A STUDY TO DEVELOP A MOTOR PERFORMANCE SURVEY OF THREE AND FOUR YEAR OLD CHILDREN

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INTRODUCTION TO THE STUDY

Where can parents or educators of preschool children hope to find answers to their questions about the motor development of the young child? How can they be assured that meaningful movement experiences are being provided for the preschool child? Is there a way to discover whether the activities and programs are providing sufficient opportunities for the child to develop mature, quality motor performance? Only by employing some measurement procedures can the parent or educator discover the present status of the child and evaluate the continued progress. A search for answers to these questions leads to the search for an appropriate assessment instrument for preschool children.

Many problems were revealed when the presently available testing instruments were studied; such as, the tests generally require administration by specialists trained in motor development. Quite frequently these tests require a psychometrist or experienced psychological test administrator since the test batteries have combined cognitive, psychological, and psychomotor testing within one instrument.

Tests of this nature are lengthy and demand much time of the administrator and the child. A related problem with these batteries is that they are frequently quite expensive to purchase and must be accompanied by costly materials or supplies for the testing procedure.

Less expensive and less time consuming checklists might suffice if only precursory information concerning the child's development is sought. But such checklists generally employ a pass-fail marking which reveals only if the child has accomplished the movement. The quality or degree of motor performance cannot be determined by the checklists; however, they do not require much training or experience to conduct, nor do they require much time to administer.

If the criteria for the testing instrument demands more definitive answers than checklists provide, many of the tests currently produced are eliminated for the reasons stated: time, expense, background required, and because they fail to employ tasks which can be related to the skills and activities that the child will be learning at this age. The individuals who guide the development of the preschool child have need of an instrument which addresses these specific criteria.

The failure to locate such an instrument which specifically met the demands of measuring and rating the performance of motor behaviors by preschool children led to the research for answers to the problem. The analysis of tests which measure motor performance and development was continued. The problem of selecting criteria and requirements for such as assessment tool was addressed. The specific demands of preparing a useful survey meant treating five related problems. The five related problems were: (1) to determine the criteria for measuring meaningful, quality movement behaviors; (2) to select the appropriate components; i.e., factors of motor performance to be measured; (3) to define how the data would be collected, analyzed, and interpreted; (4) to include tasks which are related to common learning activities

rather than unfamiliar ones; and (5) to give consideration to the time element involved in the administration of the survey. The latter problem was twofold in that not only must the child's attention span be of concern, but the limited time that might be allowed for the parent and preschool educator to conduct testing must be considered.

Still another important item to explore was what guidelines of observable or expected characteristics could help the test administrator define the motor behaviors of preschool children. These guidelines would help provide the framework for observing, collecting, and interpreting the data the survey generates.

Seaman and DePauw (1982) spoke to this matter when they declared:

> Once the observer knows what motor performance to expect an any given age and what the criterion is for a mature or good quality performance, identification of deviations or failures to perform certain expected motor patterns may merely be the result of lack of practice or of insufficient opportunity. Likewise, the performance variations should be expected of individual children, for no two individuals develop or mature at precisely the same rate (p. 165).

Another viewpoint Keogh and DeOreo (1980, p. 96) called attention to was, "When a child is not performing the task adequately, it is important to note what he/she is doing rather than worrying only about what he/she is not doing." This statement indicates that the evaluator may be required to examine their observation practices so that the assessment of the child will be reliable. It is also valuable for the preschool educators and parents to become familiar with motor development guidelines so that they will not coerce or expect certain motor skills to be acquired before the child's maturation and ability have equipped them to achieve that goal.

Need for the Study

Typically, unless some lag in development is noticed, the child may be assessed when he/she is an infant by the physician or pediatrician, and then not evaluated again until the age of five, or pre-kindergarten. This means that during these early years when movement is the primary source for exploration and learning, the evaluation of the child's motor ability is often neglected.

Diem's (1982) investigations of the developing motor capacity of children began in 1968. From this study she concluded: ". . . as a functional area, motor training in early childhood permits the child to make best use of and more fully experience his/her individual competency" (p. 25). The ability to learn to control their bodies and their environment successfully promotes the child's development toward becoming autonomous individuals. But the ages of three and four remain the time when the child is least frequently evaluated.

