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thesis entitled

A COMPARISON OF BODY IMAGE AND MOTOR PERFORMANCE
IN NORMAL CHILDREN AND CHILDREN WITH
GROSS MOTOR DYSFUNCTION

presented by

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has been accepted towards fulfillment
of the requirements for

Masters degree in Health and Physical Education

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Date April 1, 1985

A COMPARISON OF BODY IMAGE AND MOTOR PERFORMANCE IN NORMAL CHILDREN AND CHILDREN WITH GROSS MOTOR DYSFUNCTION

By

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Health and Physical Education

1985

ABSTRACT

A COMPARISON OF BODY IMAGE AND MOTOR PERFORMANCE IN NORMAL CHILDREN AND CHILDREN WITH GROSS MOTOR DYSFUNCTION

By

Marianne Zinn

The purpose of this study was to investigate the relationship between knowledge of body parts, a measure of body image, and performance on selected gross motor skills. The subjects, matched by age and gender, included 18 boys and 8 girls who were normal in their motor development, and 18 boys and 8 girls with gross motor dysfunction. They ranged in age from 62 to 144 months. Both groups were tested on body image and selected motor skills. Body image was assessed with a 30-item checklist of body parts. The motor skills battery consisted of 7 qualitative and 7 quantitative tests. Qualitative assessments were made of running, catching, throwing, hopping, kicking, skipping and jumping where the subjects were scored according to their stage of performance on each skill. Quantitative assessments were obtained on the standing long jump, a speed and agility run, right and left foot balance tests, a beam walk, a figure 8 run, and an agility jump. Performance on these tests was recorded according to the student's best score in time, inches or number of repetitions. Each child was tested individually by the same examiner. A two-way analysis of variance for the total score of body parts did not support the hypothesis that normal children differed from children

with gross motor dysfunction in their knowledge of body parts. A multivariate analysis of variance for differences among the two groups of children in their performance on the motor skills revealed that normal children perform qualitatively and quantitatively better than children with gross motor dysfunction. Discriminant function analyses identified the figure 8 run, agility run and sum of stages score as the most important variables in differentiating the normal children from children with gross motor dysfunction. Multivariate analysis of variance procedures also showed gender differences in motor performance. Discriminant function analysis revealed that the gender differences were determined by the sum of stages score, and performance on the agility run, right foot balance, left foot balance, balance beam walk, and figure 8 run. A discriminant classification analysis revealed that children were better classified into normal or gross motor dysfunction groups (86.5%) than as boys and girls (69.2%).

A Pearson Product Moment correlation matrix indicated a significant positive correlation between knowledge of body parts and performance on selected motor skills. An additional multivariate analysis of variance run with the knowledge of body parts score included as a dependent variable also yielded significant group and gender main effects, but discriminant function analysis showed that knowledge of body parts contributed only to differences in performance between boys and girls and not to differences in performance between normal children and those with gross motor dysfunction.

To

Bruno, Marcelo and especially my dear husband, Walter, for their love and understanding during the many hours that "Mom" and "Wife" was not at home.

ACKNOWLEDGMENTS

I wish to thank the many individuals who have provided assistance in the completion of this work. I would like to express my gratitude to the members of my Guidance Committee, who greatly aided me in the preparation of this thesis. I would like to express sincere thanks to Dr. John Haubenstricker, Chairman of my committee and also my adviser. Dr. Haubenstricker has provided much support and guidance throughout my school years. His patience in correcting my English, as well as his concern for me as a student, have left a lasting impression on me.

I would also like to extend my appreciation to other members of my committee: Dr. Vern Seefeldt, who encouraged me and advised me on the preparation of this work; and, Dr. Marty Ewing for her valuable suggestions and assistance with the statistical analysis of the data.

I also would like to acknowledge the cooperation of Ms. Lola Omara, Principal of Pinecrest Elementary School for her unconditional support; Mr. Arthur Frentz and Mr. William Triola, physical education instructors who helped me in selecting the children to be assessed; and, the parents and their children for their valuable participation in the collection of the data.

I am thankful for the financial support provided by the Brazilian government through the CAPES institution.

I also would like to acknowledge the great support of my family for their constant interest in my work, despite living so far away.

Finally, I want to express my gratitude to my husband for his tireless encouragement and support. He was always available for the constructive exchange of ideas and provided comfort during my graduate school years.

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CHAPTER I

INTRODUCTION

Physical activities, including play, make an important contribution to the normal growth and development of children. Physical growth, motor development and perceptual motor development all are dependent on physical activity, particularly during the childhood years. It is during these years, when the child is acquiring knowledge about his or her body, that movement involving positive sensory and perceptual-motor experiences plays a major role in the formation of the child's body image. It is through movement that the child becomes aware of the existence of the various parts of the body and their relative locations and also acquires knowledge of the body as a functioning unit.

Several investigators have suggested that early movement experiences result in individuals who have better and more extensive skill repertoires (Kephart, 1960; Arnheim & Sinclair, 1979; Cratty, 1975). Gallahue (1982) suggests that the body image and movement capacities of children are related to each other. Although investigators have suggested the existence of this important relationship, no systematic study has been conducted which simultaneously tested children on both their knowledge of body parts and their motor skill performance. Such an investigation is needed to determine the accuracy of this suggested relationship.

NEED FOR THE STUDY

Games and physical activities are important components in the motor development of children. It is during the childhood years that children begin to realize that to be liked and accepted, they must be able to play well and learn to take their turns. Children who are unable to express themselves through indispensable skills such as running, catching and hopping are likely to be unpopular among their peers. If this is true for normal children, what about those children whose coordination poses a problem? The lack of coordination and the subsequent failures in play activities often result in poor self-concepts and exclusion from physical play activities.

Several studies have focused their attention on body part identification as a means for understanding factors such as personality, dimensions of body parts, level of maturity, obesity and laterality (Harris, 1963; Nathan, 1973; Coryell, 1975). However, to date, no study has given primary attention to body part identification as it relates to motor skill performance, although some evidence suggests that the body image and movement capacities of the children are related to each other (Gallahue, 1982). Thus, in order to provide a better understanding of factors related to childhood behavior; to provide qualitative and quantitative play experiences which help build a good self-concept; and, to provide knowledge about the similarities and differences among normal and gross motor dysfunction populations, it seems appropriate to determine if knowledge of body parts, a measure of body image, is related to motor skill performance in children.

DELIMITATIONS OF THE STUDY

This study investigated the relationship between body image and motor performance in a group of normal children and a group of children with gross motor dysfunction. Twenty-six subjects were included in each group. The children with gross motor dysfunction, 18 boys and 8 girls ranging in age from 62 to 144 months, were obtained from the waiting list of the Remedial Motor Clinic and from elementary schools in the East Lansing, Michigan school district. They were matched by age and gender with 26 subjects from the same school district.

Body image was measured by a test of body parts in which the subjects were asked to identify 30 body parts on their own person by pointing to them. About 20 random lists of the 30 body parts were generated. The body parts included the toes, earlobes, knuckles, shins, cheeks, calves, knees, ankles, heels, thumb, jaw, backbone, bottom, stomach, forehead, shoulder, shoulder blades, elbows, wrists, palms, soles, thigh, hips, waist, forearm, chest, eyelids, chin, ribs, and hips.

Motor performance was assessed using 13 tasks that yielded qualitative and/or quantitative scores. The tasks included the locomotor skills of running, hopping, skipping and jumping; a speed and agility run; a figure-8 run; an agility jump; a balance beam walk; a standing jump for distance; static balance on the right and left foot; and, the object manipulation skills of throwing, catching and kicking.

All tests were administered individually by the same person under standardized conditions. The data were subjected to both descriptive and inferential statistical techniques.

LIMITATIONS OF THE STUDY

This study is subject to the following limitations:

1) The subjects with gross motor dysfunction were an available sample, therefore generalizing the results to populations whose characteristics are not represented by this sample needs to be done with great caution.
2) Subject selection was not controlled for possible group differences in social and economic status. Results may have been biased by the extent to which these factors differentially influenced the performance of the two groups.

3) Sleep, diet and fatigue factors were not controlled. These may have varied between the two groups and influenced the results.
4) Group differences in self-concept and in the ability to relate to the test administrator may have existed and conceivably could have influenced the performance of the subjects.
5) The amount of physical activity previously experienced by the subjects in each group was not determined. Differences in skill instruction and practice between the two groups undoubtedly would have an impact on the results obtained.
6) Some of the parents were present when the children with gross motor dysfunction were tested, but none were present when the normal children were present. Although only a few parents interacted with their child while the testing was being conducted, the physical presence of the parent in the general testing area may have either facilitated or inhibited the performance of the child.

PURPOSE OF THE STUDY

The purpose of this study was to compare the relationship between knowledge of body parts and performance on selected motor skills in two groups of children: 1) 26 normal boys and girls, and 2) 26 boys and girls with gross motor dysfunction (GMD).

HYPOTHESES

Three hypotheses were formulated and tested in this investigation:

(1) Normal boys and girls have a better body image than boys and girls with gross motor dysfunction, as measured by a body part identification checklist.

(2) Normal boys and girls perform better, qualitatively and quantitatively, on selected motor skills than boys and girls with gross motor dysfunction.

(3) Knowledge of body parts is significantly related to performance on selected gross motor skills.

DEFINITION OF TERMS

The following terms are defined to promote understanding and consistency in interpretation:

Body Image - The view a person has of his or her physical body, including knowledge of its individual components and its performance capacity. In this study, only the knowledge component of body image was assessed.

Fundamental Motor Skills - A selected group of locomotor, manipulative, and stability skills that are basic to the development of more specific and complex sport skills. Examples include running, hopping, throwing, kicking and balancing.

Gross Motor Dysfunction - A condition in which children, when compared to normal children of similar age, have difficulty in coordinating the whole body and/or its parts when attempting to perform motor skills.

Locomotor Movements - Movement skills where the body changes position by traveling through space from one location to another. Examples are the run, hop and skip.

Stability Movements - Movement skills where the body is maintained in a static position or in balance in relation to gravity when moving. Examples include the one foot balance and the balance beam walk.

Motor Performance - The act of executing motor skills such as running, catching, jumping or balancing; or the outcome of such performance (e.g., stage, time, distance).

Remedial Motor Clinic - A program at Michigan State University with the goal to prescribe individual programs for the remediation of motor skill deficiencies in children.

CHAPTER II

REVIEW OF RELATED LITERATURE

Psychologists have investigated the importance of body image in the total development of the self in normal and handicapped children. Physical educators have measured the performance of children on fundamental motor skills as well as body image. However, studies relating body image to motor performance in children are few in number.

The review of the literature in this chapter is divided into two major sections. The first section focuses on body image, including its nature and development, its relationship to self-concept, how it is assessed, factors that affect it, and programs designed to enhance it. The second section is devoted to fundamental motor skills, their development, methods of assessment, and factors that affect the performance of these skills.

BODY IMAGE

Definition of Body Image

Body image has received considerable attention from educators, psychologists, psychiatrists and others concerned with child growth and development. The perceived importance of body image in the development of individuals has motivated researchers to investigate what body image really represents in this development.

The term "body image" has been neither satisfactorily defined (used interchangeably with body schema, postural model of the body, perceived body, body ego, body boundaries, body concept, body percept and body awareness) nor rigorously measured in the clinic or laboratory (Traub & Orbach, 1964). Some definitions are very broad, including sensory experiences, movement capacities, and psychological relationships. Others are more specific and operational, based on: 1) a subject's judgment of his or her performance ability and feelings of approval or disapproval; 2) an individual's perception of his or her body configuration; 3) a person's feelings about his or her body, i.e., the rigidity or penetrability of its psychological boundaries; and 4) the ability of an individual to identify and/or name his or her body parts.

Henry Head (1920) was the first to develop an elaborate theory of body schema or body image. He visualized the body image as a unity derived from past experiences and current sensations organized in the sensory cortex. He conceptualized an area of sensori-motor functioning which he called a postural model of the body. The presence of this model brings about the possibility of recognizing postures and the projection of the body boundary to the ends of instruments held in the hands. Anything which participated in movement of the body was seen as added to the postural model and becoming part of the body image.

Other investigators extended the body image concept to include a sociological meaning for both the individual and society. Body image is the picture of one's own body formed in one's mind as a tri-dimensional unity involving interpersonal, environmental and temporal factors. Body image also is a self-appearance of the body formed not only through the senses as a mere perception, but as an image. Body image not only influences the way an individual perceives, but it also shapes the way an individual behaves (Schilder, 1950). Body image is considered to be an awareness of one's body in space and how it moves (Fait, 1971), and what a person thinks of his or her own physical body and how it looks to others (Heckelman, 1969).

Body image, for the purposes of this study, is defined as the view an individual has of the physical structures of his or her body, it's individual components and its performance capacity. Body image is the sum result of experiences that a person has with his or her own body as a physical, psychological, sociological and physiological entity.

Body Image and Self Concept

There has been a lack of clear delineation between the concepts of body image and self-concept. Some authorities have conceptualized that body image is the point of origin of the ego (Freud, 1960), or that a positive or negative self-concept is dependent on one's body characteristics (Wylie, 1961). Body image is composed of the surface and depth of the body (Traub & Orbach, 1964) and has attached emotional characteristics (Traub & Orbach, 1964; Prosen, 1965). Brody image is the result of a series of reactions that an individual and others have about the individual's body and his or her feelings of adequacy and worth (Prosen, 1965). It is the base for the development of one's identity (Fisher & Cleveland, 1958).

Body image and self-concept are two important factors which influence the global development of children. Several investigators have examined the relationship between body image and self-concept. Body image, feelings about the body, or body concept has been found to be moderately and positively related to self-concept (Secord & Jourard, 1953; Rosen & Ross, 1968; Zion, 1965). However, extreme caution should be exercised in generalizing the results obtained with normal children to brain injured children (Cruickshank, 1980).

The moderate relationship obtained between body image and self-concept may be a function of the instruments used for assessing the two constructs. Several studies attempting to measure body image, per se, used tests and techniques which invariably ended up measuring self-concept. This practice helped to increase the already existing misunderstanding about the two concepts. Attempts to measure body image also were problematic due to the interchangeable use of terms such as body schema, body awareness, and body concept with body image.

Williams (1983) presents body schema, body awareness and body image in a hierarchy, where each subsequent component is built upon the previous one. Body image is the last component of this hierarchy, which she calls "Components of the Physical Self-Concept." Self-concept is composed of various aspects of a person with the physical-self and the psychological-self being examples of them. The physical-self of individuals pertains to their concept of their physical appearance, their gender appropriateness, the relation of their body to their behavior, and the prestige their body gives them in the view of others. The psychological-self is composed of the individuals' concept of their abilities and disabilities, their worth, and their relationship with others. In the beginning, these two aspects are separate, but they gradually fuse as childhood progresses (Hurlock, 1972).

Development of Body Image

Body image develops through reciprocal experiences between the organism and the environment. In order to take advantage of such experiences, the young child must be able to process information about the body, provided by the sensory systems, in the central nervous system, and then store such information for future use. For such processing and storage to take place, the child must possess normal perceptual-motor functioning which is thought to be derived from early sensory and sensory motor experiences (Kephart, 1960). These experiences are represented by a sum of the visual, tactile, kinesthetic, olfactory, auditory, and affective experiences individuals have with each other and in relation to objects.

Body image isn't simply a perception of a person's body (Schilder, 1950; Wapner & Werner, 1965; Ajuriaguerra, 1965; and Witkin, 1965). It is the result of the entire cognitive and affective organization of the subject (Wapner & Werner, 1965). A person may be born with characteristics which will influence the type of self-concept (body image) that he or she develops (Felker, 1974), but the actual development of self-concept (body image) is a learned process (Felker, 1974; Kephart, 1960). This learning results from observing movements of body parts and the relationship of the different parts of the body to each other and to the environment (Kephart, 1960; Arnheim, 1979). It is also a result of how the individual feels or experiences his or her body (Ajuriaguerra, 1965).

A continually changing body image is one of the most important aspects of body image (Ajuriaguerra, Cleveland, Fisher, and Witkin, in Wapner & Werner, 1965; Schilder, 1950; Herod, 1961; Cruickshank, 1980). Due to its constant relationship with internal perception, memories, affects, cognition and actions, body image is developed from early sensations and changes constantly with each situational experience as a unique form of body image (Horowitz, 1966).

Perception

The term "perception" refers to the process of organizing and giving meaning to sensory input. This depends on the ability of the child to interact with and take information from the surrounding environment.

Infants receive all sorts of sensory stimulation (visual, tactile, kinesthetic, auditory, gustatory and olfactory). At the beginning, their responses to stimuli are diffuse and basically reflexive in nature. With maturation and experience, sensory stimuli become integrated with stored data (memory) acquiring meaning and further produce a perception of the present experience. With the improvement of this intersensory integration, maturing children develop a more precise ability to detect, discriminate, organize and select cues from incoming sensory information and thus provide more accurate, efficient and meaningful responses to the environmental demands.

The way children mature, interact with their environment, and develop a personal framework of the body, is vital to the development of a sound body image, and to their functioning in the motor area. The knowledge of the body must be complete in order to promote actions for which this particular knowledge is necessary. Body image is essential in order to start movements, and when actions are directed toward one's own body. If an individual has trouble in gnosia and in perception, generally change in the action will occur (Schilder, 1950).

Early Reflexive Behavior

Primitive reflexes are inborn movements which normally persist for a short period of time after birth, then due to maturation they lessen in strength and eventually are inhibited. Reflexive movements are involuntary reactions of the body to different forms of external stimulation (Gallahue, 1982). Primitive reflexes such as the Moro Reflex, Search and Sucking Reflex, Hand-mouth Reflex, Palmar Grasping Reflex, Babinski Reflex, Plantar Grasp Reflex, and the asymmetrical and symmetrical TNR (tonic neck reflex) first appear during fetal life and persist well into the first year. They are associated with nourishment and protection.

Reflexive response to tactile sensation is probably the first to appear in the human fetus. It is first observed at eight weeks of age, when the fetus is able to respond to tactile stimulation in the areas of the mouth, which induces responses of the upper lip and skin around the nostrils, chin and part of the neck (Hooker, 1944).

