check roll.

Lesson:

10 minutes Pressure on the back is applied by the instructor concurrently while children administer pressure to their partners. Areas to receive pressure include the back, legs, arms, feet, and hands.

4 minutes Developmental exercises.
Tuck, Prenatal Release, Tuck & Extend, Tuck Rock & Sit, Tuck & Sit, and Prone Extension.
2 repetitions.

11 minutes Homolateral crawl.
Children perform homolateral crawl with blindfolds. Children work in partners with one person manually assisting the other by guiding the lower extremities.

Materials & Equipment Tape recorder, tape, blindfolds, back strips.

Date: Wednesday, April 7, 1982

Experimental Group Lesson Plan

Concept:	Deep pressure tactile stimulation Developmental exercises Cross-pattern crawl
Objectives:	Apply pressure in correct areas holding each pressure point at least 3 seconds. Perform developmental exercises with a smooth transition between each exercise. Perform correct cross-pattern crawl with vision toward the extended upper extremity.
Procedures:	Children sit by stage and remove shoes and socks. On cue as the tape "Lullaby from the Womb" begins, children assume a prone-lying position with eyes closed.
Lesson: 10 minutes	Pressure by instructor on back, arms, and legs. Self pressure on hands and feet. Brisk rubbing on arms and legs done by students.
7 minutes	Developmental exercises Entire sequence of 7 exercises 2 sets of 4 repetitions each. Emphasize quick transition between exercises and 100% participation by all students on each exercise. Blindfolds used on developmental exercises.
8 minutes	Independent crawling cross-pattern Manual guidance is provided on lower extremities for children who are having difficulty with coordination of arm and leg patterns.
Materials & Equipment	Blocks, tape recorder, tape, blindfolds.
Date:	Tuesday, May 4, 1982

APPENDIX K

LESSON PLANS FOR THE CONTROL GROUPS

Lesson Plans for Control Group

The regular physical education program was conducted in the gymnasium and/or asphalt slab area at Crockett Elementary School, San Marcos, Texas, for the same time period as the experimental group. The control groups' classes were held for 30 minutes duration. The lessons consisted of warm-up exercises and stunts, low organization games, skill practice done at teaching stations, obstacle courses and rhythmical and movement exploration activities. The control groups' activities were conducted according to the San Marcos Independent School District Physical Education Curriculum Guide for Grades K-1 (Burruss & Cobarruvias, in press). The regular physical education teacher compleded daily lesson plans according to the objectives in the San Marcos Independent School District Physical Education Curriculum Guide. These objectives coincided with those formulated by the investigator for the sensory-motor program. The lesson plans for the control group are presented in the next section.

Control Group Lesson Plan

Concept:	Fitness & Ball Handling
Objective:	Children will experience activities designed to improve their fitness level and ball-handling skills
Warm-up actitities:	Record: A Fifth of Beethoven from album Learning by Doing, H. B.Glass
Lesson:	Station I Sit-ups Station II. Flexed arm hang from chinning bars Station III. Bench push-ups on chairs Station IV Jogging circle Station V Seal Crawl on mats Station VI. Bouncing and catching a utility ball. Teacher encourages various ways of using ball varying amount of force utilized Station VII. Foam Balls. Children throw foam balls onto the walls nd attempt to catch the rebound Station VIII. Tennis Balls. Children stand in scattered formation, each with a tennis ball. Each child catches the tennis ball as it rebounds from the floor either with one or two hands
Equipment:	Mats, Mat racks, chinning bars, chairs, cones, utility balls, tennis balls, foam balls.
Date:	February 3, 1982

Control Group Lesson Plan

Concept: Manipulative skills--throwing and ball handling

Objective: Children will participate in activities which will enhance their ability to manipulate balls of various sizes.

Warm-up actitities: Six small containers of tennis balls are spaced evenly around the gymnasium. Children find their personal space and go to nearest container to get one tennis ball.In their personal space they are encouraged to do different stunts and activities by themselves with one tennis ball. Children are prompted by the teacher if necessary. Creative responses are praised verbally.
Examples include: a) arm circles with the ball in one hand, b) hold the ball under the chin while performing the head to toes exercise, c) Superman exercise with ball held in both hands in front of the face, d) push ball between hands held in front of the chest, e) squeeze the ball with alternating hands, f) pick up ball between two feet, g) pick up ball with chin from floor, h) carry ball under arm while jumping in a circle.

Lesson: Game: Barrel Ball. Children stand behind orange circles attempting to throw balls into the barrels in the center of the circle for specified time periods.

Equipment: Tennis balls, containers, barrels.

Date: February 16, 1982

Control Group Lesson Plan

Concept: Body Awareness-Body Surfaces

Objective: Children will participate in various activities that will enhance their awareness of how the body moves on different body surfaces.