As long ago as the 1600s the value of motor performance development was realized. Witness to this fact is the statement attributed to Commenius (cited in Quick, 1975), who lived from 1592 to 1677:

> Education should proceed in the following order: First, educate the senses. Then the memory, then the intellect. The child first perceives through the senses, these perceptions are stored in the memory, and called up by the imagination (p. 157).

Other authorities in the profession have attested to the need for preschool programs to provide satisfactory motor performance education. Seefeldt (1971), Sinclair (cited in Seefeldt, 1971), Halverson (1971), Omwake (cited in Halverson, 1971), and Riggs (1980) are but a

few of the professionals who have recommended that more attention should be directed toward the preschool child's motor performance.

The literature concerning the preschool child's development and the role the sensorimotor mode plays as the primary learning modality for early learning experiences are the foundations for later, more complex and abstract learnings (Hunter, 1971; Seaman and DePauw, 1982). Yet, when parents or educators seek to assess the child's motor development progress there are few instruments that they may employ because their knowledge and experience with conducting tests is limited. Many individuals who work with preschool children on a daily basis have not received extensive training in areas which provide the knowledge required for evaluating children's motor or physical performance. This lack of training points to the need to provide easy, inexpensive, and time considerate testing devices for the preschool child's abilities to be measured. There is also the need to provide assessments which reveal whether the activities and progress that are being provided are sufficient to promote the optimal development of the child. Only through such information as the assessments can the preschool educators and parents discover the adequacy or inadequacy of programs that are being provided for the child.

If the appropriate motor behaviors have not been successfully developed, then the curriculum can be altered to promote and encourage essential movement behaviors that are lacking. The longer the child lacks or practices a motor pattern incorrectly, the more difficult will be the process of changing or correcting that pattern (Hottinger, 1980). The preschool educator should become precise at observing the child's performance and be able to demonstrate fairly accurate examples

of movement. They should learn to recognize efficient motor patterns. Patterns such as throwing, catching, and moving in response to rhythms are not inherent but must be taught to the child.

There is evidence that the child's ability to perform motor skills efficiently will not only influence future learnings but future social acceptance and self-perception as well. Briggs (1975, p. 3) reports, "Acceptance from agemates and the mastery of physical and social skills nurture the sense of competence."

As to the influence of motor performance capabilities on self-perception that was alluded to above, Lockhart (1980) stated:

> It is through play that children two to six develop their abilities to move, talk, and work with others; develop their curiosity and self-assurance; develop their attitudes about learning, about objects and people; develop their concepts of self; and extend the length of their attention spans (p. 248).

Furthermore, Lockhart emphasized that all learning and motivation are affected by knowledge of results so that improvement and continued interest demand that the learners be informed of their progress.

Purpose of the Study

The study evolved from the search for a composite instrument for evaluating motor performance of the preschool child. A test was sought which would not be too expensive, too time consuming, nor would it require a large, special testing area. Although the Bayley (1936), the Peabody (1974), the Denver (1982), and the Purdue (1966) tests are used by child development specialists, motor development is only one facet of these tests. The Bruininks-Oseretsky (1978), the Ohio State University Sigma (Seaman and DePauw, 1982), and the California State

University Motor Development Checklist (Seaman and DePauw, 1982) are examples of motor performance tests which may be used during early childhood by persons having some knowledge of assessment. All of these scales would supply information about the child's motor ability but they do require some background knowledge and experience to administer. Some of these scales are not practical because of the expense of testing materials, the space required, or the necessity of having extensive knowledge in human development so as to correctly interpret the findings.

Since it was necessary to develop a motor performance survey which would incorporate the specific needs of the preschool child and would be suited to the qualifications of preschool educators, it was also imperative to consider several related purposes:

1. To examine factor analytic studies that lead to decisions as to which factors should be most important to include as components of this particular survey.

2. To define the characteristics and developmental patterns that influence the observation and evaluation of three and four year old children.

3. To conduct the survey with a sample population of subjects in order to determine the validity and reliability of measurements produced.

4. To determine what the collected data revealed concerning relationships and differences between three year old and four year old children's motor performance.

5. To identify what differences were evident between male and female subjects' motor behaviors as measured by the parameters selected for the survey.

6. Further, the same survey would be administered to the same group of children a second time to provide data which would indicate the consistency of the measurement capacity of the tasks that are included in the survey.