The first contact of the newborn with the mother, when in search for milk, will elicit the primitive reflexes developed during the fetal period. This first relationship, called "tonic emotional reactions," is based upon the affective schemata (Wallon, cited in Wapner & Werner, 1965, p. 87) and similar to the cognitive schemata (Piaget, cited in Maier, 1965, pp. 95-96). These primitive reflexes or "reactions" create affective schemata, and these affective schemata are in one way or another dependent on the tonic and postural reactions (Wallon, cited in Wapner & Werner, 1965, p. 87).

As the child matures, primitive reflexes are inhibited and voluntary movements replace them. Persistance of the primitive reflexes is considered to be any indicator of delayed neurological and motor development. The nerve cells of the central nervous system must myelinate if the development of voluntary movements is to occur. This myelination and the development of voluntary movements occurs at about 6 months of age, when the child also starts to distinguish himself or herself from others, and, according to Nacht, starts forming a body image (1952). Although initially only reflexes predominate during fetal and early infancy life, tactual and kinesthetic senses predominate when voluntary movements evolve.

Thus, for the young child to be able to grow and develop to full capacity, all the intersensory processes must develop early in life. The extent of body image development will be greatly influenced by the number and quality of sensory modalities available at and early age, and by the future interaction of the newborn and young child with the environment.

Visual Sensation

Vision is an important component in the development of body image (Schilder, 1950; Ajuriaguerra, 1965; Gorman, 1969; Symonds, 1951). It is the richest and fastest source of information about our environment.

Vision develops gradually during the fetal and the neonatal period, but it is during the third and fourth month after birth that the child is seen to engage in coordinated movements of the hands and eyes, and to begin to expend a considerable time examining the hands and feet, alternately (Cratty, 1979).

The young child relies a great deal upon the tactile-kinesthetic senses as a major source of information, and uses vision in a supporting role (Williams, 1983). Later on, these senses interchange roles, depending on the situation and which is more appropriate (or more useful in getting information) at that time (Schilder, 1950). Tactile and visual examination and further mouthing experimentation are activities that are important in the body image formation of the individual. Visual sensations are important for the development of the self (Symonds, 1951) and function as a source of knowledge of one's own body through old and new optic impressions (Schilder, 1950).

Optical images that the child has of his or her body, its parts, and the environment, are important: 1) for the improvement of knowledge about the body, 2) to organize himself or herself to properly process incoming information such as perceived distances between the body and objects and people, between objects in the environment, and 3) to interpret distance and location in space with greater velocity than if the body had to be moved to perceive it (Kephart, 1960). All these visual experiences utilize the body as a point of reference (Kephart, 1960) and are important components in body image formation.

Tactile Sensation

During the third and fourth month of fetal life, the sense organs associated with cutaneous sensitivity begin to differentiate. The sensory paths subserving kinesthetic and tactile activities are the first to complete myelination (Langworthy, 1933). At six months of fetal life, touching sensation is evident through the primitive Grasp reflex, and the Babinski reflex. At seven and eight months of fetal life, the Moro, Tonic Neck and other righting responses can be elicited (Williams, 1983) and at one year of age the tactile corpuscles are completed (Timiras, in Espenshade & Eckert, 1980, p. 78).

It is mainly through tactile sensations on the skin that the child first becomes aware of his or her body and its parts. The skin is the main sense organ during infancy, and is the most vital sense organ of the body (Montagu, 1971; Ayres, 1973; Arnheim & Sinclair, 1979). Tactile sensations are essential for the development of body image, to elicit reflexive responses, and in establishing body boundaries in an unconscious and primitive form. The infant does not become equally familiar with all physical boundaries of his or her body at the same time. When searching for milk, the newborn learns that his or her body is not a part of mother's body, but a separate entity (Fisher, 1968). This process of differentiation gradually develops, and it takes about a year for the child to form a complete image of his or her body (Kessler, 1966). According to DiLeo (1973), the mind cannot grow without the touching stimuli because the tactile sense is the only sense that can give meaning about the body.

Kinesthetic Sensation

Kinesthetic sensations are important contributors to body image development (Schilder, 1950; Gorman, 1969; Arnheim & Sinclair, 1979; Montagu, 1971; Head, cited in Gorman, 1969, p. 52), especially during early childhood. Some authors find vision as the dominant sense (Schilder, 1950), while others find perception of posture and movement by means of kinesthetic perceptions as the main factors in the formation of a body schema (Head, cited in Gorman, 1969, p. 52).

The proprioceptors (sensory nerve terminals located in the muscles, tendons and joints and the semi-circular canals of the inner ear), are responsible for providing constant information about movement, body position in space and the relationship of body parts to each other. Without such information, the individual is unable to maintain his or her body against gravity and in the upright position (Singer, 1969; Sage, 1977; Espenshade & Eckert, 1980).

The formation of the proprioceptive system tends to follow a cephalo-caudal progression, and begins during the eleventh fetal week. From about the fourth fetal month, sensations are constantly reported to the brain or to spinal nerves. These sensations later allow the individual to know various body positions, degrees of flexion or extension, as well as the amount, direction and force of movement of the body and its parts (McCandless, 1967).

Early in life, the exploratory movements of the hands over the body, of the feet touching different surfaces, all provide primary kinesthetic and tactile sensations. As was pointed out earlier, kinesthetic and tactile sensory paths in the central nervous system are the first ones to complete myelination. However, the proprioceptive system is highly dependent upon the structural and functional development of the other systems for its own functional development.

Kinesthesis and Movement

Movement is the avenue to develop kinesthesis and consequently, body image. The primary means by which people can know about their bodies is through movement (Schilder, 1950). Movement allows the individual to relate to others and to the environment. Unless a person moves, he or she will not know if the part of the body chosen to move was the right one, or if the final action would be accomplished (Schilder, 1950).

Through movement and the kinesthetic receptors, more specifically the vestibular system, the individual is apprised of body positions such as upright posture and equilibrium. The vestibular system helps the muscles of the eyes to maintain visual fixation, which is very important for rotary movements of the head and entire body; mediates the body righting reflexes that use the muscles of the head, neck and shoulders; and, along with the receptors from joints, muscles, and tendons, apprises the central nervous system of the body's orientation in space.

When a child engages in any kind of activity, a series of actions occur, including: 1) activation of specific receptors of the parts moved apprising the child about where to go (visual) and which body parts (body image) to move; 2) formation of a specific schema of the body which, if useful, will form a new postural model of the body; and 3) a comparison of new movements and new positions with previous ones which may or may not modify body image. These modifications will affect the cortex and new sensations will be evoked which will, in turn, affect the total body schema and result in recognition of new postural models (Fisher & Cleveland, 1968).

Through movement and the concomitant feedback from kinesthetic senses and proprioceptors, the child will be able to increase his or her movement repertoire, knowledge about his or her body and its capacities, and build a stronger body image. With the integration of visual and tactile-kinesthetic information, the infant begins to establish his or her body boundaries and a flexible body schema, two important components for the formation of skillful motor planning (Ayres, 1972).

<u>Laterality</u>

The ability of a child to detect and discriminate between the two sides of his or her body has been called laterality. Laterality, or internal awareness of the two sides of the body, is closely associated with body image (Kephart, 1960; Ayres, 1972; Schilder, 1950). It develops slowly in early childhood (Benton, cited in Coryell, 1975, p. 535; Fait, 1978). Laterality is important: 1) in the execution of motor skills; 2) as a precursor of handedness and naming the sides of the body; and 3) for the development of directionality. Around the age of two years, dominance and handedness, among other things, appear to develop (Kephart, 1960) and by age six, motor laterality is well established (Sparrow & Satz, cited in Coryell, 1975, p. 535).

In order to act properly, an individual must have full knowledge of parts of the body (body image), and their location in relation to each other (laterality). One cannot be fully developed without the other. If a child is to function normally in the outside world, the body must be used as a point of reference (Kephart, 1960; Arnheim & Pestolesi, 1978).

Schilder summarizes this topic very well by saying that

> When our orientation concerning left and right is lost in regard to our own body, there is also a loss of orientation in regard to the bodies of other persons. The postural model of our own body is connected with the postural model of the others" (1950, p. 16).

Directionality

The ability of the individual to apply concepts such as up-down, right-left, and front-back to objects or persons in the environment has been called directionality. However, in order to recognize such dimensions in the surrounding space, the child must first be able to identify them in his or her own body. Identification of external spatial dimensions (directionality) is dependent upon well established internal spatial dimensions (laterality).

Spatial relationships and spatial directions develop as the child uses his or her body to experiment with objects, persons and relationships between them (Kephart, 1960; Arnheim & Pestolesi, 1978; Gallahue, 1982); and, it is only with maturation and experience that the child will develop such abilities in external space, without first having to refer to his or her own body.

Directionality also is important in areas other than the gross movements of the body, such as writing and reading. These skills are dependent on knowledge of body parts (body image), of right-left, up-down and front-back as spatial references for recognizing shapes, letters, and words. These spatial references are first developed in relation to a person's own body (Kephart, 1960; Arnheim & Pestolesi, 1973; Arnheim & Sinclair, 1979; Godfrey & Kephart, 1969).

Although right-left discrimination of body dimensions occurs at about age six, right-left identification of others (di

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(directionality) and of dimensions of space may not appear until age eight or nine (Cratty, 1979). Children who still experience confusion in direction at about 6-7 years of age must be of some concern to the teacher because this is the time when they start reading instruction in school (Gallahue, 1982). It is also during childhood that children may be classified as clumsy at play, or unable to perform a series of skills that require the perception of time, distance, space and many other characteristics that are inherent in the concept of directionality (Arnheim & Pestolesi, 1978).

Cognition

In order for individuals to function at desired levels, they must develop a system that allows them to know how people and objects are organized in space without having to rely upon primitive sensory functioning. According to Piaget, the first phase of the cognitive developmental process is the most important one. It is a period where children depend predominantly upon sensori-motor and body-motor experiences, and where they use their body for self-expression and communication (cited in Maier, 1965, pp. 93-94). At this stage, children are still a part of the external world, from which they are undifferentiated (Ajuriaguerra, 1965).

With the effort of children to make events last, they are developing the capacity to follow the image of objects and anticipate their new position. This can be accomplished when perceptual differentiation of vision and prehension develop. At this point, children have developed a very primitive state of the permanence of objects (objects continue to exist after they disappear and/or are hidden) which is still associated to sensori-motor activity. With integration and refinement of tactile and visual sensations, practical permanence of an object develops, though still depending on the sensory-motor schemata.

The ability to recognize that an object still exists, even if out of sight, is accomplished when knowledge of space, time, as well as practical notion of causality are formed. When children reach the point of looking for an object that is out of their sight, it can be said that the object becomes substantial, with properties and finally, it has permanence. This occurs after six months of age, and it is at this same time that children become aware that their body is differentiated from the external world. This distinction between self and non-self is first made on the basis of physical differences when the infants first notice their hands and experience touching, being touched, and then seeing them simultaneously (Kessler, 1966).

According to Ajuriaguerra (1965), the evolutionary process that occurs in the cognitive domain has characteristics similar to those found in the process of ego or body conception formation. He also recognizes the influence that the affective and cognitive aspect has upon individualization and awareness of the body. The cognitive aspect deals with the body as it is perceived and known. It evolves developmentally in a series of stages through the child's interactions with objects in the environment. The affective value of the different parts of the adult's body is tied to the past history of these parts, and in particular to the affective repercussions which characterized the acquisition of knowledge of them. In relation to the ego and body, Ajuriaguerra states that both concepts and their representation is marked by similar restructurings (1965).

Family-Child Interaction

The body image as a dynamic force is influenced by the interactions an individual has with other people in the environment. One's body image originates during the early childhood period with the parents as socialization agents (McCandless, 1967). The attitudes that parents express toward a child's body and the amount and the way they handle, nurture, love and trust the child will determine to a large extent the development of a positive or negative body image. The gender of the child influences parental attitudes, since boys and girls are expected to exert different roles in life, according to the values and rules of the society.

Parental attitudes toward different parts of the body are also egotized by the child (Schilder, 1950). Some body parts may be enhanced and considered pure, while others may be considered "dirty" or "bad," leading to denial of the existence of those body parts or negative feelings about them (Staffieri, 1967). Thus, the influence of parental attitudes is very strong in the development of body image in children.

Significant Others

Once the child attends school, teachers and peers become models of behavior, and consequently lessen the child's dependency upon his or her parents. Being accepted and being able to participate in activities is a very important aspect of a child's development. It is through physical activities and games that the child evaluates his or her body image. Information gained from this evaluation is used as the basis for continual reevaluation of the body (Mosey, 1969).

Children who receive positive feedback from teachers and peers about their bodies are more apt to participate in physical activities and develop a positive body image. Negative experiences will foster feelings of inadequacy about doing things as well as toward other children, and will direct children to engage in parallel activities such as being the official, the towel provider, or the scorer (Williams & Beeson, 1980). Thus, the "significant others" in the lives of children have an important impact on the formation and development of their body image (Schilder, 1950).

Assessment of Body Image

Little attention has been given to the relationship of body image to performance on fundamental motor skills, for normal children or for children with gross motor dysfunction. This probably has been due to the lack of information about body image, and to the fact that the concept of body image as a physical and psychological construct has been very difficult to evaluate and measure. Some of the techniques that have been devised to evaluate body image include human figure drawing, assembling body parts, rating scales, word association tests, questionnaires, posture imitation tasks, and verbal identification of body parts.

Human Figure Drawing

During childhood, a person's ideas are imbued with unconsciously expressed symbols. As drawings are made of symbols, they reflect a person's cognitive and effective development, dreams and actions. Through drawings, the child is representing what is going on in his or her inner world, as well as the reality of the outside world. However, the symbols in drawings only achieve meaning when viewed within the context of the drawer's personal history (DiLeo, 1983).

The way children experience their body parts in day-to-day living, both on a conscious and unconscious level, affects the way they draw human figures (Harris, 1968). The drawings may or may not correspond to their actual physical appearance (DiLeo, 1983; Koppitz, 1963); and may be only a reflection of their body image (Machover, 1949; Elbaum, 1964). While drawing, children rely on both cognitive and affective concepts (Elbaum, 1964; Harris, 1963; DiLeo, 1983), and use the body as a point of reference with attached emotions (Machover, 1949).

The Draw-A-Person Test, developed by Goodenough (1926) and later revised by D. B. Harris (1963) was a method devised to measure cognitive growth (intellectual maturity). However, since its conception, it has been used largely as a measure of body image. The test has a carefully developed and standardized scoring system, and has demonstrated strong positive correlations with the Stanford-Binet and Wechsler Intelligence Scale for Children (DiLeo, 1983). It is composed of seventy-three items, and is scored on an all-or-none basis with the score being basically quantitative and analytical. The points are attributed to details and, to a lesser degree, to bone structure (DiLeo, 1983). Test-retest reliability for the Draw-A-Person Test has been found to range from the low .80's to .90 (DiLeo, 1973).

Attempts to use the drawings for the assessment of the personality characteristics of children (used as a projective technique) has failed to satisfy the standards required of a test (Arnheim & Sinclair, 1979; DiLeo, 1983). Poor correlations were obtained through the analytical approach, and an uncontrollable variable was introduced when the drawings were subjectively interpreted (DiLeo, 1983). So, if used as initially projected, the Draw-A-Person Test is a reliable and valid measure of the cognitive abilities of young and pre-adolescent children (DiLeo, 1983).

Several studies used the Draw-A-Person Test to test various aspects of body image in obese, mentally retarded (MR) and normal field dependent children (Nathan, 1973; Wysocki & Wysocki, 1973; Machover, cited in Witkin et al., 1954, p. 34; Witkin, Dyk, Faterson, Goodenough, & Karp, 1962). The focus of these studies was on: 1) body concept; 2) unconscious attitudes, percepts, needs and conflicts of the body image; 3) relationships of figure drawings to certain types of perceptual performances; and 4) the relationship between body concept and field dependency/independency. The findings suggest that obese, MR, and field dependent children present drawings with less detail, without gender differentiation, with weak body boundaries, with body parts omitted, with rigid or sticky figures, and with bizarre images, when compared to normal and field independent children. The test offered empirical evidence of undifferentiated and immature body images, and the dependency of children upon external persons and situations for structure and definition (Nathan, 1973).

Several other tests related to the Draw-A-Person Test were devised to assess body image. The tests included: 1) drawing the inside of the body (Tait & Asher, 1955; Brumback, cited in DiLeo, 1983, p. 123); 2) a list of thirty emotional indicators to detect and differentiate children with and without learning and/or behavioral and emotional problems (Koppitz, 1968); and 3) drawing in missing body parts upon presentation of the drawing of an incomplete man (Ilg & Ames, 1966).

Although several studies have assessed the body image of children, there is skepticism about the methods. Some criticisms are: 1) that children with poor motor control may not be able to transfer their inner feelings in a drawing (Arnheim & Pestolesi, 1973); 2) that research on the basic meaning of human figure drawings is lacking (Swensen, cited in Cratty, 1970, p. 106); and, 3) that it is still difficult to differentiate which aspects of the drawing are linked with body image, which are a function of drawing skill and which are tied to the way the drawing is obtained (Fisher & Cleveland, 1968).

According to Koppitz (1968), Machover's projective technique has become of great influence and significance, although no scoring system and no controlled research data are offered to support her claims. Machover's hypothesis has been difficult to compare and assess due to the weak definitions and different meanings given to each variable with the same signs on human figure drawings.

Assembling Body Parts

The technique of assembling body parts has been used to study body image (Katcher & Levin, 1955; Adams & Caldwell, 1968; Gellert, 1975; Wallach & Bordeaux, 1976; Brittain & Chien, 1980). In this approach, the subject is asked to assemble several body parts in order to construct a human figure (male and/or female), or is requested to select a figure that is most similar to himself or herself. In several studies, the Mannequin Assembling Test either was used alone (Gellert, 1975); with a body parts identification test (Wallach & Bordeaux, 1976) or in conjunction with a series of other tests (Brittain & Chien, 1980). These studies not only were concerned with children's concept of their body size, but also with their knowledge of body parts, the meaning of those parts and the representation of their self-image.