Explanation of activities at the various stations:

1. Balance beam. Children move on the front body surface
2. Tripple beam. Children will "spider-walk" on either side of the beam.

Lesson:

3. Ropes and cones. Children move under ropes on the back body surface.
4. Mats Combat crawl
5. Tunnel. Blue barrel with mats. Children crawl through
6. Plank. Children scoot across plank on their posterior body surface
7. Tires. Children Crawl through the maze of tires.
8. Tall balance beam. Children pull themselves on the front body surface
9. Mat mountain. Tumbling table. Children crawl up and roll down the tumbling table.
10. Mat tunnel. Children crawl through tunne.
12. White mats (2) Children creep across.
13. Red and blue mats. Children Crab walk across
14. Belly crawl under tall beam
15. Gray mats. Seal crawl

Equipment:

16. Groovey loops. Children do the Bear walk
17. Extra long ropes. Children pull body along rope using arms only.
18. Thick mat, forward roll
19. Gray mand blue mat. Log roll
20. Red and blue mats. Knee walk holding ankles

Date: March 4, 1982

Control Group Lesson Plan

Concept: Throwing for accuracy

Objective: Children participate in activities designed to improve their throwing accuracy.

Warm-up actitities: Head rotations
Shoulder rotations
Scissor jumps
Straddle jumps
Sit-ups
Baby twister
Push-ups

Lesson:

Station I. Target throwing. (Overhand)
Children throw at a target on the floor.
Tires are placed at varying distances.
Children are in line formation
Each child retrieves his own beanbags and brings them to next person.

Station II. Target throwing (Underhand)
Children throw at a target on the wall
Children's lines are situated at varying distances from the wall.
Each child retrieves his own beanbags and brings them to the next person.

Station III. Throwing beach balls through a suspended target.
Children throw beach balls through rgroovey loops attached to the top of the bars

Equipment: Bean bags, tires, groovey loops, beach balls, wall targets, bars.

Date: April 13, 1982

Control Group Lesson Plan

Concept:

Low organization games
Locomotor skills
Arm & Shoulder strength

Objective:

Children participate in activities to enhance their ability to follow rules and play cooperatively in games of low organization

Warm-up actitities:

Sit-ups
Push-ups against wall
Baby twister
Straddle toe-touch

Lesson:

Game: Hot Ball (Outside)
Children stand in a circle passing five or six balls around the circle. Sound a signal. Children holding the ball at that time step back and run clockwise around the circle back to their place. Each signal a different locomotor step is cued. If a ball falls outside the circle, children must sit down facing outside the circle.

Game: Memory Cones (Outside)
Cones are scattered around the slab. with three or four items under each cone. Children hold a bandana between partners (in pairs) and skip to a cone designated by the teacher. They identify the objects and remember them. If they correctly identify the objects when they return to the teacher, they get a small mark on their fingers. Three marks earn a chance to go across the monkey bars.

Equipment: Cones, items, marker, bandanas, foam balls.

Date: April 30, 1982

APPENDIX L

MATRICES OF MEAN DIFFERENCES INDICATING CONTRAST RATIOS AND TUKEY B FORMULA

'Table I

Matrix of Cell Means Indicating Contrast Ratio on the Bruininks-Oseretsky Test Short Form for Groups and Trials

	EAH PRE 33.00	CAH PRE 33.60	EN PRE 39.40	CN PRE 39.33	EAH MID 36.13	CAH MID 40.00	EN MID 43.47	CN MID 46.60	EAH PST 43.67	CAH PST 44.80	EN PST 50.27	CN PST 50.60
EAH-PRE		.60	6.40*	6.33*	3.13	7.00	10.47*	13.60*	10.67*	11.80*	17.27*	17.60*
CAH-PRE			5.80*	5.73*	2.53	6.40*	9.87*	13.00*	10.07*	11.20*	16.67*	17.00*
EN-PRE				-.07	-3.27	.60	4.07	7.20*	4.20	5.40*	10.87*	11.20*
CN-PRE					-3.20	.67	4.14	7.27*	4.34	5.47	10.94*	11.27*
EAH-MID						3.87	7.34*	10.47*	7.54*	8.67*	14.14*	36.13*
CAH-MID							3.47	6.60*	3.67	4.80	10.27*	10.60*
EN-MID								3.13	.20	1.33	6.80*	7.13*
CN-MID									-2.93	-1.80	3.67	4.00
EAH-PST										1.13	6.60*	6.93*
CAH-PST											5.47*	5.80*
EN-PST												8.33*
CN-PST												

*$\underline{C}_{.99} \pm 4.87$

Note. See Appendix L for contrast ratio (*C*) formula.