The major intention of this research was to produce a practical assessment survey that would be easy to use and interpret. This means that the individuals who work directly each day with the children concerned would conduct the survey rather than a trained motor develoopent specialist who was not acquainted with the child. Ultimately, the results of the survey would be utilized by the preschool educators and parents to enhance the activities and programs that involve the child.

Statement of the Problem

The primary problem addressed in this research was the development of a survey to assess the level of motor capacity or potential of three and four year old children. The survey addresses the problem of how to generate information about each preschool child's motor performance so that developmental progress, or lack of progress, would be evident.

Subproblems which were addressed by the study are: First, it was necessary to provide a method to determine the reliability of the survey instrument. Secondly, it was essential to address the question of selecting activities or tasks which would measure the range of

performances of three and four year old children. A third subproblem was to determine the differences in the children's performances that were a result of either age or of the sex of the child. Consistent consideration was given to the pursuit of the objectives of presenting an instrument which conformed to the time constraints, which used only materials and space that could be easily provided by the examiner, and which utilized tasks that were consistent with activities that are appropriate for the young child's motor development.

Hypotheses

The hypotheses to be tested in the research are for the purpose of investigating the differences and relationships of the components of the survey and the data generated by the test and retest. The relationships between the selected predictors of motor abilities will be examined and tested for statistical significance. Hypotheses which will explore the various dimensions of the problems are:

1. There is no significant difference between test and retest scores on the 24 items of the survey.

2. There is no significant difference in the development nor in the motor development patterns of the subjects who were randomly drawn for this study.

3. There is no significant difference between boys and girls in the performance of the items selected for the survey.

4. There is no significant difference between the subjects' ages and their motor performance capability.

5. There is no significant difference in the tasks (items) which were selected as being representative of the various motor components.

The statistical hypotheses will be tested by computing the means, standard deviations, and correlation coefficients:

$H = \rho = 0$, where H is the null hypothesis and

$H = \rho \neq 0$, where H is the research hypothesis,

and ρ (rho) = correlation between variables on test and retest.

A test, retest correlation will support the first hypothesis. The correlations between each item on the survey will be computed. The test and retest values will be subjected to statistical treatment to compare responses to the test items.

Limitations of the Study

Time constraints and travel expense resulted in this study being limited to a sample population drawn from a small university community. The community, Stillwater, Oklahoma, has a population of approximately 37,000 and may not be truly representative of other regions of the country, or of larger metropolitan cities with larger and more diverse populations. The sampling process for subject selection was random to minimize the limitations of sample size and location of the study.

The results of the study are limited to locations or environments of this approximate size, but replication of the study in other regions with larger numbers would give indication as to the generalizability of the data. This study was limited to a small number, 30 subjects, and it was not intended to set representative norms for any other than the specified population.

Further limitations were in the test construction criteria; ease of administration, time efficiency, and appropriateness of the tasks to assess motor ability.

A final limitation was that it was not possible to achieve an ethnic and racial mix in the sample because no forms were returned or signed at the Headstart facility that was to participate. No children of the ages to be tested were attending the nursery there at the time the testing was being conducted.

The validity of the items selected as measures is supported by the related literature. But the ability of the subjects to fully comprehend verbal instructions and their willingness to cooperate cannot be predicted. The necessity of demonstrating test items as well as giving verbal instruction is also supported in the related literature chapter. The instruction and demonstration combined afford the subjects more opportunity to understand the activities the survey's performance requires.

In keeping within the time limitations it was not possible to include measurement of all the developing motor patterns such as striking, skipping, and kicking. It was theorized that those patterns may best be evaluated at the time the child is given the pre-kindergarten test batteries.

Assumptions of the Study

It is assumed that parents and preschool educators agree that it is desirable to help the child to achieve mature, efficient movement behaviors at an early age. Such accomplishments, it is theorized, encourage the child to develop independent, self-assured behavior.

A second assumption was that the population sample is normally distributed and truly representative of the population that is being considered. Since only 30 cases can be sampled, it is assumed that sample randomness will allow for means which are close representations of the means of the population.

The third assumption concerning this study was that assessment of preschool children should focus on gross motor and sensorimotor performance. It is understood that perceptual; i.e., sensorimotor and fine motor performance, are inexorably interwoven in the responses of motor behavior the child exhibits. The dimensions, or components, to be selected as measures are chosen as the preferred method of eliciting the specific motor responses sought in this research study.

Delimitations of the Study

The nature of this study was to measure motor performance and developing skills of three and four year old children. It is delimited to measuring motor skills, not cognitive or language skills.