Use of the body part assembling technique produced some pertinent results, but also identified several shortcomings inherent in the technique. Among the findings were the following: 1) a sex-linked correlation of .71 (Katcher and Levin, 1955); 2) that being able to name body parts was a sufficient condition for successful figural assembly (Wallach & Bordeaux, 1976); 3) the subjects' ability to name body parts was independent of scores they obtained on other tests (Brittain & Chien, 1980); and 4) that subjects succeeded in assembling a human figure (Gellert, 1975). Some of the shortcomings of the body-construction test are that: 1) it gave clues to where the body parts should go; 2) it was difficult to distinguish between manual dexterity and general perceptual acuity, on the one hand, and conceptualizations of the self-image on the other (Gellert, 1975).

Rating Scale

The rating scale also has been used to measure body image in children. Secord and Jourard (1953) utilized this technique to develop a body-cathexis scale and a self-esteem scale. They found a moderate correlation of +.58 for men and +.66 for women between the two scales. Similar results were obtained by Rosen and Ross (1968).

Word-Association Test

A word-association test was developed by Secord (1953) to measure the degree of concern an individual has about his or her body. Secord's findings suggested that those who scored high on the word-association test were significantly less satisfied with the appearance of their bodies than those who scored low.

Questionnaire

The questionnaire is another method used to assess body image in children. Some investigators have employed the questionnaire to assess the memory of children about body parts that first attracted their attention, and to determine their ideas about internal organs (Hall, 1898). Others utilized this method to investigate a trend of body-cathexis between gender, and to compare body-and-self differentiations within and between genders (Jourard & Remy, 1957). Jourard and Remy found that girls had a more highly differentiated body image than men; and that among women, body image and self-concept are differentiated to an equivalent degree.

Imitation of Posture

Another method devised to assess children's body image is the Imitation of Gestures or Imitation of Postures Test. It is a test developed by Berges and Lezine (1963), where the child has to copy the movements of the experimenter. The test has been used: 1) to measure neuro-muscular control and translation of visual clues into motor movement (Kephart, 1966); 2) to evaluate a child's ability to plan and direct body movements in a coordinated and smooth manner (Ayres, 1973); and, 3) to provide clumsy children with an understanding of body-space relationships (relationship between body and environment), body knowledge (who they are) and body image (Arnheim & Sinclair, 1979).

Although some authors criticize that imitation of movement involves more visual perception than body awareness (Cratty, 1970), others suggest that although a visual perception component is involved in the capacity to imitate, "the actual imitative response is motoric and based upon the use of kinesthetic information" (Williams, 1983). This imitative behavior of the child will enable him or her to interact even more with persons and objects in the environment, thus further developing and improving the ability to plan movement and establish body boundaries.

Verbal Identification of Body Parts

The Verbal Identification of Body Parts is another test devised to measure body image in children. It has its roots in the 1920's and 1930's when neurologists like Head and

Benton were studying cases of patients with phantom-limbs problems, finger agnosia and right-left discrimination problems. Since then, numerous studies have been carried out in an attempt to find a more suitable test to detect body image disturbances. The technique of assessing body image by requesting the subject to identify a body part by pointing to it is the second most widely used procedure, after drawing a human figure technique (Shontz, 1956; Ayres, 1961).

The verbal identification of body parts has been approached in different ways, with different aspects of body image being assessed. These include: 1) the ability to correctly identify body parts in a picture and to discriminate right-left, despite the inaccurate identification of the body parts (Benton, 1959); 2) a child touching his or her own body to become aware of the existence of the name and of the location of that body part (Kephart, 1960); and, 3) asking the child to name body parts or identify them by pointing to them (Shontz, 1956; Ayres, 1961). Inaccuracies in labeling or in localizing body parts were attributed to disturbances of the body image (Barch, 1968).

A few studies have been completed using the body parts identification test through verbal request (Morgan, 1979; Korytkowski, 1980; DeChiara, 1982; Zinn & Haubenstricker, 1983). The objectives of these studies were: 1) to investigate whether or not a visual art program related to the human figure would enhance body image concept (DeChiara, 1982); 2) to develop norms of children's ability to correctly identify body parts (Korytkowski, 1980); 3) to include the test as a part of a perceptual motor test battery (Morgan, 1979); and, 4) to determine the ability of children to identify different parts of their own bodies and to develop appropriate age group norms based on the results obtained (Zinn & Haubenstricker, 1983).

The findings of these studies indicated: 1) a better body image due to a visual art program (DeChiara, 1982); 2) that as age increases, the number of body parts identified also increases (Korytkowski, 1980; Zinn & Haubenstricker, 1983); 3) that there is an order in which the names of body parts are learned (Zinn & Haubenstricker, 1983); and, 4) that sex differences favoring the girls occur at each age level (Zinn & Haubenstricker, 1983).

Several other tests have been devised to measure body image. Some investigators measured body image through body size (Beller & Turner, 1964; Nash & Harris, 1970; Allebeck, Hallberg & Espmark, 1976; Predebon, 1980); body stereotype (Staffieri, 1967, 1968; Kirkpatrick & Sanders, 1978); or a distorting mirror technique (Traub & Orbach, 1964). Additional methods have been used, but as most of the already mentioned studies, they lack potential and standardized procedures; they also lack adequate statistical treatment.

Factors Affecting Body Image

There are other factors that can affect body image development in children. Among these are: 1) age, gender and body configuration; 2) motor ability; and, 3) instructional programs.

Age, Gender and Body Configuration

Body image formation in children is highly influenced by the manner in which they perceive their own body configuration and/or the manner in which others perceive it. Sheldon (1954) and Heath and Carter (Carter, cited in Thomas, 1984, p. 6) are well known for their methods of assessing somatotype. Although Sheldon (1954) utilized the anthroposcopic technique, whereas Heath and Carter utilized both anthroposcopic and anthropometric techniques (use of photo and measurement of body size and composition, respectively), both methods give a good indication of body build for either gender at any age.

Several investigators have conducted studies investigating children's desire for body configuration (Staffieri, 1967, 1968; Nathan, 1973; Allebeck, Hallberg, & Espmark, 1976). Although using different methods, they generally obtained the same results. The body type that was generally preferred, the one that was assigned the most positive behavior traits, was the mesomorphic type. This was especially true for boys.

Other studies investigated whether body image stereotype was related to behavior. It was found that normal and mentally retarded males make definite associations between selected behavior/personality traits and different body builds; and, that mesomorphic individuals were rated favorably and very well accepted when compared to ectomorphic and endomorphic body types (Staffieri, 1967, 1968; Kirkpatrick & Sanders, 1978).

The age at which accuracy of self-perception becomes apparent (about 8 to 9 years) may also be the beginning of dissatisfaction with one's body, and the degree of dissatisfaction may well be proportional to the extent that one's body configuration differs from the mesomorph image (Staffieri, 1967). Similar findings were obtained for obese children (Nathan, 1973; Mendelson & White, 1982). The beauty or ugliness of one's body is not only one's own impression, but is also a social impression. The body image is the result of social life (Schilder, 1950).

<u>Level of Motor Ability</u>

Children who for one reason or another, cannot function at the same motor skill level as their peers are the ones who suffer the most, by not being chosen to participate in physical activities. Childhood is a period when children expend much of their time playing, engaging in new activities and participating in games (Arnheim & Sinclair, 1979; Gallahue, 1982). Those children whose environmental and organic conditions were not favorable at the right time, (e.g., good prenatal life, good postnatal care, stable and adequate social economic status, presence of both parents at home), are the ones who are most likely to present problems in the physical, psychological, and social area. These children may develop poor body image and function inadequately when in contact with other people and objects in the environment.

Opportunity to practice skills appropriate to the developmental level of the child and to discover all the capabilities of the body are of primary importance. Being successful in motor skills is of major importance at a time when physical prowess is what counts. Being successful in the physical realm will help children gain confidence in themselves, further stimulate their engagement in new and challenging activities, as well as make them recipients of respect and admiration from peers and "significant others."

> Lack of a movement repertoire during childhood can have serious ramifications, for it is through participation in locomotor skills that much of the social and emotional development of childhood is shaped (Seefeldt, 1971, p. 21).

Instruction

Different teaching methods have been used to test the influence of instruction on the development of self-concept and body concept (Martinek, 1978; Martinek, Zaichkowsky, & Scheffers, 1977; Schempp, Cheffers, & Zaichkowsky, 1983; Lydon & Cheffers, 1984). Basically, two different teaching methods were utilized: 1) a teacher decision-making approach (TDMA) or Teacher directed (TD) approach; and, 2) a shared decision-making approach (SDMA) or decision-sharing (DS) approach.

The findings suggest that: 1) no significant differences occur in the improvement of body concept in children from grades 3 and 4 (Martinek, 1978); 2) the TDMA method had a definite positive effect on self-concept development (Martinek et al., 1977; Schempp et al., 1983); and, 3) no significant differences were detected for self-concept across the TDMA, SDMA and control groups (Lydon & Cheffers, 1984).

Body Image and Motor Programs

The importance of body image for efficient human movement is a subject of agreement. In order for an individual to move, he or she must have an objective of where to go, what to do, and which parts of the body to use in each determined action. Without an adequate body image, one's ability to experience movement will be profoundly affected (Schilder, 1950; Kephart, 1960; Fisher & Cleveland, 1968).

Studies of the relationship between body image and movement skills have produced controversial findings. Several motor programs were developed in order to enhance body image in children. The focus of these programs was on: 1) rhythmic and sensory motor experiences (Painter, 1966); 2) treatment through vestibular, kinesthetic, tactile and visual sensations, gross and fine motor activities (Mosey, 1969); 3) sensori-motor and attention-control training (Maloney, Ball & Edgar, 1970); 4) sensory motor development (Montgomery, 1973); and, 5) distance running, game and sport skills, gymnastics and basic movement skills (Chasey, Swartz & Chasey, 1974).

Some of these programs resulted in significant gains in body image (Johnson, Fretz, & Johnson, 1968; Painter, 1966;

Chasey et al., 1974; Elbaum, 1964). In other studies, body image remained stable over an extended period of time (Payne, 1970), or showed now change at all (Chasey, 1972; Montgomery, 1973). Moreover, some studies did not include statistical or research support, making the extent of their impact on body image difficult to interpret (Mosey, 1969).

Importance of Body Image and Movement

Body image is an important component of movement. The way that individuals see themselves while performing motor skills will influence their body image. Positive feelings about one's body is mainly built upon positive past experiences and interactions, which in turn, develop confidence in oneself, a positive body image and self-esteem. Body image was found to be significantly related to self-esteem (Zion, 1965; Mendelson & White, 1982).

The confidence that individuals have in themselves will determine their choices about movement participation. These factors can generate a cycle, where its direction depends on the evaluation of previous experiences. For individuals lacking confidence, the involvement cycle will be a negative spiral. They are less likely to seek and choose participation, participation will be less satisfying, and participation will eventually cease (Griffin & Keogh, 1981). Also, lack of confidence to perform in situations where difficulty is perceived is based upon the absence or presence and quality of previous experiences (Griffin & Keogh, 1981). Therefore, the development of a positive body image and self-confidence are two important factors for children's future involvement and success in movement activities.

Summary

Body image is the mental representation of one's body in both static and dynamic situations. It develops from sensory (kinesthetic, tactile, visual, auditory), perceptual or cognitive (how the body is perceived and known), and affective (how the body is experienced and felt) experiences.

Body image is composed of both holistic (body as a whole, as a unity) and differentiated (the parts are articulated) aspects related to the body. Body image is important to the way an individual relates to others. According to the kind of experience, a positive or negative body image will be formed. Positive body image is important for children to engage in sports activities and to relate to others. It helps to develop the confidence to participate in motor activities.

Several studies were reviewed which discuss the relationship between sensory, perceptual and gross motor programs and body image. Due to the great diversity about the concept of body image, completely different approaches and results have been obtained. Therefore, there is still a need for a common definition of body image which would be accepted and used by those who are working with children.

Body image changes during the process of development and over time, and depends on the physiological, psychological and sociological conditions in which the individual is engaged. Body image, therefore, develops according to a series of factors that are both within and outside of the individual.

FUNDAMENTAL MOTOR SKILLS

Motor activities are the primary means by which children understand, learn and relate to others. They are an integral part of each child's behavioral repertoire.

Appropriate environmental conditions must be offered from the early stages of life if a child is to grow and function properly in the motor domain. Since success is an important component in this process, and if success is to be fostered, it is imperative that activities suitable to the age and maturation level of children be selected (Halverson, 1971).

Development of Fundamental Motor Skills

In order to understand how children develop and gradually improve their motor skill abilities, it is important to briefly review the sequential progressions that occur in the development of motor skills. Movement is the basis for motor skill acquisition. With maturation and practice, the performance of early movement patterns undergo changes so that mature forms of movement patterns can emerge.

The performance of complex movement patterns is dependent upon the acquisition and combination of fundamental motor skills. A broad repertoire of basic motor skills is essential for the future motor development of children. Seefeldt (1980) and Gallahue (1982) proposed models of developmental skill acquisition, which are related to the age at which skills are to be taught to children. These models possess four levels, each being an outgrowth of the previous one, with the neonatal period the starting point in the hierarchy.

At the moment of birth, the motor behavior of the child consists primarily of reflexes. Within a couple of months, some of these reflexes will serve as the basis for additional movements and some will be replaced by voluntary movements so that the infant gradually progresses from a reactive to a proactive being. Movements of the head, hands, and feet are more prominent. The development and improvement of prehension and the ability to stand leads the child to an important phase in development, the ability to walk. With maturation, practice and the influence of other important exogenous factors, the child gains increased control over his or her body, and the surrounding environment becomes an even more exciting place to explore. Step-by-step, the movement experiences increase and expand the child's motor repertoire. It is the time when the initial patterns of fundamental motor skills start to appear.

The fundamental motor skills, representing the second level in the hierarchy, are skills characteristically learned by children during early childhood, i.e., from 2 to 7 years of age (Gallahue, 1982). They include locomotor skills such as galloping, running, hopping, skipping, jumping and climbing; ball handling skills such as bouncing, catching, throwing, kicking, and striking (Gallahue, 1982; Thomas, 1984; Williams, 1983; Corbin, 1980; Wickstrom, 1983) and , non-locomotor skills such as swinging, turning, twisting and hanging (Seefeldt, 1980).

The acquisition of fundamental motor skills often is divided into a series of developmental stages. A three-stage sequence is suggested by Gallahue (1982). The initial stage is characterized by poor spatial and temporal integration of movements. The preparatory and follow-through actions are missing in a movement pattern at this level. The elementary stage is characterized by greater control and coordination of movements although the pattern of movement is not yet mature. The mature stage is characterized by the integration of all the components of the movement, turning it into a well-coordinated, controlled performance.

It is important to observe that not all movement patterns follow this three-stage progression. Some movements can be divided in more stages, according to their patterns and the level of sophistication of the observer (Gallahue, 1982) or will vary from one investigator to another, according to available data and intended use (Wickstrom, 1983).

The sequential progression and the order of learning fundamental motor skills are essential factors in the motor development process if success in the performance of specific sport skills is to be achieved. The mastery of fundamental motor skills is an important step in children's future motor development because it is a prerequisite to the acquisition of efficient sport and dance skills. To set the foundation for the development of more specific task-related motor skills, integration and automation of individual movement patterns must occur.

The third level of the model contains specific motor skills that eventually become integral parts of the highly organized games, sports and dances in our culture. The fourth level is the highest level in the hierarchy and is represented by the mature fundamental movements developed in specific sport-skills such as tennis and baseball. Most sport and game skills are some variation, adaptation, and/or combination of different fundamental motor skills (Williams, 1983; Wickstrom, 1983; Gallahue, cited in Thomas, 1984, p. 125).

If one wants to understand how children progress in the motor domain, one must attentively observe their movement behavior at a time when they are actively involved in exploring and experimenting with the movement capabilities of their bodies (Gallahue, 1982). Careful observation of what happens during skill development and how it happens is a concern that all researchers must have in order to obtain a complete and meaningful picture of children's motor behavior (Wickstrom, 1983).

Levels of Performance on Selected Movement Skills

How far children can jump or throw a ball or how fast they can run has been the only means by which children's motor development was measured in the past (Halverson, 1966). More recently, in order to obtain a more complete picture of child's motor performance, both qualitative and quantitative measurements have been recommended.

Qualitative descriptions (or process characteristics) refer to "how" the child moves. Quantitative descriptions (or product characteristics) refer to "how fast," "how far," or "how much" (Williams, 1983). Utilizing these two assessment methods is important because changes in the way a child moves or performs a motor skill may occur without obvious or concomitant change in achievement (quantitative) scores (Williams, 1983). Thus, for meaningful description of the nature and/or level of skill performance, both quantitative and qualitative assessment is necessary.

Qualitative Assessment of Motor Skills

Motor skill development is known to follow the principles of sequential order and predictable progression both between and within motor skills (Halverson, 1931; Shirley, 1931; Bayley, 1936; Ames, 1937; Gesell, 1940; McGraw, 1943). In order to assess qualitative changes in the development of a motor skill, the concept of stage has been utilized. The term stage is used to describe identifiable motor patterns as "steps" in the developmental process of skill acquisition. Accordingly, each stage for a given skill is a distinct movement pattern that is present at one of the progressive levels of skill development (Wickstrom, 1983).

Wild (1938) was the first to use the stage concept in her classic study of throwing behavior and the analysis of its course of development in children. Since then, several investigators utilized the stage concept, although with some variation in the number of stages for a skill (Seefeldt, Reuschlein, & Vogel, 1972; Hanson, 1961; Leme, 1973; Roberton, 1975; Gallahue, 1983).

In analyzing the developmental changes that occur in a motor skill, investigators have approached the stage concept in three different ways. Shirley's (1931) stages of locomotion consist of a sequence of motor tasks that lead to walking. Thus, standing alone is considered one stage, while walking alone another stage. This approach is an example of an inter-skill or between-task sequence.

A second approach is represented by Seefeldt and his colleagues (1972) and by Wickstrom (1977). These researchers have taken one task and analyzed the movements that compose that task from the first attempts to the mature form. The developmental stages identified have been termed intra-task stages (Halverson, Roberton, & Harper, 1973) or intra-skill stages (Seefeldt et al., 1972).

The third approach to the stage concept focuses on body components. Roberton's (1977) within-task components concept suggests that each movement must be analyzed in terms of its components (body areas, legs, arms) rather than as a total body configuration. She further maintains that when analyzing the components of the body action, differences in certain body sections occur. For example, the development of the overarm throw doesn't involve concurrent change in all body components or in the total body, but rather that certain movements or components of the body change while others do not (Roberton in Ridenour, 1978, p. 74).