Table J

Matrix of Cell Means Indicating Contrast Ratio on the Imitation of Postures Subtest for Groups and Trials

	EAH PRE	CAH PRE	EN PRE	CN PRE	EAH MID	CAH MID	EN MID	CN MID	EAH PST	CAH PST	EN PST	CN PST
	10.87	12.13	14.07	12.87	14.93	13.73	15.47	15.47	14.53	14.40	16.93	15.60
EAH-PRE		1.26	3.20	2.00	4.06	2.86	4.60*	4.60*	3.66	3.53	6.06*	4.73*
CAH-PRE			1.94	.74	2.80	1.60	3.34	3.34	2.40	2.27	4.80*	3.47
EN-PRE				-1.20	.86	-.34	1.40	1.40	.46	.33	2.86	1.53
CN-PRE					2.06	.86	2.60	2.60	1.66	1.53	4.06	2.73
EAH-MID						-1.20	.54	.54	-.40	.53	2.00	.67
CAH-MID							1.74	1.74	.80	.67	3.20	1.87
EN-MID								.00	-.94	-1.07	1.46	.13
CN-MID									-.94	-1.07	1.46	.13
EAH-PST										-.13	2.40	1.07
CAH-PST											2.53	1.20
EN-PST												-1.33
CN-PST												

*$\underline{C}_{.99}$ ± 4.08

Note. See Appendix L for contrast ratio ($\underline{C}$) formula.

Table K

Matrix of Cell Means Indicating Contrast Ratio on the Crossing the Midline Subtest for Groups and Trials

	EAH PRE	CAH PRE	EN PRE	CN PRE	EAH MID	CAH MID	EN MID	CN MID	EAH PST	CAH PST	EN PST	CN PST
	8.87	6.67	13.60	12.07	10.47	8.60	14.40	11.60	11.60	7.87	12.80	14.07
EAH-PRE		-2.20	4.73	3.20	1.60	-.27	5.53	2.73	2.73	-1.00	3.93	5.20
CAH-PRE			6.93*	5.40	3.80	1.93	7.73*	4.93	4.93	1.20	6.13	7.40*
EN-PRE				-1.53	-3.13	-5.00	.80	-2.00	-2.00	-5.73	-.80	.47
CN-PRE					-1.60	-3.47	2.33	-.47	-.47	-4.20	.73	2.00
EAH-MID						-1.87	3.93	1.13	1.13	-2.60	2.33	3.60
CAH-MID							5.80	3.00	3.00	-.73	4.20	5.47
EN-MID								-2.80	-2.80	-6.53	-1.60	-.33
CN-MID									.00	-3.73	1.20	2.47
EAH-PST										-3.73	1.20	2.47
CAH-PST											4.93	6.20
EN-PST												1.27
CN-PST												

*$C_{.99} \pm 6.93$

Note. See Appendix L for contrast ratio (*C*) formula.

Table L

Matrix of Cell Means Indicating Contrast Ratio on the Bilateral Motor Coordination Subtest for Groups and Trials

	EAH PRE	CAH PRE	EN PRE	CN PRE	EAH MID	CAH MID	EN MID	CN MID	EAH PST	CAH PST	EN PST	CN PST
	8.53	6.40	8.07	10.60	7.47	7.53	11.27	10.93	8.40	7.93	9.60	11.00
EAH-PRE		-2.13	-.46	2.07	-1.06	-1.00	2.74	2.40	-.13	-.60	1.07	2.47
CAH-PRE			1.67	4.20*	1.07	1.13	4.87*	4.53*	2.00	1.53	3.20	4.60*
EN-PRE				2.53	-.60	-.54	3.20	2.86	.33	-.14	1.53	2.93
CN-PRE					-3.13	-3.07	.67	.33	-2.20	-2.67	-1.00	.40
EAH-MID						.06	3.80*	3.46*	.93	.46	2.13	3.53*
CAH-MID							3.74*	3.40	.87	.40	2.07	3.47*
EN-MID								-.34	-2.87	-3.34	-1.67	-.27
CN-MID									-2.53	-3.00	-1.33	.07
EAH-PST										-.47	1.20	2.60
CAH-PST											1.67	3.07
EN-PST												1.40
CN-PST												

*$\underline{C}_{.99}$ ± 3.44

Note. See Appendix L for contrast ratio ($\underline{C}$) formula.