The applicability of the study may be delimited to subjects from white, middle-class families in a university community of approximately 37,000 population. The sample was sufficiently representative of this population but did not contain a sufficient number for establishing norms.

The 24 component tasks of the survey were deliminted to measures selected as appropriate to the age and understanding of the subjects. These criteria of appropriateness, plus the criteria for test construction that were given consideration, expense, time, and ease of

administration; all resulted in the decisions about the parameters of the problem.

Many biological, physiological, and psychological variables were not possible to control or alter for the purposes of this study. Some of these variables were diet, rest or fatigue, and prior practice of performance items.

Using the test, retest method for this study made it possible to investigate the reliability, validity, and specificity of the instrument. Therefore, the study did not attempt to address at this time the question of establishing norms for the survey.

Definition of Terms

Assessment. "In contrast to evaluation, assessment involves interpreting the results of measurement for the purpose of making decisions about placement, program planning, and performance objectives" (Seaman and DePauw, 1982, p. 147).

Motor. "Something that imparts or produces motion, . . . of or relating to movements of the muscles: motor coordination" (Morris, 1975, p. 857).

Performance. ". . . the act of performing. . . . The way in which someone or something functions. . . . Highly skilled performance is related to the individual's ability to regulate it voluntarily" (Morris, 1975, p. 974).

Motor Ability. ". . . denotes the immediate state of the individual to perform in a wide range of motor skills" (Singer, 1975, p. 328). The person's innate ability or potential.

Motor Capacity. ". . . is supposed to depict the maximum potential of an individual to succeed in motor skill performance" (Singer, 1975, p. 184).

Motor Development.

> . . . the development of abilities essential to movement and necessary to acquisition of motor skills. It encompasses: (1) development of abilities that are essential to movement; and (2) acquisition and refinement of motor skills. It is an extensive lifelong process (Seaman and DePauw, 1982, pp. 20-21).

Motor Patterns. Motor patterns evolve out of and are more accurate forms of motor sensory responses. "Motor patterns are those major milestones that develop within the natural sequence of events in a child's life . . . and represent simple, purposeful movement" (Seaman and DePauw, 1981, pp. 20-21).

Motor Skills.

> (a) Gross, a quality opposed to fine; large, whole, entire, or obvious, and involves the use of large muscles of the body; (b) Fine, denotes a delicate or sensitive quality; neuromuscular coordinations usually preceision oriented and often refers to eye-hand coordination; as in typing or piano playing, etc. . . (Singer, 1975, p. 13).

Adaptation. "Altering motor activities to meet the demands of new problematic situations requiring a physical response" (Singer, 1972, p. 391).

Agility. Agility is the ability to move in a quick and easy fashion; active, nimble.

Basic Movement. ". . . is a change in position by any part of the body" (Sherrill, 1980, p. 127). It is synonymous with prime movement and muscle action.

Body Awareness.

> . . . the capacity of the organism to achieve a conscious appreciation of the relationship of all body segments to movement, to be able to label body parts and to appreciate the functional properties of various body parts (Singer, 1972, p. 254).

Body Concept. ". . . refers to the verbalized knowledge one has about one's own body and its relationship to near and far space" (Corbin, 1980, p. 188).

Coordination. ". . . is used interchangeably with timing, skill, or general motor ability. It implies an ability to perform a skilled movement pattern" (Singer, 1975, pp. 232-233).

Gross Body Coordination. "Ability to coordinate the simultaneous actions of different parts of the body while making gross body movements" (Morris and Whiting, 1971, p. 161).

Growth. ". . . refers to measurably physical and biological changes" (Singer, 1972, p. 94).

Maturation. ". . . is the achievement of genetically endowed, developmental milestones" (Seaman and DePauw, 1982, p. 20).

Ontogentic. "The behavioral changes that depend primarily upon learning . . . such as swimming, skating, riding a bicycle or tricycle, and driving a car" (Corbin, 1980, p. 16).

Phylogenetic. Automatic behavioral changes that occur with the maturing of the individual (Corbin, 1980).

Perception.

> Mental process which gives particular meaning to a sensation and thereby acts as a preliminary thinking. It is the means by which the individual organizes and comes to understand the phenomena he encounters. Perception is made of a whole and occurs immediately 'all at once and nothing first' (Van Osdol, 1972, p. 38).