Although several questions have been raised regarding the term "stage" and its function (Roberton in Ridenour, 1978, pp. 63-81), and a clear, objective and effective definition still needs to be formulated, the term stage will be used in this study to describe total body configurations as developmental levels in skill acquisition. This approach is considered to be a useful tool for observing general levels of intra-task motor skill development.

An Overview of Developmental Sequences of Selected Motor Skills

This section will trace studies done with selected fundamental motor skills that are described in the literature. These studies were helpful in selecting the motor skills to be used in this study.

Running

Running is a fundamental motor skill utilized in almost all sports as well as the everyday behavior of a great majority of individuals. The mastery of running is important during childhood, due to its predominance in game situations and sport activities. Those children who present problems with running are the ones who often cannot successfully participate in many physical activities.

Running is an extension of walking. It is described as a "series of smoothly coordinated jumps during which the body weight is borne on one foot, becomes airborne, is then carried on the opposite foot and again becomes airborne (Slocum & James, 1968).

Several investigators have been very helpful in defining the developmental changes in running patterns. Their studies contained cross-sectional and longitudinal data and covered a wide age range (Clouse, 1939; Dittmer, 1962; Fortney, 1964; Glassow, Rarick, & Halverson, 1965; Beck 1966; Mersereau, 1974; Smith, 1977; Brown, 1978; Fortney, 1980).

A useful and uncomplicated method of identifying the developmental motor pattern sequence for running was proposed by Seefeldt et al. (1972). The sequence was derived from mixed longitudinal film data on approximately 150 children ranging in age from eighteen months to eight years. Four developmental stages were proposed for running and were described in terms of total body configuration (see

Appendix B for a complete description of each stage).

It is interesting to observe that, in general, stages may relate to chronological age periods. Thus, with increasing age, changes in movement characteristics should represent changes to more advance levels of skill (Wickstrom, 1977). Stage 1 is represented by children ranging from 18 months to 24 months of age. They present a very crude pattern of running, where dynamic equilibrium is a major problem. Around the second and third year (Stage 2) children improve their running skill. They become more confident and more reliable on their accomplishments. At four and five years, they continue improving in power, equilibrium and form of the run. At this stage (Stage 3), children increase their running ability and running efficiency.

By the age of five, most children have mastered the skill of running (DeOreo, cited in Williams, 1983, p. 214) and by five and six years of age, children are able to use their running skill effectively in most play activities (Espenshade & Eckert, 1980).

The use of simplified, whole-body action descriptions are most useful for observing general levels of intra-task motor development (Williams, 1983), and serve as valuable tools for teachers who cannot give individual attention due to time unavailability (Wickstrom, 1983). However, if a more detailed information is needed to provide individual improvement, the "component" approach, already mentioned and suggested by Roberton (in Ridenour, 1978, pp. 63-81), can be used in conjunction with the total body configuration approach.

Age and gender are variables that can be examined when assessing children's performance on running skill. Miller, Haubenstricker, and Seefeldt (1977), in analyzing the running skill of children ranging in age from 20 to 65 months of age, found that in terms of percentage, females presented a less mature stage for each age level when compared to males of the same age range. With increasing age, both males and females moved from less mature to more mature stages, decreasing the percentage of both groups in the first two stages. At 60-65 months of age, no children exhibited Stage 1 or 2 running form.

The results suggest that there is a developmental trend in the acquisition of the running skill, and that boys are slightly more advanced than girls in running form. However, analyzing gender differences in running skill must be done carefully. The focus of the developmentalist should be on individual progress rather than comparisons between groups (Roberton, 1984).

Although no specific study has been carried out to account for gender differences in running skill from a developmental perspective, some general contributions have been made by several researchers. Some gender differences in running can be attributed to body size and growth differences (Peterson, Reuschlein & Seefeldt, 1979). Differences in developmental levels attained also may be attributed to growth differences (Haubenstricker & Sapp, 1980), to amount of practice (Halverson, Roberton, & Langendorfer, 1982) and/or to cultural gender role expectations (Herkowitz, 1978).

Standing Long Jump

Jumping is a fundamental locomotor skill that involves the propulsion or projection of the body into the air by a thrust from one or both legs, and landing on both feet. Although there are several forms of jumping (vertical jump, high jump, hurdle jump), only standing long jump will be reviewed.

Early investigations of the standing long jump have been summarized by Wickstrom (1983). Only recently has considerable attention been given to the age, movement pattern, and stages by which children acquire jumping skill. The great majority of studies measured how far children could jump (inches) and little attention was given to "how" (process) they jumped.

Hellebrandt, Rarick, Glassow, & Carns (1961), in their classic study on the development of long jump behavior, observed that: 1) the earliest pattern of jumping is made by a one-foot take-off which will persist until a higher level of neuromuscular coordination and strength develops to make possible a two-foot take-off; and, 2) at early stages, the leg action is far more advanced than arm action. Initially, the arms move backwards at take-off. Later, they assume a winging action during take-off to help with stability. Finally, they are used for augmenting the force of the jumping action. These two analytical observations of the long jump are considered important points when beginning analysis of the skill.

The acquisition of jumping skill can be better understood if explained in terms of stages or phases. Although some inconsistency is found in the number of and nomenclature for the "stages" of jumping (McClenaghan & Gallahue, 1978; McClenaghan, cited in Gallahue, 1982, p. 185; Williams, 1983; Seefeldt & Haubenstricker, 1979), investigators have found that there is a common developmental trend among the stages (Keogh, 1965; Milne, Seefeldt, & Haubenstricker, 1976).

The majority of the recent studies use a component approach where arms, trunks, legs, hips, feet, ankles are analyzed separately. If a practical and quick analysis is needed, the stages suggested by Seefeldt and Haubenstricker (1979) are valuable tools for use by teachers and physical educators (see Appendix C).

The age at which children begin to demonstrate some jumping ability is approximately 18 months, a time when they begin to descend stairs (Cratty, 1979; Espenshade & Eckert, 1980; McClenaghan & Gallahue, 1978) or to stepdown (Wickstrom, 1983). With the increase of physical prerequisites such as leg strength, stability (balance), and coordination, and psychological qualities such as confidence and courage, the child jumps from ever increasing heights, begins to use a more vigorous push-off, and lands without losing balance.

At about two years of age, a two-foot take-off and landing is observed (Cratty, 1979). According to Poe (1976), most two-year-old children can perform a jump-and-reach task when an overhead target is provided. She further suggests that since performance differences were so great, a description of a "typical" two-year-old jump-and-reach pattern was meaningless. This difficulty can be explained, in part, by the fact that young children explore many different types of jumps (Espenshade & Eckert, 1980), and that the assignment of a precise age expectation to a particular achievement of jumping skills is a difficult task (Wickstrom, 1983).

The relation between the performance of children at various stages to ages on the standing long jump was assessed by several investigators. The age-stage relationship identified by Miller et al. (1977) have been observed by other investigators (Way, Haubenstricker & Seefeldt, 1979). Furthermore, testing older children, these investigators found that boys and girls are quite similar across all age levels, but the girls are slightly more advanced than the boys.

As Williams suggested, the developmental changes that occur in jumping result from increases in strength, limb coordination and proper practice. If the opportunity to practice correctly is not available, immature or poor performance will predominate, regardless of the age and gender of the performer (1983).

Few data are available concerning gender-age-stage relationships in jumping. However, some important studies on gender-age-scores demonstrate that a definite developmental trend exists for jumping. Keogh (1965), summarizing the data of 11 studies over a 35 year period on school children, reported that there was consistent linear improvement at successive ages and grade levels. He found no significant performance differences between boys and girls up until age eight, after which boys were the better performers. Milne et al. (1976) support the concept of improved performance at succeeding ages and/or grades in a study of 553 kindergarten, first and second grade children, with males demonstrating superiority over females. Both studies assessed the standing long jump of children in distance jumped, not in stages.

Hopping

Hopping is a locomotor skill which is treated either as a particular type of jump (Wickstrom, 1983) or as a more complicated version of the jump (Espenshade & Eckert, 1980). Essentially, hopping is a motor task where a child takes off and lands on the same foot (Wickstrom, 1983; Espenshade & Eckert, 1980; Williams, 1983; Gallahue, 1982; Seefeldt & Haubenstricker, 1976; Corbin, 1980). The development of hopping involves walking, running, and jumping skills. Balance and strength are indispensable prerequisites in projecting the body off the ground and in absorbing its landing. The study of hopping technique (how) has received little attention since it is often considered a part of other fundamental skills and not as a separate form of locomotion (Wickstrom, 1983).

Some investigators have observed the hopping behavior of children and found that there is a developmental sequence in the form of the hop ranging from the immature step-gallop form to the successful quick lifting of the foot at the peak of the upward thrust (Jenkins, 1930; Halverson, 1973). Later, Roberton and Halverson (1977) added more details, focusing their attention on more precise stages for arm and leg action. Gutteridge (1939) considered the hop to evolve from irregular forms of jumps, while McCaskil and Wellman (1938) believed that hopping on two feet occur earlier than hopping on one foot. Seefeldt and Haubenstricker (1976) organized the hopping skill into a four-stage developmental sequence, again with a total body configuration approach (see Appendix D).

In order for a child to acquire the hopping skill, sufficient balance is required. At about 29 months of age, a one-foot static balance skill is achieved (Espenshade & Eckert, 1980). With increasing proficiency in static and dynamic balance, a child 42 months of age can usually hop one to three steps. Later, the child increases the distance and number of hops. By the age of four years, most children can hop from four to six steps. By five years of age, most children can execute 10 consecutive hops (Cratty, 1979; Espenshade & Eckert, 1980).

The qualitative assessment of hopping in children has been accomplished in several studies. Way et al. (1979), using the four-stage sequences of Seefeldt and Haubenstricker (1976), classified the hopping performance of 1,986 primary grade children, ranging in age from 72 to 107 months. Stage 4 was the most common stage for girls in most age categories while Stage 3 was the dominant stage at all age levels for boys. Thus, girls were more advanced than boys in the quality of their hopping performance. The results also showed a developmental trend in the acquisition of hopping skill. Similar results were obtained with urban black and urban white children by Worthy (1984).

Skipping

Skipping consists of a combination of two other fundamental movement patterns, the step and the hop (Gallahue, 1982; Williams, 1983) and therefore is not considered as one of the fundamental motor skills (Williams, 1983). Skipping develops later than hopping and galloping. At approximately 38 months, very rudimentary forms of skipping movements in the form of a shuffle step start to appear (Espenshade & Eckert, 1980; Williams, 1983). At 43 months of age, early skipping movements that comprise a skip on one foot and a walk pattern with the other foot become more evident. With an increase in balance and proficiency in hopping on one foot, the step-hop pattern becomes easier to perform.

Subsequently, the uneven rhythm of the skip (a necessary condition for a successful skip) begins to appear, but it is not until approximately six to seven years of age that the mature form of skipping may be observed (Williams, 1983; Espenshade & Eckert, 1980). It is important to remember that not all children develop at the same rate and, according to Espenshade, even at this age (72 months), the variation in performance among children is still very great (Espenshade & Eckert, 1980).

Several investigators studying the skipping pattern of children have reported developmental sequences consisting of three stages (Seefeldt & Haubenstricker, 1976; Halverson & Roberton, 1979). See Appendix F for the sequence developed by Seefeldt and Haubenstricker (1976). Other investigators analyzing the skipping performance of children have found girls to be more advanced than boys across all age levels studied; and, that with advancing age, boys and girls become more mature in the quality of their skipping performance (Miller et al., 1977; Way et al., 1979).

Throwing

Throwing is the ability to project or release an object accurately into space with one or both hands. There are several forms of throwing (overhand, underhand, sidearm) and several ways of assessing throwing performance (form, accuracy, distance and velocity). Throwing is probably as important as running, due to its presence in many play and/or sports activities. Therefore, the mastery of it during childhood is important if successful experiences in play activities are to be achieved.

The acquisition of a mature throwing pattern is slow in its development, since throwing behavior involves many parts of the body (Corbin, 1980). It requires time and a lot of practice to achieve good skill in throwing. A very crude form of throwing appears when a child uses only the arm to release an object in space. Many children perform this act from a sitting position and at approximately six months of age (Gutteridge, 1939). Shortly before the first year of life, a ball may be thrown in a reasonably well-defined direction. It is during the second year that both direction and distance improve, although the throwing pattern tends to remain quite immature (Gesell & Thompson, 1934).

At three years of age, children are still immature in their throw (Gutteridge, 1939). They show good improvement at age four, become even more proficient between the ages of five and five and on-half years, and present a good pattern at six years of age.

One of the recent methods of studying throwing behavior has entailed detailed analysis of the components of the throwing pattern and its development. Several investigators have generated developmental sequences for the overarm throw (Seefeldt et al., 1972; Seefeldt & Haubenstricker, 1976; Roberton, 1977, 1978; Langendorfer, 1980; Roberton & Langendorfer, 1980; Halverson et al., 1982). However, Wild's (1938) original sequence is considered to be the classic study of this skill.

Wild (1938) tested 32 children within the age range of 2 to 12 years. Each child was tested once and was asked to perform three overhand throws which were filmed and carefully analyzed. From her study, she concluded that many behaviors of the different parts of the body were age-related. She identified four different types of throw which were classified in stages of development according to age.

The age-related patterns identified by Wild have been observed by other investigators (Halverson & Roberton, 1966; Seefeldt et al., 1972). However, these investigators determined that the patterns probably appear earlier than originally proposed. For a more detailed description of the stages developed by Seefeldt and Haubenstricker (1976), see Appendix F.

Wild (1938) also identified two main developmental trends in the sequential movement patterns of throwing. These were a change or gradual shift of movements from the anterior-posterior plane to movements in the horizontal plane, and a shift from an unchanging base of support to a contralateral or opposite arm-foot relationship.

Following wild's (1938) work, several other studies of throwing were carried out. These involved attempts to further define developmental stages (Roberton, 1975); to observe the effect of instruction on the throwing pattern (Hanson, 1961; Halverson & Roberton, 1979; DiRocco, 1981), and to observe improvement in throwing form (Singer, 1961).

In addition, the impact of variables such as age and gender on throwing form have been analyzed. Ekern (1969), examining the overarm throwing patterns of boys and girls from grades 2, 4, and 6, found that the throwing patterns of boys were more mature than those of girls in almost all aspects. At each age range, boys presented a greater range of movement, a faster arm action, and a more effective stride. She detected two important developmental characteristics exhibited by the girls; namely, the failure to separate spinal and pelvic rotation and the tendency of throwing patterns to be dominated by arm action. Haubenstricker, Branta and Seefeldt (1983) analyzed the overarm throwing pattern of 1,159 boys and girls ranging in age from 30 to 65 months of age, grouped in six month intervals. Their findings showed that Stage 4 is most common for boys, while Stage 3 is the dominant for girls in this age range. In an earlier study, Way et al. (1979) examined the throwing patterns of 1,986 boys and girls ranging in age from 72 to 107 months. Boys exhibited the more mature forms of throwing. At all age levels a developmental trend in throwing behavior was evident for both boys and girls. Improvement in throwing form also was found in urban children (Worthy, 1984).

Catching

The fundamental movement pattern of catching involves controlling or stopping an aerial ball or object by the use of one or two hands. Catching is an important skill to be developed in early childhood. Success in a variety of play activities, games, and sports during the elementary years is dependent upon the ability of children to catch balls. Several variations of the catching pattern are required for participation in sports such as basketball, football and baseball. The focus of this review will be limited to the developmental sequence of the catching skill and gender-age-stage relationships.

Catching behavior is difficult to describe and assess because of the number of variables influencing performance (Wickstrom, 1983). A series of environmental factors (ball size, color, speed of the ball, distance between thrower and catcher) and biological factors (age, gender, maturation) influence catching skill.

Several investigators have studied the catching performance of children, each emphasizing one or more aspects of the skill (Hoadley, 1941; Seils, 1951; Warner, 1952; Bruce, 1966; Riordan, 1979; Williams, 1968). Their assessments were mostly based on gender differences, age differences, and on the characteristics of the ball itself.

The acquisition of catching skill occurs at a relatively slow pace (Espenshade & Eckert, 1980; Wickstrom, 1983). It involves sophisticated perceptual abilities and is highly dependent on eye-hand coordination (Arnheim, 1978). Studies of the development of catching skill focus on descriptions of gradual changes in motor patterns. Despite the fact that catching is a difficult skill to study (Wickstrom, 1983), a few studies have been carried out in an attempt to detect the movement characteristics of a specific stage of development, and to relate it to an age period.

The child's first experience in catching usually occurs when a slow ball is rolled between the child's legs while in a sitting position (Wickstrom, 1983). This is the easiest and earliest catching-related experience, because no adjustment to catch the ball is necessary. With increased age, maturation, and experience, the transition from a seated to a standing position enables the child to better adapt to an oncoming rolling ball or a very carefully tossed (aerial) ball. This active catching marks the beginning of a series of changing movements where different positions of the trunk, arms and hands will lead to the more mature stage of catching.

The qualitative changes in catching behavior have received limited attention. Seefeldt et al. (1972) delineated a five-stage sequence (See Appendix G). Using this five-stage sequence, Haubenstricker et al. (1983) assessed the catching performance of 1,596 boys and girls in the age ranges of 30 to 65 months of age, grouped in six month intervals. They determined the percentage of children performing at the various stages by age and gender. Their findings suggest that Stage 3 is the dominant stage for boys and girls across all age levels. However, with increasing age, both boys and girls moved from less mature to more mature stages. The data suggest that boys are slightly more advanced than girls in catching form. Way et al. (1979) in analyzing the catching performance of 1,986 boys and girls ranging in age between 72 to 107 months found that Stage 5 is the most common for both boys and girls beginning at 84 months. From 72 to 83 months of age, they are still predominantly at the Stage 3 level. Worthy's (1984) findings essentially agree with those of the previously cited studies.

In summary, the research findings indicate that with increasing age, boys and girls improved their catching performance. There is a developmental trend in the acquisition of catching skill and boys generally are more advanced than girls in catching form.

Kicking

The fundamental patterns of kicking skill have received little attention from researchers and child development investigators. Kicking is defined as a unique form of striking in which the foot is used to impart force to a ball (Wickstrom, 1983; Gallahue, 1982).