Table M

Matrix of Cell Means Indicating Contrast Ratio on the Right-Left Discrimination Subtest for Groups and Trials

	EAH PRE	CAH PRE	EN PRE	CN PRE	EAH MID	CAH MID	EN MID	CN MID	EAH PST	CAH PST	EN PST	CN PST
	12.20	13.00	14.33	14.00	13.00	12.93	15.93	15.33	14.80	12.40	16.93	17.73
EAH-PRE		.80	2.13	1.80	.80	.73	3.73	3.13	2.60	.02	4.73	5.53
CAH-PRE			1.33	1.00	.00	-.07	2.93	2.33	1.80	-.60	3.93	4.73
EN-PRE				-.33	-1.33	-1.40	1.60	1.00	.47	1.93	2.60	3.40
CN-PRE					-1.00	-1.07	1.93	1.33	.80	1.60	2.93	3.73
EAH-MID						-.07	2.93	2.33	1.80	-.60	3.93	4.73
CAH-MID							3.00	2.40	1.87	.53	4.00	4.80
EN-MID								-.60	-1.13	-3.53	1.00	1.80
CN-MID									-.53	-2.93	1.60	2.40
EAH-PST										-2.40	2.13	2.93
CAH-PST											4.53	5.33
EN-PST												.80
CN-PST												

*$\underline{C}_{.99}$ ± 13.12

Note. See Appendix L for contrast ratio ($\underline{C}$) formula.

Table N

Matrix of Cell Means Indicating Contrast Ratio on the Balance with Eyes Open Subtest for Groups and Trials

	EAH PRE	CAH PRE	EN PRE	CN PRE	EAH MID	CAH MID	EN MID	CN MID	EAH PST	CAH PST	EN PST	CN PST
	20.47	46.40	35.67	53.40	23.27	49.27	64.87	78.60	51.67	64.93	104.47	92.80
EAH-P		25.93	15.20	32.93	2.80	28.80	44.40	58.13*	31.20	44.46	84.00*	72.33*
CAH-PRE			-10.73	7.00	-23.13	2.87	18.47	32.20	5.27	18.53	58.07*	46.40*
EN_PRE				17.73	-12.40	13.60	29.20	42.93	16.00	29.26	68.80*	57.13*
CN-PRE					-30.13	-4.13	11.47	25.20	-1.73	11.53	51.07*	39.40
EAH-MID						26.00	41.60	55.33	28.40	41.66	81.20*	69.53*
CAH-MID							15.60	29.33	2.40	15.66	55.20*	43.53
EN-MID								13.73	-13.20	.06	39.60	27.93
CN-MID									-26.93	-13.67	25.87	14.20
EAH-PST										13.26	52.80*	41.13
CAH-PST											39.54	27.87
EN-PST												-11.67
CN-PST												

*$\underline{C}_{.99}$ ± 45.41

Note. See Appendix L for contrast ratio ($\underline{C}$) formula.

Table O

Matrix of Cell Means Indicating Contrast Ratio on the Standing Balance with Eyes Closed Subtest for Groups and Trials

	EAH Pre 10.07	CAH PRE 7.60	EN PRE 11.27	CN PRE 8.53	EAH MID 12.60	CAH MID 9.60	EN MID 19.67	CN MID 11.07	EAH PST 12.60	CAH PST 9.80	EN PST 22.47	CN PST 9.47
EAH-PRE		-2.47	1.20	-1.54	2.53	-.47	9.60	1.00	2.53	-.27	12.40*	-.60
CAH-PRE			3.67	.93	5.00	2.00	12.07	3.47	5.00	2.20	14.87*	1.87
EN-PRE				-2.74	1.33	-1.67	8.40	-.20	1.33	-1.47	11.20*	-1.80
CN-PRE					4.07	1.07	11.14*	2.54	4.07	1.27	13.94*	.94
EAH-MID						-3.00	7.07	-1.53	.00	-2.80	9.87*	-3.13
CAH-MID							10.07*	1.47	3.00	.20	12.87*	-.13
EN-MID								-8.60	-7.07	-9.87*	2.80	-10.20*
CN-MID									1.53	-1.27	11.40*	-1.60
EAH-PST										-2.80	9.87*	-3.13
CAH-PST											12.67*	.33
EN-PST												-13.00*
CN-PST												

*$\underline{C}_{.99} \pm 8.73$

Note. See Appendix L for contrast ratio ($\underline{C}$) formula.

Formula for Calculation of the Contrast Ratio for the Tukey B Tests

$$\underline{C} = \underset{\substack{i\\ \text{Number}\\ \text{of}\\ \text{Cells}}}{(12)} \quad \underset{\substack{q\\ \text{Degrees}\\ \text{of}\\ \text{Freedom}\\ \text{of}\\ \text{Mean Square}\\ \text{Error Term}}}{(112)} \sqrt{\frac{\substack{\text{Mean Square Within}\\ \text{(Error Term)}}}{\substack{n \ (15)\\ \text{Number in}\\ \text{each cell}}}}$$

.01 value in
Studentized Range
Table (Winer, 1972)
is 5.44 (p. 871).

Sample

Contrast Ratio Formula for the Imitation of Postures Subtest

$$\underline{C} = \underset{i}{(12)}\ \underset{\substack{q\\ 5.44}}{(112)} \sqrt{\frac{8.46151}{15}} =$$

$$\sqrt{.5641006} =$$

$$(5.44) \qquad .7510663 =$$

$$\underline{C} = 4.085$$

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