Praxis. Capacity or ability for motor planning (Sherrill, 1980).

Apraxia. "A disorder of voluntary movement; consisting of a more or less complete incapacity to execute purposeful movements even though muscle power, sensibility, and coordination are preserved" (Sherrill, 1980, p. 345).

Psychomotor. An observable voluntary human movement and excluded involuntary reflex activity. (Seaman and DePauw, 1982 state that this term is declining in usage.)

Self-Concept. "The person's sense of his or her own identity, worth, or capabilities" (Sattler, 1982, p. 643).

Sensorimotor. ". . . refers to activities involving both sensory and motor components" (Seaman and DePauw, 1982, p. 21).

Scanning Mechanisms.

> The central nervous system appears to include a scanning device which selectively brings to attention those items which are appropriate to the task at hand and is particularly sensitive to patterns of activity. For example, in the visual cortex the device scans (much like a computer scans) over three distinct visual fields and in this way coordinates past experience and present data (Van Osdol, 1972, p. 45).

Social Competence or Maturity. "The progressive capacity for looking after oneself which leads to ultimate independence as an adult" (Van Osdol, 1972, p. 46).

CHAPTER II

A REVIEW OF THE RELATED LITERATURE

Literature Related to the Problem

Individuals planning to administer the survey that was developed in this study should become knowledgeable about some of the important issues which influence the child's motor behaviors. It is essential that certain understandings about motor development be acquired. Similarly, it is important to recognize characteristic behaviors of three and four year old children. Also important to recognize is the manner in which various external and internal forces will shape the child's responses. The child's hearing, vision, and comprehensions, the presence of other persons, and whether the child feels at ease with the examiner--these are the issues that will determine the quality of the child's responses to the survey.

It is therefore requisite that the literature review should address the issues which will be associated with the child's responses. The literature related includes general information and findings which indicate why motor ability development of the preschool child is worthy of special attention.

It should be emphasized that the improvement of programs and activities for the child was one basic reason for the creation of an assessment survey. But for the survey to be practical and applicable it had to satisfy test construction guidelines. The first section of

this chapter deals with the influences of both the sensory and the motor processes on the development and learning of the child. A second portion deals with the test construction principles. An effort was made to prepare a survey which gave considerations to these many internal and external influences and also followed guidelines which would make the results more valid and reliable. The final section addresses the statistics, data collection, and data handling procedures.

Literature Related to Creating the Survey

> The preschool child is a dynamic individual with spontaneous inquisitiveness and multiple physical abilities. Motor skills are his special tools for experimenting and expanding his environment. Play is his form of communication and learning (Flinchum, 1975, p. 2).

Early childhood and the preschool years are the most vital years for the developing child. Physical growth slows somewhat to allow the rapid development of the phylogenetic skills of running, jumping, and throwing. Riggs (1980) explained that movement is the essence of living for young children. The child learns through movement. Riggs states:

> Their bodies are both subject and object of their early learning experiences. As children gain neuro-muscular control, they grow in their capacity both to understand the physical world and to express and communicate their understanding nonverbally (p. 1).

The child learns to move in a variety of ways and increasingly complex tasks. Movement is used to explore and expand the child's knowledge about himself, his environment, and his world. Other areas that grow and develop during these early years are self-awareness and positive

self-concept as well as physical stature. The long bones increase in length and the process of ossification continues. Tissue growth is found to be less rapid and weight gain decelerates. Control of basic motor skills and speech are also rapidly developing. In light of these factors it is essential that child development specialists, physical educators, preschool educators, and parents be well informed of the values of movement activities in the overall development of the child.

The overall development of the child involves the use of all three learning modalities: the cognitive, the affective, and the psychomotor domains. In the more recent literature the psychomotor domain is more commonly referred to as sensorimotor learning. Development of the sensorimotor learning processes requires the improvement of the child's sensory discrimination, integration, and organization capacities. Educators and parents can aid the preschool child to develop the combined sensory and motor capacities.

The possibility that the child can be taught to discriminate and integrate learning modes assumes that the child's information processing senses are functioning fully. The ability to discriminate between countless sensory experiences is interpretation; hence, perception as defined by Kalakian and Eichstaedt (1982). Visual, auditory, or perceptual dysfunction can interfere with the entire learning and development process. Failure of the visual cortex to perceive or attend to a task, or failure to discriminate and select what is important to note in an experience may inhibit development of full understanding and the appropriate motor behaviors. For the reasons stated it is essential to examine, and when required, enhance, the child's

sensory and motor capacities. During the early years, when senorimotor capacities are being expanded, the child begins to rely more on the visual and less on the tactile stimuli that formerly dominated during infancy (Williams and DeOreo, 1980).