Two types of kicking are frequently used by children; namely, the stationary kick and the punt. Only the place kick or stationary kick will be included in the following discussion.

Although research on stationary kicking is limited, the developmental sequence and process characteristics of its patterns have been identified. The stationary kick is a skill widely used by elementary school-aged children, maybe because it is the easiest form of kicking, or due to its requirement in the majority of introductory games, where the level of difficulty is maintained at its lowest form (Corbin, 1980).

The developmental form of the stationary kick has been studied by a few researchers. Gesell (1940), one of the first to observe this skill in children, suggested that shortly after children are able to run, they are ready to kick. This might occur around the 18 months of age. On the other hand, according to Wickstrom (1983), any kicking behavior before the age of 2 years is extremely unpredictable because the movements are haphazard and barely recognizable as a pattern, and unworthy of serious classification.

One of the most thorough studies of the stationary kick was conducted by Deach (1950). She defined kicking as a striking movement of the leg against the ball at an advantageous point in the arc. After analyzing the stationary kicking behavior of 83 children ranging from two to six years of age, Deach observed four distinct developmental stages. Her four stages show a gradual change from a nearly straight leg with scarce involvement of the rest of the body to an effective approach and forceful kicking action. Since her study, other investigators also analyzed the pattern of the stationary kick. Seefeldt and Haubenstricker (1981), in revising their original developmental sequence for kicking (Seefeldt & Haubenstricker, 1976), retained their four stages, but improved them with additional explanatory details (see Appendix H).

In order to understand the age-stage relation of the kicking skill, several investigators analyzed the performance of children in the stationary kick. Miller et al. (1977) and Way et al. (1979), although testing children of different ages (30 to 65 months, and 72 to 107 months, respectively), found that most boys perform at Stage 3 across all age levels, whereas the majority of the girls exhibited a Stage 2 at most age levels. The findings of these studies suggested that there is a developmental trend in the acquisition of the kicking skill with boys more advanced than girls in kicking form. Similar findings were found by Worthy (1984).

Quantitative Assessment of Motor Skills

Another way to assess children's performance on motor skills is through achievement scores. Product outcomes or achievement scores are useful for measuring performance and for identifying changes in performance that occur over time. These determine "what" is the result of the movement instead of "how" the movement was performed (Williams, 1983).

A careful overview of motor performance tests developed in the past was helpful for the selection of test items for the present study. Many of the tests were concerned with physical fitness factors, while others assessed perceptual-motor factors. The items selected were those thought to differentiate the performance of normal children from that of children with gross motor problems. They included a speed and agility run, a figure 8 run, the standing long jump, an agility jump, the one foot balance, and a dynamic balance test.

Speed and Agility Run

The speed and agility run is a task where changing direction and speed are important requisites. It also requires a mature pattern of running (Williams, 1983). It is the ability to make quick and accurate shifts in body position during movement (Gallahue, 1982).

Performance of children on the speed and agility run varies by age and gender. Several investigators found that the mean performance on this agility task for boys and girls increased at successive grade levels (Seils, 1951; Milne et al., 1971, 1976). Keogh (1965) reported that girls were more agile than boys at ages six and seven, while boys were more agile at eight and nine years of age. Different findings were obtained by Milne et al. (1971, 1976) and Seils (1951). Their findings show that boys were significantly more agile than girls at kindergarten, first and second grade levels.

Agility Jump

Another approach to testing agility is the use of a side stepping or side jumping test. A modified side stepping was employed by Seils (1951), where the score was the total number of times the child shuttled back and forth over an area during the period of 10 seconds. Seils reported a reliability coefficient between the first and second trials of .956. The results showed an increase in the mean performance of the boys and girls at successive grade levels.

Standing Long Jump

The standing long jump is a skill that has been measured for decades. One of the first studies to include the standing long jump was conducted by Jenkins in 1930.

Since then, numerous studies have been conducted that included the standing long jump in the test battery. Unfortunately, some of the studies did not report reliability coefficients, directions or scoring methods (Taylor, 1939; Carpenter, 1942).

Performance on the standing long jump has been studied in children. The ages studied ranged from 6 to 8 years (Taylor, 1939; Carpenter, 1942; Seils, 1951); from 9 to 11 (Latchaw, 1954); from 6 to 14 (Glassow & Kruse, 1960); from 5 to 7 (Milne et al., 1976); and from 3 to 6 years of age (Morris et al., 1982). In general, the findings of these studies show that boys increase their jumping performance at each age level (Seils, 1951; Latchaw, 1954; Milne et al., 1976; Morris et al., 1982), and that gender and grade differences exist (Milne et al., 1971; Hanson, 1965; Jenkins, 1930). Jumping performance increases with successive grades and boys generally jump farther than girls at specific age or grade levels.

Figure 8 Run

The figure 8 run, as an agility test, has been designed in various ways such as running in a zig-zag or in a figure eight pattern around chairs or cones. This test has been used with children of different ages. Johnson (1961), testing the motor achievements of 4,744 elementary children in Grades 1 through 6, included a zig-zag run test. It consisted of having the children run around four chairs placed six feet apart. Performance was scored to the nearest tenth of a second. Three trials were given, with the shortest time being the score. His findings show that with increasing age, boys and girls improve in their performance. Boys exceeded girls at all grade levels except in Grade 3 where both performed at the same level.

One Foot Balance

Static balance, as measured by the one foot balance, is the ability of the body to maintain equilibrium in a stable position (Arnheim & Sinclair, 1979; DeOreo & Keogh, in Corbin, 1980, p. 87; Gallahue, 1982; Williams, 1983). Different techniques have been used to test the one foot balance performance of children. Children have been asked to maintain equilibrium on a piece of wood (Seils, 1951), to stand on a 14" x 14" unstable platform placed on aluminum rockers (DeOreo, 1970), to maintain balance on a board mounted on a central pivot (Eckert & Rarick, 1976), or to balance on either foot as long as possible (Morris et al., 1982).

The age of the children studied in the previous paragraph ranged from three to five years (DeOreo, 1970); from three to six years (Morris et al., 1982) from six to eight (Seils, 1951); and from seven to nine years (Eckert & Rarick, 1976). From these studies, it was found that static balance performance increases with age (Frederick, 1977; Seils, 1951; DeOreo, 1970); that there was no significant difference in performance for boys and girls (Hanson, 1965; DeOreo, 1970); and, that there was a slowing down of increased performance with age, particularly between seven and eight years of age (Eckert & Rarick, 1976).

Dynamic Balance

Dynamic balance is the ability of the body to maintain equilibrium and control posture while moving from one point to another in space (Arnheim & Sinclair, 1979; DeOreo & Keogh, in Corbin, 1980, p. 87; Gallahue, 1982; Williams, 1983). The most typical measure of dynamic balance is having the child walk a balance beam.

Several investigators tested the dynamic balance of children of various ages and motor skill levels, but utilized different techniques. Seils (1951) used nine balance beams of different widths, each 10 feet long, DeOreo (1970) used three beams 12 feet long, whereas, Cinelli and De Paepe (1984) used one beam 16 feet long. The ages studied ranged from 5 to 18 years (Seils, 1951); from 3 to 5 years (DeOreo, 1970) or was limited to children 6, 8, and 10 years of age (Cinelli & DePaepe, 1984). Only Cinelli and DePaepe compared normal children to children with learning disabilities.

Despite the diversity in the length, width, procedure and scoring methods used by various investigators, some similarities can be noted in the results of their investigations. Data from the studies indicate that balance performance increases with age. There is a slight difference in performance between boys and girls, with girls generally outperforming boys. Older children perform better than the younger ones, and normal boys perform better than boys with learning disabilities.

Factors That Affect Motor Performance

There are numerous factors that can affect the motor performance of children. Among these are age, gender, mental ability, clumsiness, prior experience, and social facilitation. For the purpose of this review, only two such factors--clumsiness and gender--will be considered.

Clumsiness

Clumsiness in children influences their behavior in many areas of personal development. Gubbay (1975) defined a clumsy child as:

> . . . one who is mentally normal, without bodily deformity, and whose physical strength, sensation, and coordination are virtually normal by the standards of routine neurological assessment, but whose ability to perform skilled, purposive movement is impaired. (p. 39)

Children who present a delay in skill attainment are often classified as clumsy, particularly if such delay is apparent in many skills to which they are exposed. Children who have difficulty in acquiring proficiency in motor skills are also classified as having gross motor dysfunction and often exhibit certain identifiable characteristics.

Some of the characteristics that can be observed in children with motor dysfunction include: 1) inconsistency in repeating a skill; 2) perseveration; 3) mirroring; 4) asymmetry; 5) loss of dynamic balance; 6) falling after performance; 7) extraneous motion; 8) inability to maintain a rhythm or pattern; 9) inability to control force; and, 10) inappropriate motor planning (Haubenstricker et al., 1974). Others are poor intersensory integration and specific deficits of auditory and visual perception (Hallahan & Tarver, 1974).

It is important to point out that not all of these characteristics are observed in every child. Some children may present only one or two, while others may exhibit many of them. These characteristics contribute to the performance discrepancies encountered when comparing normal children and children with gross motor dysfunction.

A developmental delay in the motor domain can be exemplified by the inability of the child to maintain attention to a task, i.e., short attention span, distractibility or perseveration (Fait, 1978), which will restrict the child in his or her ability to attend to necessary and sufficient stimuli for an adequate length of time (Arnheim & Sinclair, 1979). The result is loss of appropriate information and consequently, poor performance.

Children with gross motor problems have difficulty performing most motor activities, when compared to normal children of the same age. Haubenstricker, Seefeldt, Fountain, and Sapp (1981), in determining the usefulness of the Bruininks-Oseretsky Test as a tool for assessing the motor proficiency in children, found that children with gross motor dysfunction score lower than children without motor impairment. According to Bruininks (1977), learning disabled children are most deficient in balance skills, simultaneous or sequential bilateral coordination of movements involving the arms and legs, and in controlled fine visual-motor coordination required for drawing designs and tracing images.

Performance delays in motor skills among clumsy children also have been reported by other investigators. According to Cratty, children with gross motor dysfunction (or learning disabled) are usually delayed by about two to three years in most skills (1967). He reported that the balance of a 10-year-old disabled child can be compared to that of a normal five and a half year old child (Cratty, 1967). A two-year disparity was found between learning disabled and normal children in basic throwing and catching skills (Cratty, 1967); and, it was also found that learning disabled children are less agile than normal children (Cratty, 1967, 1972). Cruickshank (1967) reported that children with motor problems may present a discrepancy as great as four years between motor skills and chronological age. This means that when comparing children of the same chronological age, those with gross motor dysfunction will lag far behind in motor skills as well as other related areas.

It is quite obvious then, that a child who has such disadvantages cannot function at the same level or within the same frame of reference established for the majority of the population referred to as normal. As mentioned before, not all gross motor dysfunction children present all the aforementioned characteristics; however, only the presence of a few is sufficient to alienate them from normal functioning individuals.

Gender

Gender differences in motor performance have been found as early as two years of age. These gender differences may be due, in part, to physiological and structural differences, but also may be due to early behavioral and emotional stimulation.

During early childhood (from two to five years) girls excel in tasks requiring jumping, hopping, rhythmic locomotion and balance, while boys perform better in tasks requiring strength and speed (Espenshade & Eckert, 1974; Sinclair, 1971). During middle childhood, boys generally outperform girls in running, jumping and throwing, while girls excel in hopping (Keogh, 1965; Espenshade & Eckert, 1974). Performance on balance activities often failed to provide clear-cut boy-girl differences, but girls seemed to perform better than boys at some ages (Keogh, 1965). Although some gender differences are apparent, there is still a great deal of variability in performance in the majority of the activities at all age levels, and an overlap in performance for boys and girls within a given age level.

Boys and girls have few differences in the proportional growth of their body segments between two to six years of age. The differences that exist are minimal and do not account for the differences in motor performance observed at these early ages. However, from 7 to 12 years, girls increase more in hip width while boys increase more in shoulder width and leg length. These changes can contribute toward the performance advantage of boys in throwing, jumping and running activities (Espenshade & Eckert, 1980; Haubenstricker & Sapp, 1980).

The gender differences in height and weight show that from birth to approximately 12 years of age, boys tend to be slightly taller than girls (Herkowitz, in Ridenour, 1978, p. 85; Haubenstricker & Sapp, 1980). From birth to four years, boys also tend to be heavier than girls, but between 4 and 11 years of age, no gender differences in weight occur (Herkowitz, in Ridenour, 1978, p. 85). The slight superiority of boys over girls in these two factors combined with some others (shoulder width, leg length), may help explain the gender-related superior motor performance of boys on power-oriented tasks (Haubenstricker & Sapp, 1980).

Differences in body composition between boys and girls can also influence motor performance. Gender differences in body composition can be observed at all ages, with girls having more fat than boys (Herkowitz, in Ridenour, 1978, p. 87; Corbin, 1980). This difference between boys and girls seems to provide some explanation for the better performance of boys in certain gross motor activities.

Strength is another differentiating variable between boys and girls. From 6 to 12 years of age, boys are slightly stronger than girls (Herkowitz, in Ridenour, 1978, p. 87), perhaps explaining their better scores on jumping, a task known to be a predictor of body strength (Carpenter, 1942) and diagnostic of motor coordination (Espenshade & Eckert, 1980). But this difference in strength between boys and girls does not necessarily account for discrepancies in the performance of all motor skills (Herkowitz, in Ridenour, 1978, p. 88). There are other factors that must be examined if differences in motor performance are to be explained.

Behavioral differences, as influenced by cultural habits, also can be observed from very early ages. Mothers treat their sons differently than they do their daughters (Goldberg & Lewis, 1969). According to these researchers, one-year-old boys spend more time in gross motor activity, while girls of the same age spend more time in fine motor activities. Boys are more vigorous and more exploratory, while girls are more dependent and prefer a more quiet style of play (Corbin, 1980).

The influence of socializing agents on gender performance in physical activities also has received attention. Summarizing some research studies, Greendorfer (1980) observed that boys and girls are socialized into sports differently. The family, particularly parents, seems to be the most important and primary source of influence. The school is more influential over boys than over girls regardless of the socioeconomic, geographical, or social factors involved. The socialization of females into sports is inconsistent, and the influence of school is minimal. It is important to observe that all these factors will influence children's personality development and preference for specific games and movement behavior.

Learning and performing motor skills generally occur in a social setting. Thus, the types of motor skills learned by boys and girls and the motives for learning and performing them are influenced, in large part, by social and emotional factors. Govatos (1966) observed that boys during middle childhood are superior to girls on ball handling skills, throwing and jumping, due to their greater interest in these skills and more frequent opportunities for practice. Girls, on the other hand, are superior to boys in balancing activities (balance beam) due to a combination of factors such as a better concentration on the task, better balancing ability, and more advanced maturity.

Other investigators have found that this gender-task specificity also is related to self-confidence, where the more confident a boy or girl is on a task, the better will be the performance (Feltz & Doyle, 1981). Herkowitz (in Ridenour, 1978); maintains that socialization is a potent factor in explaining the discrepancies in performance between boys and girls. She states that

> . . . children's game preferences, their perceptions of sex-appropriate motor behavior, and the influence of sex labels on motor performance and motor activity attractiveness clearly demonstrate the effect of socialization on performance. (p. 95)

<u>Summary</u>

Fundamental motor skills are important in the development of children's understanding, learning, and relationships with others. Appropriate environmental conditions and freedom from disturbances are required if children are to become proficient in the motor domain. To foster such proficiency, it is imperative that the activities selected be suitable to the age, gender, maturity level and physical characteristics of children.

Physical educators must evaluate both qualitative and quantitative skill performance if maximum improvement is to occur. Knowledge of developmental characteristics and motor abilities during childhood is essential for identifying and helping to remediate children who have gross motor dysfunction.

Motor prowess in games is vital to a child's status at school, where the inability to catch a ball, when crucial for the game, makes the child with gross motor problems a recipient of social rejection. From such experiences, the resulting emotional and behavioral complications will become the main source of trouble for a child, rather than the disability itself.

Children with gross motor dysfunction present some characteristics which make them unable to function at the same level or within the same frame of reference as the majority of the population referred to as normal. It is important then to understand normal children's development in the motor, social, and cognitive areas in order to provide meaningful experiences for those with gross motor dysfunction.

CHAPTER III

METHODOLOGY

The purpose of this study was to investigate the relationship between knowledge of body parts, a measure of body image, and performance on selected gross motor skills in normal children and those with gross motor dysfunction.

Subjects

The subjects in this study were 18 boys and 8 girls who were normal in their motor development (NOR), and 18 boys and 8 girls with gross motor dysfunction (GMD). They ranged in age from 62 to 144 months. The subjects were matched by age and gender. The children with gross motor dysfunction were drawn from nearby schools in East Lansing, Michigan, and from the waiting list for the Remedial Motor Clinic, an ongoing program in the Department of Health and Physical Education at Michigan State University. These children were not physically handicapped or mentally retarded, but for various reasons were uncoordinated. The sample of normal children (without motor problems) was selected from elementary schools in East Lansing, Michigan. Identification of the normal children and those with gross motor dysfunction was through the physical education teacher and/or classroom teachers in the individual schools. Due to the limited number of children with gross motor dysfunction, it was not possible to randomly select them. Therefore, those children whose chronological age was within the required age range for this study were selected for testing. The difference in age between boys and girls within each group (NOR and GMD) showed that the boys were approximately seven months younger than the girls in the normal group, and three months younger than the girls in the gross motor dysfunction group. See Tables 3.1 and 3.2 for number of children selected for the study, and their respective ages in months.

A consent form (see Appendix I) was sent to the parents to receive permission for the testing of their child. A follow-up phone call was made to make arrangements for the testing.

Study Design

The research model for this study was an Ex Post Facto design with a 2x2 level, with group (NOR, GMD) and gender (M, F) as the independent variables. Univariate and multivariate analyses of variance (ANOVA and MANOVA, respectively) were used to differentiate among the groups on knowledge of body parts and performance on selected gross motor skills. In addition, a Pearson Productive Moment correlation matrix was used to determine the relationship between measures of body image (TSBP) and performance on motor skills.