The shift to visual dominance rather than tactile-kinesthetic dominance of sensory input stimuli occurs during early childhood. As Williams and DeOreo (1980, p. 144) reported, the visual system has ". . . much more highly refined information processing capacity." For this reason, it is important that the young child should have a thorough visual examination by an optometrist. Perfunctory vision testing would not disclose the subtle vision deficits that might prevent the child from receiving stimulation effectively. Eye-hand and foot-hand coordination test items might expose difficulty with coordination. Even so, the examiner of motor performance would not be qualified to determine whether visual, or motor factors, or a combination of the two, was at fault.

The early childhood educator, or parent, should closely scrutinize the child's behavior and should there be any question of visual intactness an experienced optometrist should be consulted. The child cannot benefit from stimulation if deficiencies prevent the establishment of concepts and foundations for future learning. Robb (1972), and Singer (1975) have both written of the meaningfulness of early stimulation. Robb authoritatively remarked that early childhood experiences lead to the formation of patterns that will form the basis for skilled movement and planning as adults. Before these learnings can occur, the child must receive the stimuli through the sensory organs.

Auditory and kinesthetic senses are two of the senses that are crucial to the perceptual motor learning modes, but for gross motor skills the visual and kinesthetic systems are most valuable at the ages of concern in this study. The development and maturation of sensorimotor capabilities progresses in a sequential hierarchy. Because each child is an individual and subject to differing influences from the environment and is also limited by genetic endowment, the level and/or stage of development can be expected to vary from child to child.

Espenschade and Eckert (1980) spoke of these early childhood years as a time when gross motor activity is directed toward exploring the expanding world; a time to perfect locomotor skills and eye-hand coordination. Other developments occurring almost simultaneously with those of prehensile and locomotor skills are: language, erect posture, bipedal motion, manual dexterity and fine manipulation (Espenschade and Eckert, 1980). These developments are summed up by the statement that by the age of three the child has left the infant world, has gained sensory control over his surroundings, and will continue in more diverse skill development (Riggs, 1980). All the while the child will continue refining and building upon those skills already achieved.

Refinement and development of motor performance skills are ". . . one of the major developmental tasks of childhood" (Malina, 1980, p. 198). This progressive development continues to form a foundation for more complex skills "Through a process of absorbing [assimilating] meaning from direct experiences, young children increasingly see relations and create order out of their direct experiences. They classify

properties of objects" (Fromberg, 1977, p. 51). McClenaghan and Gallahue (1978) and Espenschade and Eckert (1980) also concluded that physical skills have impact upon the evolution of representational thought and symbols that are related to understanding relationships to objects, space, time and causality.

At what age can children learn complex cognitive operations? Numerous recent investigations have considered this problem. Leithwood and Fowler (1971) stated that complex gross motor learning is highly dependent upon cognitive mediation and regulation. They concluded from their study that:

> Like language [and reading], complex motor skills are based on cognitive rules for spatially and temporally organizing multiple unit chains in various combinations; unlike language, complex motor skills [except dance] lack the complex, symbolic extensions of semantic systems. Basic language rules are typically organized in all cultures by 3-4 years of age, and graphic language processes [reading] can be induced by [but apparently not before] a mental age of 4 (p. 789).

They then hypothesize that early stimulation would accelerate competence in music, speech, athletics, and other specific activities. In a related intervention study, DuBose and Folio (1977) found similar evidence of markedly different levels of motor skill proficiency between delayed and nondelayed children.

These findings would seem to lend even further support to recommendations such as those from Sinclair (1971). After a conference which brought together physical educators, physicians, optometrists, occupational therapists, physical therapists, and day care providers; she remarked that there seemed to be a consensus that early intervention was essential for the developing child. She furthermore said that the degree of motor skill developed during childhood will affect

the level of participation of the individual in activities during their more mature years.

Factors That Influence Motor Development

It is necessary to review other factors which are relevant to the child's performance of motor behavior. What Halverson (1971) calls internal and external factors are entitled by Malina (1980) as biologically related factors, environmentally related, or biological-environmental factors. Internal factors that affect motor behavior include neuro-physiological and psychological factors which result in change. External factors are: Comments that are made and how they are said, equipment, facilities, presence of others or older children, speed of objects (such as thrown balls), or perceived dangers. The following lists are composed from Malina's descriptions of factors affecting development and refinement of motor skill:

Biological Factors	Environmental Factors
general genetic endowment	rearing and sex differences
body size--including body size at birth	birth order
physique	ethnic considerations
rate of maturation	cross-cultural considerations

Biological-Environmental Interaction

(These factors must be considered together, as one deals with a total person.)

> Motor development is obviously a plastic process. there is variation in the timing and rate of development which can be related to a variety of biocultural correlates. . . . Many interacting and covarying factors impinge upon the motor development and motor behavior of children during infancy and childhood (p. 221).

Ontogentic factors not previously listed were given mention by Teeple and Roberton (1978). They are: nutrition, disease, injury, and emotional-social influences. Other factors which are of value in the motor development repertoire are: coordination, strength, and balance. To be discussed more fully later in this chapter will be the factors of motivation, opportunity, and stress, and how they are given impetus by interest or parental influence.

Locomotor Characteristics of Three and Four Year Old Children

As the preceding factors influence what the young child is capable of achieving, so do certain characteristics that appear at certain stages of development. Eight characteristics were identified by Sinclair (1971) in her constructs standards model as being useful predictors of motor performance. These characteristics are: (1) dynamic balance; (2) opposition and symmetry; (3) total body assembly; (4) rhythmic locomotion; (5) eye-hand efficiency; (6) agility; (7) postural adjustment; and (8) dominance. The last item, dominance, was found by her study not to be significantly related to the other seven factors for ages two through six. Riggs (1980, p. 2) would add to the constructs model ". . . increased body and spatial awareness and the concepts of direction and laterality." Her argument was that the child needs to be aware of left and right and needs kinesthetic information about the body in space so as to make the necessary adjustments in relation to other objects.

Other than the process of learning to adjust to the environment, locomotor tasks which the child might be expected to accomplish during

the span of years from age three to age four, are to be seen in the checklist by Sherrill (1981). This checklist shows locomotor tasks which the child might be expected to accomplish within the time from 37 months to 48 months, and from 49 months to 60 months (Table I). The checklist does not give a definite description of criterion of a system for rating the quality of performance that could be statistically calculated. It employs, rather, a check system which rates incapacity, immature, developmental, or mature behaviors. This form could be most useful during occasional observations of the child during play activity. But a more detailed criterion would be beneficial for the preschool educator seeking to plan programs designed to enhance this locomotor development and meet the current needs of the child.

Concerning locomotor tasks, Eckert (cited in Diem, 1978, foreword) wrote, ". . . the selection of tasks for movement development programs should be based upon an assessment of the current movement capabilities of the children in each program." She also stressed the importance of group activities for the vital role they plan in teaching cooperative aspects of socialization. The competitive aspects of group interaction, she stated, would ". . . promote a realistic development of the individual's personal assessment" (Eckert, cited in Diem, 1978, foreword).

At a younger age, lack of maturation and the concomitant neurological development would prevent the young child from accomplishing many of the motor behaviors that are expected of him at this age (Holle, 1976). The readiness, also defined as developmental stage or

TABLE I

A CHECKLIST OF LOCOMOTOR TASKS DEVELOPED
FOR AGES THREE-FIVE

Ratings*				Directions: Check level at which child performs.	
Incapacity	Immature	Developmental	Mature	Locomotor Task	Average Age (in months) of Children's First Performance of Task
					Between 3-4 years
				Walk a line 1 inch wide for distance of 10 feet without stepping off	37
				Distance jump--1-3 feet	37.3
				Alternate feet part way on balance beam	38
				Execute 1-3 consecutive jumps	38
				Jump over a rope 6 inches high	38
				Execute 10 or more consecutive jumps	42
				Execute 1-3 consecutive hops	43
				Perform early skipping movements with skip on one foot and walk on other foot (shuffle-skips)	43
				Walk a circular path 21-1/2 feet without any step-offs	45
				Descend short flight of stairs with alternate feet, with support	48
				Gallop (43 percent can imitate this task)	48
				Propel and manipulate wagon with one knee on wagon floor and other foot on ground	48

TABLE I (Continued)

Ratings*				Directions: Check level at which child performs.	
Incapacity	Immature	Developmental	Mature	Locomotor Task	Average Age (in months) of Children's First Performance of Task
					Between 4-5 years
				Descend short flight of stairs using alternate feet without support	49
				Demonstrate control over starts, stops, and turns in running	48-60
				Walk, alternating feet, the full length on balance beam	56
				Walk length of balance beam in 6-9 seconds	59.5
				Execute 10 or more consecutive hops	60
				Gallop (78 percent can imitate this task; success in gallop usually occurs before skip)	60
				Alternate feet in mature skipping pattern	60

*Check level at which child performs.