Table 3.1

Number of Children Included in the Sample; By Group and Gender

Gender	Group NOR	GMD	Total
Boys	18	18	36
Girls	8	8	16
Totals	26	26	52

Table 3.2

Description Statistics for the Ages (in months) of the Children Included in the Sample

	NOR		GMD		Total	
Gender	Mean	S.D.	Mean	S.D.	Mean	S.D.
Boys	88.27	15.51	91.44	20.26	89.85	17.88
Girls	95.00	19.75	94.87	21.97	94.93	20.86
Total	91.64	17.63	93.16	21.12	92.4	19.37

Testing Materials

The testing materials for the Body Image test consisted of a printed sheet containing a list of 30 body parts. These parts were selected as the result of a review of the available literature. Space was provided for recording the number of the subject, the subject's birthday, the day of assessment, the school attended, the subject's gender, and four different columns for recording the subject's answers (see Appendix J for a sample form). Twenty different lists were generated by randomly choosing the numbers related to each body part. The body parts were selected according to the degree of difficulty they presented to 60-month-old children. Those parts that were easily recognized by all the children were eliminated.

A separate recording sheet was generated for the motor skills tests. The first set of tests was comprised of seven skills on which the quality of the performance (stages) was assessed. The second set of tests was comprised of six skills, on which the quantity of the performance was assessed (see Appendix K for a sample form). The test items were selected based upon a review of the literature and included skills within the repertoire of a normal elementary school-age child. A pilot study was conducted to determine the adequacy of the procedures as well as the estimated number of trials necessary for obtaining consistency in performance. The materials utilized for the testing were:

- a room that was part of the Center for the Study of Human Performance at Michigan State University. The floor was made of non-slippery rubber material, installed for motor performance testing.

- the gym and outside area at schools where children were enrolled.

- a mat, 4' x 8', used for the standing long jump and figure 8 run tests.

- a pencil to take notes.

- a stopwatch to assess performance on all the quantitative test items, except the dynamic balance.

- a score sheet.

- masking tape to mark the distances in the agility run, secure the measuring tape for the standing long jump, and build the square for the agility jump.

- 3 tennis balls, a 5-1/2" diameter size ball, and a 8" diameter size ball for throwing, catching and kicking skills, respectively.

- a bean bag on which to place the large ball for testing kicking ability.

- 2 blocks of wood (2" x 2" x 4") for the agility run test.

- a balance beam (2" wide x 8' long) to test dynamic balance.

<u>Testing Environment</u>

All subjects were assessed on their knowledge of body parts and on their ability to perform motor tasks by the same examiner and with the same testing materials. The testing was done in a room in the Center for the Study of Human Performance at Michigan State University or in the gymnasium of individual East Lansing schools. The examiner made sure that the testing location was secure from outside disturbances. The subjects were tested individually with only the examiner and the subject present. In situations when a child exhibited shyness or seemed insecure, a parent was allowed to stay while the data were being gathered.

Data Collection

Each child was scheduled for testing by appointment. On the body parts identification test, the child was asked to sit in a chair arranged in such a way that he or she faced the examiner. The parent (who sometimes was asked to stay due to shyness of the child) was instructed to stay in any part of the room, but not to help his or her child during the assessment. The child then was asked by the examiner to identify specific body parts upon request by touching them on his or her own body. Each subject was tested sequentially on each body part listed. A few minutes were allowed for each answer, so the child would not feel pressured by a time limit. However, it only took about five minutes to administer the test.

After the subject was assessed on knowledge of body parts (TSBP), the battery of motor skills test was administered. The test battery consisted of two parts: 1) a qualitative assessment of running, catching, throwing, hopping, skipping, kicking, and jumping where the child was classified according to his or her stage of performance on each skill; and, 2) a quantitative assessment of the standing long jump, a speed and agility run, a one foot balance test, a beam walk, a figure 8 run, and an agility jump where the child was classified according to his or her best score (in time, inches or number of jumps) on each of the motor tasks.

In the qualitative assessment of running, skipping, kicking and jumping, the score was the most consistent pattern observed in three fair trials. A total of 8 trials were administered for the catching task. Two trials were administered at each of two distances using two different size balls. The score was the most consistent pattern for each size ball. The throwing score was the most consistent pattern out of 5 trials. For hopping, a score was given for the most consistent pattern observed during the pre-established number of trials. Additional trials were allowed until some consistency in performance was observed.

To provide objectivity in the measurements and to decrease bias in judgment on the qualitative assessments, the tester watched films and made use of a summary table containing the stages of motor skills to be tested. Substantial prior experience in observing children also should have helped in the accuracy of the data collected.

In the quantitative assessment, the speed and agility run (AGIL RUN), dynamic balance (BALANCE), figure 8 run (FIG 8 RUN), and agility jump (AGIL JUMP) tasks involved 2 fair trials each. The distance jump required 3 trials and the balance task involved 4 trials, 2 on each leg. The best score in seconds or inches was recorded as the subject's score.

The motor performance test battery was administered in the Center for the Study of Human Performance at Michigan State University and in the gymnasium of each individual school of East Lansing. It took from 45 to 50 minutes to administer the test.

In order to be successful, gain the confidence and cooperation of children, the following steps were carefully observed.

1. Some time was taken for introductions and generalities.
2. The test was administered in an informal and enjoyable atmosphere.
3. The test was not done in a hurry. Enough time was given for the child to execute the tasks at his or her own pace.
4. Verbal encouragement was given to maximize effort.

At the end of the testing session, a lollypop was given to the child as a reward for participating in the study.

Data Analyses

The descriptive statistical analyses were employed to provide information on knowledge of body parts and stages on fundamental motor skills. A two-way analysis of variance ($p<.05$) was used to test for group (NOR and GMD) and gender differences on the total scores of body parts (TSBP). Multivariate analysis of variance (MANOVA) was conducted to determine differences among children in their performance on the motor skills. Discriminant function analysis was used to identify those variables, if any, that discriminated between the groups. Discriminant classification analysis was run to provide information on group membership. A Pearson Product Moment correlation matrix was computed to determine the relationship between knowledge of body parts (TSBP) and motor skill performance. An additional multivariate analysis of variance was run, including TSBP as a dependent variable, to account for any significant relationship between body image and the motor skill scores. The 0.05 level of significance was established for all tests.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to compare the performance of normal children (NOR) to that of children with gross motor dysfunction (GMD) on a measure of body image and on selected gross motor skills. In addition, the relationship between body image and motor skill performance was examined.

This chapter is divided into three major sections. Each section contains results and a discussion of the results as they pertain to one of the three hypotheses tested in this study.

HYPOTHESIS ONE

Normal boys and girls have a better body image than boys and girls with gross motor dysfunction, as measured by a body part identification test.

Results

The body image of NOR children and children with GMD was assessed with a 30-item body part checklist. The percentage of children in the two groups that correctly identified each of the 30 items is reported in Table 4.1. Six body parts were correctly identified by all the children. These included the cheeks, chin, thumb, stomach, knees, and

Table 4.1

Knowledge of Selected Body Parts for Normal Children and Children with Gross Motor Dysfunction

Body Parts	Normal & GMD % Correct	Rank	Normal % Correct	Rank	GMD % Correct	Rank
Cheeks	100.0	3.5	100.0	6.5	100.0	3.5
Toes	100.0	3.5	100.0	6.5	100.0	3.5
Stomach	100.0	3.5	100.0	6.5	100.0	3.5
Chin	100.0	3.5	100.0	6.5	100.0	3.5
Knees	100.0	3.5	100.0	6.5	100.0	3.5
Thumb	100.0	3.5	100.0	6.5	100.0	3.5
Forehead	99.5	7.0	100.0	6.5	96.2	7.0
Elbows	96.2	8.0	100.0	6.5	92.4	8.0
Shoulders	94.2	9.5	100.0	6.5	88.5	10.0
Bottom	94.2	9.5	100.0	6.5	88.5	10.0
Jaw	92.4	12.0	100.0	6.5	84.7	12.5
Backbone	92.4	12.0	100.0	6.5	84.7	12.5
Wrists	92.4	12.0	96.2	13.0	88.5	10.0
Ankles	84.6	14.0	88.5	16.0	80.8	14.0
Eyelids	82.7	15.0	88.5	16.0	77.0	15.0
Waist	80.8	16.0	94.2	14.0	69.3	16.5
Heels	76.9	17.0	84.7	18.5	69.3	16.5
Chest	75.0	18.0	84.7	18.5	65.4	19.5
Knuckles	73.1	19.0	88.5	16.0	57.7	22.5
Palms	67.3	20.5	69.3	21.0	65.4	19.5
Ribs	67.3	20.5	77.0	20.0	57.7	22.5
Eyebrows	65.4	22.0	65.4	22.0	65.4	19.5
Soles (of foot)	55.8	23.0	61.6	23.0	65.4	19.5
Hips	53.8	24.0	42.4	25.0	50.0	24.0

Table 4.1. (Continued)

Body Parts	Normal & GMD % Correct	Rank	Normal % Correct	Rank	GMD % Correct	Rank
Earlobes	48.1	25.0	53.9	24.0	42.4	25.0
Shins	28.8	26.0	34.7	26.0	23.1	27.5
Forearms	21.2	27.5	19.3	27.0	23.1	27.5
Thighs	21.2	27.5	15.4	28.0	27.0	26.0
Shoulder Blades	7.7	29.0	3.9	29.5	11.6	29.0
Calf	5.8	30.0	3.9	29.5	7.7	30.0

toes. An additional six body parts were correctly identified by all of the NOR children. They were the forehead, shoulders, elbows, jaw, backbone and bottom. Normal children equalled or surpassed GMD children in identifying all but six of the body parts. Those identified by a greater percentage of the GMD children were the soles, hips, forearms, thighs, shoulder blades and calf.

The average number of body parts correctly identified by NOR children and GMD children was 22.57 and 20.57, respectively (see Table 4.2). In addition, the performance of the NOR children was less variable than that of the GMD children. Means and standard deviations for boys and girls within each group are presented in Appendix A.

A 2-way analysis of variance (ANOVA) was run to determine if groups or genders differed in their knowledge of body parts (TSBP). Analysis of the computed scores for number of correct body parts identified showed that the NOR children did not perform significantly better than the GMD children (see Table 4.3).

The ANOVA resulted in F-values that failed to reach the criterion level of significance for the group and gender main effects as well as the group by gender interaction. Thus, the research hypothesis is not supported and it is concluded that NOR children do not differ significantly from GMD children in their body image as measured by knowledge of body parts. In addition, boys and girls do not differ in their ability to identify body parts.

Table 4.2

Means and Standard Deviations for Performance on Motor Skills and Body Parts Identification Tests; Normal and GMD Children

	Normal		GMD		Total	
Variable	Mean	S.D.	Mean	S.D.	Mean	S.D.
TSBP[1]	22.57	3.11	20.57	4.53	21.57	3.98
STAGETOT[2]	38.69	4.05	30.73	8.02	34.71	7.47
DIST JUMP	47.34	7.91	42.05	11.56	44.70	10.17
AGIL JUMP	18.80	6.05	15.03	5.82	16.92	6.18
AGIL RUN	12.66	1.18	14.42	2.11	13.54	1.91
FIG 8 RUN	6.74	0.65	8.41	1.17	7.58	1.26
L BALANCE	9.73	0.95	8.88	2.17	9.31	1.71
R BALANCE	10.00	0.00	9.06	2.20	9.53	1.61
BALANCE	4.92	0.39	3.73	1.80	4.32	1.42

[1] Total score of body parts identification test.
[2] Sum of stages for selected motor skills.

Table 4.3

Analysis of Variance Comparing Body Part Knowledge of Children; By Group and Gender

Effect	Sum of squares	Degrees of Freedom	F-Value	Sig. of F*
Group	52.00	1	3.428	.070
Gender	28.50	1	1.879	.177
Group-Gender	0.09	2	0.006	.939

*Significance established at the .05 level (p<.05).

<u>Discussion</u>

The results obtained from the statistical analysis indicated that knowledge of body parts was not significantly different among children in terms of group or gender. Inspection of the means and standard deviations between and within groups shows that NOR children knew more body parts than the GMD children and that the girls from both groups scored higher than the boys (see Appendix A). However, these differences were not significant at the .05 level.

The characteristics of the GMD children in this study might be one explanation for the lack of a significant difference among the subjects. Selection of children from a waiting list for a remedial motor program and referral by physical education teacher were procedures carefully followed in order to obtain children with gross motor problems. These subjects did not receive extra amounts of skill practice beyond their regular physical education in the school, as was reported by their parents before the testing sessions. Perhaps this group of children did not possess serious problems in their sensory and perceptual systems, deficiencies often observed in children with gross motor problems. They may have been exposed to sources of information other than physical activities such as T.V. programs (Seasame Street) and/or books which improved their knowledge of body parts. The small sample size also might be an explanation for the lack of difference between groups since the significance of the group F-value (.07) was close to the

.05 value of significance set for this test.

HYPOTHESIS TWO

Normal boys and girls perform better qualitatively and quantitatively on selected motor skills, than boys and girls with gross motor dysfunction.

Results

The qualitative performance of NOR children and children with GMD was assessed on eight fundamental motor skills using the stage approach. Frequencies and percentages of children in each stage for each motor skill are presented in Table 4.4. The skills are composed of three stages (skip), four stages (run, hop, jump, kick), or five stages (throw, catch). To compensate for the differences in the number of stages and to statistically analyze the qualitative data obtained from the fundamental motor skills, each motor skill was weighted equally. In this way, skipping, which is composed of three stages, could be analyzed in conjunction with catching, which has five stages.

Four motor skills were performed at the more mature stages by both the NOR and the GMD children. These included running, skipping, throwing and catching. Hopping also was performed at the more mature level, but only by the NOR group of children. Running was the most advanced skill with the mature stage (Stage 4) exhibited by 92% of the NOR children and 54% of the GMD children. Normal children were less skilled in jumping and kicking than in running,

Table 4.4

Qualitative Performance on Fundamental Motor Skills for NOR and GMD Subjects.

		Pre-Stage				Stage One				Stage Two				Stage Three				Stage Four				Stage Five			
		NOR		GMD		NOR		GMD		NOR		GMD		NOR		GMD		NOR		GMD		NOR		GMD	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
RUN		0	0	0	0	0	0	0	0	2	7.6	3	11.5	0	0	9	34.6	24	92.3	14	53.8	No Stage			
JUMP		0	0	0	0	1	3.8	9	34.6	11	42.3	12	46.1	11	42.3	5	19.2	3	11.5	0	0	No Stage			
HOP		0	0	0	0	1	3.8	3	11.5	2	7.6	13	50.0	9	34.6	8	30.7	14	53.8	2	7.6	No Stage			
SKIP		1	3.8	3	11.5	1	3.8	4	15.3	0	0	8	30.7	24	92.3	11	42.3	No Stage				No Stage			
KICK		0	0	0	0	0	0	2	7.6	2	7.6	12	46.1	17	65.3	12	46.1	7	26.9	0	0	No Stage			
THROW		0	0	0	0	0	0	2	7.6	0	0	3	11.5	3	11.5	8	30.7	9	34.6	7	26.9	14	53.8	6	23.0
CATCH 10'	SML	0	0	0	0	0	0	3	11.5	0	0	0	0	3	11.5	5	19.2	2	7.6	5	19.2	21	80.7	13	50.0
	MED	0	0	0	0	0	0	2	7.6	0	0	1	3.8	2	7.6	7	26.9	4	15.3	9	34.6	20	76.9	7	26.9
CATCH 15'	SML	0	0	0	0	0	0	3	11.5	0	0	0	0	4	15.3	3	11.5	6	23.0	8	30.7	16	61.5	12	46.1
	MED	0	0	0	0	0	0	3	11.5	0	0	0	0	2	7.6	7	26.9	7	26.9	7	26.9	17	65.3	9	34.6

NOR = 26

GMD = 26

skipping, throwing and catching. In addition to kicking and jumping, GMD children had difficulty hopping at the more mature stages. Four of the 52 children could not skip.

The mean scores for the stages summed across the eight motor skills (STAGETOT) for NOR children and GMD children were 38.69 and 30.73, respectively (see Table 4.2). In addition, the performance of NOR children was much less variable than that of the GMD children. (Respective means and standard deviations for boys and girls within each group are presented in Appendix A).

The _quantitative_ performance of NOR children and children with GMD was assessed on seven gross motor skills. These included the distance jump (DIST JUMP), agility run (AGIL RUN), figure 8 run (FIG. 8 RUN), left foot balance (L BALANCE), right foot balance (R BALANCE), and balance beam walk (BALANCE WALK). The means and standard deviations for the motor skill performance of the NOR and GMD children are presented in Table 4.2. Overall, the NOR children obtained better mean scores than the GMD children on all seven motor tasks. Normal children differed only slightly from GMD children on three motor skills. These included the left foot balance, right foot balance, and balance beam walk. In addition, the performance of the NOR children was less variable than that of the GMD children. (Means and standard deviations for boys and girls within each group are presented in Appendix A.)

A multivariate analysis of variance (MANOVA) was run to determine if significant differences existed among the children (by group, gender or interaction) according to their performance on the eight dependent variables. These were sum of stages, distance jump, agility jump, agility run, figure 8 run, left foot balance, right foot balance, and balance beam walk. A summary of the MANOVA results is presented in Table 4.5. Group and gender main effects were significant at the .05 level. However, no significant interaction was observed between group and gender. Thus, the results of the MANOVA showed that children differed in their performance on the gross motor skills according to their status as NOR or GMD and as boy or girl.

Table 4.5

Multivariate Analysis of Variance on Performance of Selected Gross Motor Skills Test; By Group and Gender

Effect	Approx. F	Hypoth. df	Error df	Sig. of F
Group	6.00055	8.00	41.00	.005*
Gender	2.72716	8.00	41.00	.017*
Gender by Group	1.10767	8.00	41.00	.378

*F-Value significant at .05 level ($p<.05$).

Separate discriminant function analyses (of the dependent variables) was run to provide information about the best discriminating variable(s) that distinguished between the groups (NOR, GMD) and gender (M, F). A summary of the discriminant analysis results is presented in Table 4.6. A significant discriminant function for groups was found ($X^2_{(3)}$=34.61, p<.001). Analysis of the computed scores showed that three dependent variables differentiated the NOR children from the GMD children. The variables in descending order of contribution were the figure 8 run, agility run, and total sum of the stages. In addition, a significant discriminant function for gender was found ($X^2_{(6)}$=16.31, p<.012). Six dependent variables were found to differentiate the boys from the girls. The variables in descending order of contribution were agility run, total sum of the stages, right foot balance, balance beam walk, figure 8 run, and left foot balance.

The results of the discriminant analysis showed that three variables discriminated between NOR and GMD children, and six variables discriminated between boys and girls. These were the variables that contributed the most in differentiating children on the basis of groups and gender.

A discriminant classification analysis technique was used to provide information on the children's group membership. A summary of the classification results is presented in Table 4.7.

Table 4.6

Standardized Discriminant Coefficients of Selected Gross Motor Skills Tests; By Group and Gender

Variable	Normal/GMD Function 1	Males/Females Function 1
STAGETOT	.46162	1.39692
DIST JUMP	* * *	* * *
AGIL JUMP	* * *	* * *
AGIL RUN	.95802	1.56305
FIG. 8 RUN	-1.36921	-.58861
L BALANCE	* * *	-.55317
R BALANCE	* * *	.96872
BALANCE WALK	* * *	-.91120
Eigenvalue	1.04145	.41508
Canonical Correlation	.7142496	.5415974
Chi-Square	34.61	16.31
Significance	.001	.0121
degrees of freedom	3	6

* * * Motor skill test not included in discriminant function.

Table 4.7

Internal Classification Results for Group Membership

Actual Group	Number of Cases	Predicted Group Membership 1	2
Group 1	26	25	1
Normal		(96.2%)	(3.8%)
Group 2	26	6	20
GMD		(23.1%)	(75.9%)

Percent of cases correctly classified = 86.5%

Boys	36	25	11
		(69.4%)	(30.6%)
Girls	16	5	11
		(31.3%)	(68.8%)

Percent of cases correctly classified = 69.2%

The classification of children into group membership showed that performance on three variables (figure 8 run, agility run, sum of the stages) correctly classified 86.5% of the children as NOR and GMD. From the NOR group, 3.8% of the children performed as GMD, while 23.1% of the GMD children performed as NOR. The group membership classification for gender showed that performance on six variables (figure 8 run, agility run, sum of the stages, left foot balance, right foot balance, balance beam walk) correctly classified 69.2% of the children. There were 30.6% of boys who performed as girls and 31.3% of girls who performed as boys (see Table 4.7).

Discussion

The analysis of the internal classification of children into group membership shows that the percentage of GMD children classified as NOR is high, when compared to the classification of NOR children to the GMD group. The high percentage of GMD children (23.1%) in the NOR group might be due to several factors such as: (1) the capacity of the test items to discriminate NOR from GMD children, and (2) the accuracy of teachers in identifying GMD children.

The appropriateness of the items could be considered as a factor in the classification of children if the test items were not powerful enough to contribute to the differences between the groups. The performance of children on the motor test showed that some of the test items did not contribute significantly to the difference between the two groups, while others did. This lack of significance was probably due to characteristics such as ease of performance which resulted in a ceiling effect, or items that measured the same attributes, and therefore were selectively dropped during the statistical analysis.

The second possible explanation may lie in the selection criteria used by the physical education teachers, who identified GMD children according to their performance during a regular physical education class. Most physical education classes usually require group participation, and some children, due to social and emotional problems may perform less well in a group setting than in a one-to-one situation. Thus, some children identified as having GMD may, in fact, be capable of performing normally when tested on an individual basis. The impact of personal and social variables on performance was not controlled in the selection of subjects for this study.

The results of the statistical analysis of the motor skills performance data revealed that NOR boys and girls performed better qualitatively and quantitatively than boys and girls with GMD. Inspection of the means and standard deviations in Table 4.2 revealed that GMD children scored consistently lower on all test items when compared to the NOR children. This difference in performance was found despite the NOR and the GMD children being matched by age and gender. These results are in agreement with findings reported in the literature (Cratty, 1967, 1972; Bruininks, 1978; Haubenstricker, 1981). The greater inconsistency in performance of children in the GMD group, a characteristic observed in young children at early stages of learning, also may have influenced their scores.

The qualitative performance on the fundamental motor skills contributed significantly in differentiating the NOR children from the GMD children (see Table 4.6). A greater percentage of the NOR children reached the more mature forms of performance when compared to the GMD children (see Table 4.4). More mature perceptual-motor systems along with other factors such as better eye-hand coordination, better attention to specific stimuli, and more mature rehearsal strategies might help explain the superiority of the NOR children over the GMD children.

The fact that the greatest percentage of children exhibited the most mature stage of running (Stage 4) is in accord with the intraskill developmental sequence for the acquisition of motor skills. This finding was expected, since none of the children tested presented a physical handicap, mental retardation and/or other similar characteristics.

The form used in catching a 5-1/2 inch ball and a tennis ball at distances of 10 and 15 feet showed that catching a 5-1/2 inch ball was more difficult at Stage 5 than catching a tennis ball (see Table 4.4). The tennis ball was generally caught with both hands at either distance, while the 5-1/2 inch ball was caught with both hands at 10 feet and with hands and chest at 15 feet. The size of the ball apparently was a factor that forced children to regress to more immature forms of catching, thereby, explaining the decreased percentage of children in Stage 5 for the medium-size ball. This finding is in agreement with that found by Victors (1961) and Isaacs (1980). However, the regression in the catching pattern for the arms was not accompanied by the ability of the children to change position (move) in space, as one might expect. This was true both for NOR children and children with GMD. The regression observed for the arms clearly demonstrated that in order to correctly analyze a child's movement behavior and provide qualitative feedback to improve performance, each component of the skill must be evaluated separately. However, a global assessment of the body must also occur, since the whole body participates in the act of catching. The poorer performance of the GMD group might be due to poor eye-hand coordination, inefficient spatial-temporal perception or other characteristics such as the inability to focus attention on a specific stimulus, i.e., the ball. The inability to select cues from the environment to improve performance is a characteristic of young children and children with perceptual problems (Thomas, 1984). This characteristic is observed in children until about age 6 which is the age level at which the GMD children are performing. The superiority of males from either group might be due to socio-cultural factors, where ball playing is a boy type of activity, encouraged from early ages.

The skipping skill was the only motor task in which very immature forms of movement were noted. The coordination of a step-hop sequence is a difficult task to master. This was true for NOR children and children with GMD. There was some avoidance among the GMD boys to perform this task, probably because they were conscious of their lack of success.

Jumping and kicking were two skills that were difficult to perform at the more mature stages for both groups of children. In the jumping skill, the coordination of movements involving the arms and legs was a difficult task to be accomplished by the NOR children and much more difficult for the GMD children. However, this was expected. The fact that children with GMD performed at lower stages than their normal peers is consistent with other findings (Cratty, 1967, 1972). The kicking skill of the NOR children also is consistent with that found by others (Way et al., 1979), but no studies of kicking were located in the literature for children with GMD at this age period. The throwing and hopping skill levels of NOR children were in agreement with other studies (Haubenstricker et al., 1983; Way et al., 1979, respectively). In general, GMD children were found to lag behind the NOR children one to two stages on most of the skills. In the skills of skipping, catching and running, they were delayed one stage. For jumping, hopping, kicking, and throwing, they were behind 2 stages (see Table 4.4).

The delays observed in this study are consistent with observations of others (Cratty 1967, 1972).

The quantitative assessments also differentiated the NOR children from the GMD children (see Table 4.6). The figure 8 run and agility run are tasks that require motor planning, understanding of a serial organization, and attention. The performance of a run with an object in hand (agility run) might have divided the children's attention, decreasing the performance of the GMD children, and thereby increasing the power of this test as a discriminant variable between the NOR and GMD children (see Table 4.6). For more details, a summary of the means and standard deviations within and between groups is presented in Appendix A. The three measures of balance did not generate sufficient power to discriminate NOR children from children with GMD (see Table 4.2). These measures were too easy to perform and many children reached the highest possible score (ceiling effect). However, a difference was found between boys and girls, favoring the girls. The agility jump and distance jump did not discriminate between groups or gender. This may be because these two tasks are related to other tasks in the battery and therefore were dropped from the analysis or they are not common activities engaged in by children.

HYPOTHESIS THREE

Knowledge of body parts is significantly related to performance on selected gross motor skills.

Results

The relationship between body parts knowledge and performance on selected motor skills was assessed by correlating the total scores of the Body Parts Identification Test (TSBP) with the scores of all motor skills. The Pearson Product Moment correlation coefficients by groups and gender are reported in Table 4.8. The .05 level was the criterion employed to determine the significance of the individual intercorrelation coefficients. Twenty-six of the thirty-two correlation coefficients obtained were significant. There was an overall tendency for correlations to be positive and of a moderate value, indicating a relationship between TSBP and measures of motor performance. Five of the eight motor items did not correlate significantly ($p>.05$) with TSBP in the NOR group. These were the agility run, figure 8 run, left foot balance, balance beam walk, and right foot balance, with correlations ranging from a low of .02 to a high of .30. All correlation coefficients were significant at the .05 level ($p<.05$) for the GMD children, except the figure 8 run for girls, which had a correlation coefficient of .38. The coefficient values for the three balance tests for the GMD girls were of the same magnitude (.45). The highest correlation coefficient was .66 for TSBP and the distance jump.

Table 4.8

Intercorrelation Coefficients Between Knowledge of Body Parts and Selected Measures of Motor Performance; By Group and Gender

	TSBP			
	GROUP		GENDER	
Variable	NOR	GMD	Boys	Girls
STAGETOT	38[a]*	45*	52*	52*
DIST JUMP	38*	66*	66*	42*
AGIL JUMP	56*	43*	48*	58*
AGIL RUN	-30	-60*	54*	57*
FIG 8 RUN	-15	-38*	40*	38
L BALANCE	4	47*	38*	45*
R BALANCE	**	64*	62*	45*
BALANCE	-02	59*	52*	45*

[a] Decimal points have been omitted. Normal (N=26); GMD (N=26); Boys (N=36); Girls (N=16).

* Significant at the .05 level (p<.05).

** Not computable due to ceiling effect in the performance scores.

Discussion

According to the results obtained from the intercorrelations between TSBP and gross motor skills, it was concluded that knowledge of body parts is related to motor performance, but more so for GMD children than for the NOR children (see Table 4.8). Age, motor skills, maturity level, and movement experiences were factors considered to explain this relationship.

Age and motor skills were considered together, in order to observe performance of the children in those skills characteristic of their age and maturity level. Children with GMD performed at lower levels on the motor skills than the NOR children. This was expected and supported by data from other studies (Bruininks, 1977; Haubenstricker et al., 1981; Cinelli and DePaepe, 1984). Young children rely on sensations and perceptions through movement to acquire knowledge about themselves and the environment. This was observed in the GMD children when they were asked to localize a specific body part. They placed their hands on the body, trying to "feel" and find the body part requested. This behavior also was observed with the younger children of the NOR group, although not as intensely. The greater dependency on sensory-perceptual and perceptual-motor systems by the GMD children, might explain their need for movement experiences in order to develop motor and cognitive proficiency. This relationship between movement and cognition was observed on the correlations obtained for the GMD group. They were all significant and of moderate value, ranging from a low of .38 to a high of .66 (see Table 4.8). The NOR group, on the other hand, presented significant correlations for only three variables out of eight. These were sum of stages, distance jump and agility jump. Their correlations with TSBP were .38, .38, and .56 respectively. The correlations for the first two variables were of low value and of little practical consequence. The significant and moderate correlation between the agility jump and TSBP for the NOR group may be due to the higher levels of cognitive function required to jump from side-to-side since this task was not a very familiar task for the children. Figure 8 run, agility run, and the three balance variables did not correlate significantly with TSBP for the NOR group. It seemed that the figure 8 run and agility run were not difficult to perform. An important factor to be considered is that some NOR children from one of the schools were exposed to similar tasks during their physical education class, thus eliminating the novelty effect. The GMD children, on the other hand, although some of them also had been exposed to such tasks, still relied considerably on cognitive processes to perform the tasks. The figure 8 run and agility run require processes such as understanding the task, motor planning, and attention when running with an object in hand. These characteristics are known to negatively influence the performance of the GMD children (Ayres, 1972; Cratty, 1972; Thomas, 1984).

The three balance tasks did not yield significant correlations. They were easy to perform, probably did not require any significant cognitive processing, therefore many children were successful which contributed to a ceiling effect. For example, the right foot balance correlation for the NOR group was not computable because all children scored the highest possible value. In relation to gender, all variables were significantly correlated for boys and girls, except figure 8 run for girls (see Table 4.8). No plausible reason was found to explain the lack of a significant correlation for this test.

Overall, the relationship between TSBP and motor performance was significant for the GMD group. Their less mature neurological system demanded greater cognitive and motor processing to perform the motor skills. The inability to motor plan, to attend to specific cues related to the tasks, and inadequate understanding were some of the possible reasons for their inferior performance.

Since some of the Pearson Product Moment correlation coefficients obtained between TSBP and gross motor skills were found to be of a moderate magnitude (.66), a further exploratory investigation (MANOVA) was undertaken to find whether TSBP would significantly contribute to the differences between groups, gender, or group-gender interaction. The inclusion of TSBP as a dependent variable did not affect the overall results of the three effects reported previously (compare Table 4.9 to Table 4.5). Total scores of body

Table 4.9

Composite Scores in the Multivariate Analysis of Variance on Knowledge of Body Parts and Motor Performance Tests; By Group and Gender

Effect	Approx. F	Hypoth. df	Error df	Sig. of F
Group	5.61281	9.00	40.00	.005*
Gender	2.60687	9.00	40.00	.018*
Group-Gender	.96778	9.00	40.00	.482

* F-value significant at .05 level ($p<.05$).

parts (TSBP) was significant in discriminating differences between boys and girls, but not between NOR children and children with GMD (Table 4.10).

Table 4.10

Standardized Coefficents from Discriminant Analysis
with Knowledge of Body Parts as Dependent
Variable; By Group and Gender

Variable	Normal/GMD Function 1	Males/Females Function 1
TSBP	* * *	-.63616
STAGETOT	.46162	1.57178
DIST JUMP	* * *	* * *
AGIL JUMP	* * *	* * *
AGIL RUN	.95802	.96929
FIG 8 RUN	-1.36921	* * *
L BALANCE	* * *	-.67435
R BALANCE	* * *	1.42164
BALANCE	* * *	-.91915
Eigen value	1.041	.465
Canonical Corr.	.714	.571
Chi-square	34.61	18.60
Significance	.001	.004
Degrees of freedom	3	6

* * * Motor skill tests not included in discriminant function.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the relationship between knowledge of body parts, a measure of body image, and performance on selected gross motor skills. The subjects of this study were 18 boys and 8 girls who were normal in their motor development, and 18 boys and 8 girls with gross motor dysfunction. They ranged in age from 62 to 144 months. The subjects were matched by age and gender. Both groups were tested on body image and motor skills. Body image was assessed with a 30-item checklist. The motor performance test consisted of a battery of 7 qualitative and 7 quantitative tests. Qualitative assessments were made of running, catching, throwing, hopping, kicking, skipping, and jumping where the child was classified according to his or her stage of performance on each skill. Quantitative assessments were obtained on the standing long jump, a speed and agility run, a one foot balance test, a beam walk, a figure 8 run, and an agility jump. Each child was scored according to his or her best score in time, inches or number of repetitions. The children were tested individually and by the same examiner. It took 45 to 50 minutes to administer the tests.

A two-way analysis of variance for the total scores of body parts revealed that no significant difference existed between the two groups of children and led to the rejection of the hypothesis that normal children differed from GMD children in their knowledge of body parts ($p>.070$). Multivariate analysis of variance procedures were used to determine if any significant difference existed among children in their performance on the motor skills. The results revealed significant group ($P<.005$) and gender ($p<.017$) main effects. Thus, the hypothesis that normal children perform qualitatively and quantitatively better than children with gross motor dysfunction was accepted. A discriminant function analysis was run to determine the variables that discriminated between the two groups. The results revealed that the figure 8 run, agility run and sum of stages scores had important roles in differentiating the normal children from children with gross motor dysfunction. A similar analysis showed that gender differences were determined by the sum of the stages, agility run, right foot balance, left foot balance, balance beam walk, and figure 8 run scores. A discriminant classification analysis was run to provide information on group membership. The results revealed that children were better classified into normal or gross motor dysfunction groups (86.5%) than as boys and girls (69.2%).

A Pearson Product Moment correlation matrix was generated to determine the relationships between knowledge of body parts and motor skill performance. The results indicated that there was a significant positive correlation between knowledge of body parts and performance on selected motor skills. All eight motor scores for the children with GMD correlated significantly with knowledge of body parts, while only three out of the eight measures were significantly correlated with knowledge of body parts for the normal group. All motor skill variables were significantly correlated with knowledge of body parts for boys and girls, except the figure 8 run for girls. The hypothesis that total scores of body parts was significantly related to motor skills performance was accepted, although the correlations were of low or moderate magnitude.

An additional multivariate analysis of variance was run with total scores of body parts included as a dependent variable in order to further investigate its contribution to group and gender differences. Although significant group and gender main effects were obtained, discriminant function analysis failed to identify TSBP as a discriminant variable between the normal and gross motor dysfunction groups. However, TSBP contributed to differences in performance between boys and girls.

Conclusions

Within the limitations of this study, the results obtained from the performance of two groups of boys and girls on body parts identification and motor performance tests permit the following conclusions to be drawn:

1) Normal children do not differ from GMD children in their knowledge of body parts.
2) Normal children perform better on qualitative and quantitative motor tests than GMD children.
3) There are significant relationships between knowledge of body parts and performance on gross motor skills for normal children and for children with gross motor dysfunction. These relationships are stronger in GMD children than in normal children. However, the magnitude of these correlations are not high enough to be of value in predicting performance.
4) Boys and girls do not differ significantly in their knowledge of body parts.
5) Boys and girls do differ significantly in their performance of selected gross motor skills.
6) The performance of boys and girls on motor skills correlated significantly with their knowledge of body parts.
7) Children with gross motor dysfunction are more variable than normal children in their knowledge of body parts and in their performance on gross motor skills.

Recommendations

Based on the results obtained in this study and some of the problems encountered in conducting the study, several recommendations are proposed:

1) The sample of GMD children in this study was an available sample and of limited size. Moreover, only eight girls were included in this group. The small sample undoubtedly limited the power of the statistical test to detect a significant difference in knowledge of body parts for both the group and gender effect. The F-value for group effect ($p<.070$) approached the criterion significance level set for the test whereas that of the gender effect was slightly higher ($p<.177$). Since the normal children and the girls had higher scores than their respective counterparts on the body parts test, an increase in the sample size may produce significant findings. The small sample size may have prevented the detection of a difference that actually exists.
2) The heterogeneous nature of the children classified as having gross motor dysfunction makes generalization to larger populations and other groups difficult. It is recommended that future studies attempt to divide such children into subcategories based on the characteristics exhibited. For example, GMD children with attentional problems could be placed in one category, whereas those with perceptual deficits could be placed into another. Findings related to such categorizations would be more readily generalized to other groups or individuals with similar characteristics.
3) A third recommendation is that some form of visual record, such as videotape or movie film, be obtained as

part of the assessment procedures. This would permit a more accurate and detailed analysis of the qualitative performance of the children on the motor tasks and provide a basis for subsequent remediation of deficiencies found.

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APPENDICES

APPENDIX A

Means and Standard Deviations on Motor Performance and Body Parts Identification Tests; By Group and Gender

Variable	Normal				GMD					
	Boys		Girls		Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
TSBP	22.11	3.30	23.62	2.50	20.05	4.80	21.75	3.88	21.88	3.62
STAGETOT	38.83	3.82	38.37	4.80	31.55	8.47	28.87	7.05	34.40	6.03
DIST JUMP	47.58	8.25	46.81	7.60	41.27	11.81	43.81	11.57	44.86	9.80
AGIL JUMP	18.11	5.64	20.37	7.02	14.33	5.78	16.62	5.99	17.35	6.10
AGIL RUN	12.75	1.21	12.47	1.17	14.78	2.32	13.61	1.30	13.40	1.50
FIG 8 RUN	6.70	0.57	6.84	0.83	8.48	1.29	8.25	0.88	7.56	0.89
L BALANCE	9.61	1.13	10.00	0.00	8.75	2.16	9.17	2.33	9.38	1.40
R BALANCE	10.00	0.00	10.00	0.00	9.04	2.13	9.11	2.51	9.53	1.16
BALANCE	4.88	0.47	5.00	0.00	3.38	1.88	4.50	1.41	4.44	0.94

APPENDIX B

DEVELOPMENTAL SEQUENCE OF RUNNING

Stage 1. The arms are extended sideward at shoulder height (high-guard position). The stride is short, and of shoulder width. The surface contact is made with the entire foot, simultaneously. Little knee flexion is seen. The feet remain near the surface at all times.

Stage 2. Arms are carried at "middle guard" (waist height), the stride is longer and approaches the mid-saggital line. Contact is usually with the entire foot striking the surface simultaneously. Greater knee flexion is noted in the restraining phase. The swing leg is flexed and the movement of the legs becomes anterior-posterior.

Stage 3. The arms are no longer used primarily for balance. Arms are carried below waist level and may flex and assume a counter-rotary action. The foot contact is "heel-toe." Stride length increases and both feet move along a mid-saggital line. The swing leg flexion may be as great as 90 degrees.

Stage 4. Foot contact is heal-toe at slow or modest velocities but may be entirely on the metatarsal arch during sprint running. Arm action is in direct opposition to leg action. Knee flexion is used to maintain the momentum during the support phase. The swing leg may flex until is is nearly in contact with the buttocks during its recovery phase.

Insufficient movements common to running patterns are: <u>inversion</u> or <u>eversion</u> of the foot during the support phase. Inversion results in a medial rotation of the leg and thigh during the support phase and is characterized by an oblique rather than an anterior-posterior pattern as the leg is brought forward in the swing phase.

Eversion of the foot during the support phase results in lateral rotation of the leg and thigh. This pattern is often accompanied by an exaggerated counter-rotary action of the arms in an attempt to maintain a uniform direction.

APPENDIX C

DEVELOPMENTAL SEQUENCE OF THE STANDING LONG JUMP

Stage 1. Vertical component of force may be greater than horizontal, resulting jump is then upward rather than forward. Arms move backward, acting as brakes to stop the momentum of the trunk as the legs extend in front of the center of mass.

Stage 2. The arms move in an anterior-posterior direction during the preparatory phase, but move sideward (winging action) during the "in-flight" phase. The knees and hips flex and extend more fully than in stage one. The angle of take-off is still markedly about 45°. The landing is made with the center of gravity above the base of support, with the thighs perpendicular to the surface rather than parallel as in the "reaching" position of stage four.

Stage 3. The arms swing backward and then forward during the preparatory phase. The knees and hips flex fully prior to take-off. Upon take-off, the arms extend and move forward but do not exceed the height of the head. The knee extension may be complete but the take-off angle is still greater than 45°. Upon landing, the thigh is still less than parallel to the surface and the center of gravity is near the base of support when viewed from the frontal plane.

Stage 4. The arms extend vigorously forward and upward upon take-off, reaching full extension above the head at "lift-off." The hips and knees are extended fully with the take-off angle at 45° or less. In preparation for landing the arms are brought downward and the legs are thrust forward until the thigh is parallel to the surface. The center of gravity is far behind the base of support upon foot contact, but at the moment of contact, the knees are flexed and the arms are thrust forward in order to maintain the momentum to carry the center of gravity beyond the feet.

APPENDIX D

DEVELOPMENTAL STAGES OF HOPPING

Stage 1. The non-support knee is flexed at 90° or less with the non-support thigh parallel to the surface. This position places the non-support foot in front of the body so that it may be used for support in the event that balance is lost. The body is held in an upright position with the arms flexed at the elbows. The hands are held near shoulder height and slightly to the side in a stabilizing position. Force production is generally limited so that little height or distance is achieved in a single hop.

Stage 2. The non-support knee is fully flexed so that the foot is near the buttocks. The thigh of the non-support leg is nearly parallel to the surface. The trunk is flexed at the hip resulting in a slight forward lean. The performer gains considerable height by flexing and extending the joints of the supporting leg and by extending at the hip joint. In addition, the thigh of the non-support leg aids in force production by flexing at the hip joint. Upon landing, the force is absorbed by flexion at the hips and the supporting knee. The arms participate vigorously in force production as they move up and down in a bilateral manner. Due to the vigorous action and precarious balance of performers at this stage, the number of hops generally ranges between two and four.

Stage 3. The thigh of the non-support leg is in a vertical position with the knee flexed at 90° or less. Performers exhibit greater body lean forward than in stages one or two, with the result that the hips are farther in front of the support leg upon take-off. This forward lean of the trunk results in greater distance in relation to the height of the hop.

The thigh of the non-support leg remains near the vertical (frontal) plane, but knee flexion may vary as the body is projected and received by the supporting leg. The arms are used in force production, moving bilaterally upward during the force production phase.

Stage 4. The knee of the non-support leg is flexed at 90° or less, but the entire leg swings back and fourth like a pendulum as it aids in force production. The arms are carried close to the sides of the body, with elbow flexion at 90°. As the non-support leg increases its force production, that of the arms seems to diminish.

APPENDIX E

DEVELOPMENTAL SEQUENCE OF SKIPPING

Stage 1. A deliberate step-hop pattern is employed, an occasional double hop is present, there is little effective use of the arms to provide momentum, an exaggerated step or leap is present during the transfer of weight from one supporting limb to the other, the total action appears segmented.

Stage 2. Rhythmical transfer of weight during the step phase, increased use of arms in providing forward and upward momentum, exaggeration of vertical component during airborne phase i.e., while executing the hop.

Stage 3. Rhythmical transfer of weight during all phases, reduced arm action during transfer of weight phase, foot of supporting limb carried near surface during hopping phase.

APPENDIX F

DEVELOPMENTAL LEVELS OF THROWING
(OVERHAND THROW FOR VELOCITY)

Stage One

1. Vertical (Upward-Backward) Wind-Up
2. Little or No Weight Transfer
3. No Spinal Rotation
4. "Chop" Throw

Stage Two

1. Wind-Up in Horizontal or Oblique Plane
2. Straight-Arm Throw (Sling) In Horizontal or Oblique Plane
3. Block Rotation With Weight Shift to Opposite Foot
4. Follow-Through Across Body

Stage Three

1. High (Upward-Backward) Wind-Up
2. Forward Stride With Ipsilateral Foot
3. Hip Flexion, Arm Movement in Vertical Plane
4. Little Trunk Rotation
5. Follow-Through Across Body

Stage Four

1. High (Upward-Backward) Wind-Up
2. Forward Stride With Contralateral Foot
3. Trunk/Hip Flexion, Arm Movement Forward, Elbow Extension
4. Limited Trunk Rotation
5. Follow-Through Across Body

Stage Five

1. Low (Downward-Backward) Wind-Up
2. Body (Hip-Shoulder) Rotation
3. Forward Stride With Contralateral Foot
4. Sequential De-Rotation for Force Production
5. Arm-Leg Follow-Through

APPENDIX G

DEVELOPMENTAL LEVELS OF CATCHING
(TWO HANDS - NO GLOVE)

Stage One

1. Arms Extended Forward
2. Little Response to Flight of Object
3. Object Usually Trapped Against Chest

Stage Two

1. Arms Extended Laterally
2. Arms Encircled Object (Hugging Action)
3. Object Trapped Against Chest

Stage Three

1. Arms Extend Forward
2. Arms Move Under Object (Scooping Action)
3. Object Trapped Against Chest

Stage Four

1. Arms Extended to Meet Object
2. Hands Contact Object
3. Arms/Body "Give" to Absorb Force
4. Object is Caught With the Hands Alone

Stage Five

1. Locomotion Required to Intercept Object
2. Stage Four Behavior Follows
3. Regression to Stage Three May Occur

APPENDIX H

DEVELOPMENTAL SEQUENCE OF KICKING

Stage 1. <u>Preparatory Phase</u> - The performer is usually stationary and positioned near the ball. If the performer moves prior to kicking, the steps are short and concerned with spatial relationships rather than attaining momentum for the kick.

<u>Force Production</u> - The thigh of the kicking leg moves forward with the knee flexed and is nearly parallel to the surface by the time the foot contacts the ball. Knee joint extension occurs after contact, resulting in a <u>pushing</u> rather than a striking action. Upper extremity action is usually bilateral, but may show some opposition in older performers. (If the performer is too far from the ball as the extremity moves to meet the ball, the knee flexes only slightly and the leg swings forward from the hip in a pushing action).

<u>Follow-through Phase</u> - The knee of the kicking leg continues to extend until it approaches 180°. If the trunk is inclined forward following contact with the ball, the performer will step forward to regain balance. If the trunk is leaning backward, the kicking leg will move backward after ball contact to achieve body balance.

Stage 2. <u>Preparatory Phase</u> - The performer is stationary. Initial action involves hyperextension of the hips and flexion at the knee so that the thigh of the kicking leg is behind the mid-frontal plane. The arms may move into a position of opposition in situations of extreme hyperextension at the hips.

<u>Force Production</u> - The kicking leg moves forward with the knee joint in a flexed position. Knee joint extension begins just prior to foot contact with the ball. Arm-leg opposition occurs during the kick.

<u>Follow-through Phase</u> - Knee extension continues after the ball leaves the foot, but the force of the kick usually is not sufficient to move the body forward. Instead, the performer usually steps sideward or backward.

Stage 3. Preparatory Phase - The performer takes one or more deliberate steps to approach the ball. The support leg is placed near the ball and slightly to the side of it.

Force Production - The kicking foot stays near the surface as it approaches the ball resulting in less flexion than in stage two. The trunk remains nearly upright, thereby preventing maximum force production. The knee begins to extend prior to contact. Arm-leg opposition is evident.

Follow-through Phase - The force of the kick may carry the performer past the point of contact if the approach was vigorous. Otherwise, the performer may remain near the point of contact.

Stage 4. Preparatory Phase - The approach involves one or more steps with the final "step" being an airborne run or leap. This permits hyperextension of the hip and flexion of the knee as in stage two.

Force Production - The shoulders are retracted and the trunk is inclined backward as the supporting leg makes contact with the surface and the kicking leg begins to move forward. The movement of the thigh nearly stops as the knee joint begins to extend rapidly just prior to contact with the ball. Arm-leg opposition is present as in the previous two stages.

Follow-through Phase - If the forward momentum of the kick is sufficient, the performer either hops on the support leg or scissors the legs while airborne in order to land on the kicking foot. If the kicking foot is not vigorous, the performer may merely step in the direction of the kick.

APPENDIX I

College of Education

Department of Health and Physical Education

January 15, 1983

Dear Parents:

An area of great interest to educators and parents is the development of children's ability to recognize their own body parts, their individual bodies as a unit, and how efficiently they can maneuver their bodies in a variety of play situations. The major question related to this aspect of children's development is how well young children can recognize their own body part and the relationship of such knowledge to their performance on skills like running, catching, and throwing. The results of some research studies show that as children grow older, a greater number of body parts can be identified, and also that children progressively improve in their performance on fundamental motor skills. Since no study has been done relating these two factors to each other, it seem appropriate to determine if there is any relationship between high and low knowledge of body parts and high and low levels of performance on selected fundamental motor skills.

The project is being supervised by Dr. John Haubenstricker, Dr. Crystal Branta and Dr. Vern Seefeldt, from the Department of Health and Physical Education at Michigan State University. It will be conducted during the Winter and Spring terms. Testing will take place in the IM Sports Circle Building or in the Erickson Laboratory both at Michigan State University or at individual schools in East Lansing and Lansing.

The first test will examine knowledge of body parts, where the child is asked to point to some part of his/her own body such as the toes or head. The second test will assess the child's level of performance on selected motor skills. Each child will be tested individually. Test results will be treated with strict confidence and the names of subjects will remain anonymous unless specific permission has been obtained from you as parent/guardian. The test will take about fifty minutes to be administered.

Please consider permitting your child to participate in the study. If you agree to allow your child to participate in the study, I will call you to arrange for the testing session. Of course, you may withdraw your child from the study at any time. After the study is completed, I will be happy to provide you with a summary of the results. If you have any questions, please contact me at 351-1954, Dr. John Haubenstricker at 355-4741 or Dr. Crystal Branta at 353-9467.

Please complete the enclosed form and return it to me in the enclosed stamped envelope no later than one week after having received it. Please return the form regardless of your final decision.

I look forward to having your child participate in this special project and anticipate that it will be a rewarding experience for him/her.

Sincerely,

Marianne Zinn

Marianne Zinn
Graduate Student
Motor Development

Crystal Branta

Crystal Branta, Ph.D.
Assistant Professor & Coordinator
Remedial Motor Clinic

John Haubenstricker

Endorsed by: John Haubenstricker, Ph.D.
Professor and Coordinator
Motor Performance Study

Vern Seefeldt

Vern Seefeldt, Ph.D.
Professor and Director
Youth Sports Institute

APPENDIX I

CONSENT FORM

I have read the enclosed letter and abstract and understand their content.

I understand that in the unlikely event of physical injury resulting from research procedures, Michigan State University, its agents, and employees will assume that responsibility as required by law. Emergency medical treatment for injuries or illness is available where the injury or illness is incurred in the course of an experiment. I have been advised that I should look toward my own health insurance program for payment of said medical expense.

I agree/do not agree (circle one) to allow my child ______________________________, to participate in the study of Body Parts Identification and Motor Performance, as described in this letter.

______________________________	____________________	____________
Signature of parent/guardian	Telephone number	Date

______ ______________________ : ______________________ : ____________

APPENDIX J

SCORESHEET - BODY PART IDENTIFICATION

Number ______________________ Sex: M F

Assessment Date: ______________________

Birth Date: ______________________

School: ______________________ City ____________

Examiner: ______________________

	Immediate Accurate Identification	Hesitant Accurate Identification	Inaccurate Identification	No Identification
28. Toes				
24. Soles (of foot)				
17. Knees				
27. Thumb				
6. Chest				
11. Eyelids				
29. Waist				
7. Chin				
13. Forehead				
8. Earlobes				
23. Shoulder Blades				
10. Eyebrows				
14. Heels				
9. Elbows				
30. Wrists				
26. Thigh				
12. Forearm				
20. Ribs				
2. Backbone				
25. Stomach				
15. Hips				
1. Ankles				
5. Cheeks				
3. Bottom				
19. Palms				
21. Shins				
22. Shoulders				
18. Knuckles				
16. Jaw				
4. Calves (calf)				

APPENDIX K

FUNDAMENTAL MOTOR SKILL TEST

Number ______________________________ Sex M F

Assessment Date: __________________________

Birth date: _______________________________

School: ____________________________________ City: ______________

Examiner: _________________________________

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Arm preference Leg preference

right left mixed right left mixed

QUALITATIVE ASSESSMENT

1. running: stage ______, ______, ______, ______.
   1 2 3 4

2. catching:

   distance: 5' stage ______, ______, ______, ______, ______.
   1 2 3 4 5

   10' stage ______, ______, ______, ______, ______.
   1 2 3 4 5

   15' stage ______, ______, ______, ______, ______.
   1 2 3 4 5

3. throwing: stage ______, ______, ______, ______, ______.
   1 2 3 4 5

4. hopping: stage ______, ______, ______, ______.
   1 2 3 4

5. skipping: stage ______, ______, ______.
   1 2 3

6. kicking:

   stationary stage ______, ______, ______, ______.
   1 2 3 4

7. jumping: stage ______, ______, ______, ______.
   1 2 3 4

QUANTITATIVE ASSESSMENT

1.	distance jumped: (keep the best)	________ 1 trial	________ 2 trial	________ 3 trial	(nearest half inch) = ________ best
2.	speed and agility run: (keep the best)	________sec. 1 trial	________sec. 2 trial		= ________ best
3.	balance time: (L) (keep the best)	________sec. 1 trial	________sec. 2 trial		= ________ best
	(R)	________sec. 1 trial	________sec. 2 trial		= ________ best
4.	dynamic balance:	________steps 1 trial	________steps 2 trial		= ________ best
5.	figure 8 run: (keep the best)	∓ = ____sec. 1 trial	∓ = ____sec. 2 trial		(nearest 1/10 secs.) = ________ best
6.	quadrant jump: (keep the best)	± = ____j. 1 trial	± = ____j. 2 trial		= ________ best