Source: C. Sherrill, Adapted Physical Education and Recreation: A Multidisciplinary Approach (1981) (by permission from the author).

maturational ability, needs to be recognized and assessed so that meaningful instruction and practice may be provided for the child.

As can be seen in the following table (Table II), the young child moves through four stages toward developing mature movement: reflex, symmetrical, voluntary, and automatic (Sherrill, 1980). The myelination process (myelin is the innermost covering of the nerve fibers) seems to be the primary determinant of motor maturation. Motor coordination, such as creeping, standing, and walking, cannot be achieved until myelination on the related nerves and spinal tract is completed (Sherrill, 1980). As the myelination progresses, so does the child's ability to proceed with locomotor development.

Table II indicated that certain motor behaviors may be expected of the three year old child. Locomotor development that they may demonstrate should include more control of manipulation, of the throwing release movement, and they may have their arms outstretched when attempting to catch. The locomotor development might also show a well coordinated walk, more control in the run, the ability to hop on one foot, and use of alternating feet on stair climbing.

The four year old child might be expected to throw with horizontal arm action and the catching behavior could demonstrate that they catch with elbows extended and hands in a use that is more vise-like. Their locomotor movement might include galloping and adjusting to the ball in catching and kicking. Table II further indicates that four year old children nearing age five may demonstrate ipislateral stepping forward, hands cupped in catching, and locomotor movement which shows better turning and stopping in the run, in skipping ability, and use of the entire leg when kicking.

TABLE II

MATURATIONAL STAGES THE CHILD MOVES THROUGH FROM BIRTH TO ADULTHOOD: LOCOMOTOR AND MANUAL DEVELOPMENT

Age	Relationship Between Myelination and Motor Development		
	Degree of Myelination	Manual Development	Locomotor Development
Birth	Motor roots Sensory roots Optic tract Superior cerebellar peduncle	Grasp reflex	Trotting and swimming reflex
4 months	Sensory roots Optic trace	Crude reaching; palmar grasp	Sit with support
6 months	Superior cerebellar peduncle Middle cerebellar peduncle Pyramidal tract	Reaching smoother; radial shift in grasp; more manipulation of object	Sit alone momentarily Rolling over
9 months	Striatum	Reaching well coordinated; radial grasp and manipulation	Creeps Walks when led Pulls to stand
12 months	Pyramidal tracts Striatum	Pincher grasp and manipulation; controlled release of objects	Stands alone Walks alone
2 years	Corpus callosum	Increased control of manipulation; force may be applied to released objects; arm outstretched in catching	Rocker action of foot; run becoming smoother; two-foot jumping; mark-time stair climbing

TABLE II (Continued)

Age	Relationship Between Myelination and Motor Development		
	Degree of Myelination	Manual Development	Locomotor Development
3 years	Middle cerebellar peduncle	Anterio-posterior throwing action; arm scooping in catching; can strike stationary object with paddle	Well coordinated walk; more control in run; one-foot hopping; alternate foot stair climbing
4 years	Reticular formation	Horizontal arm action in throw; elbows in front, vise grip in catching	Galloping Adjust to ball in kick and catching
5 years	Corpus callosum Intracortical neuropil and association areas	Ipsilateral step forward in throw; elbows at side, hands cupped in catching; can strike object thrown underhand	Turn and stop in run Skipping Use entire leg in kick
6 years		Alternate arm-step forward action in throw; one-hand catching	Alternate foot-arm action in kick; good control of locomotor actions
15-20 years	Intercortical neuropil and association areas	Adult movement patterns	Adult movement patterns

Source: C. Sherrill, Adapted Physical Education and Recreation: A Multidisciplinary Approach (1981) (by permission from the author).

The developmental progress as was shown in Table II indicates the advancement from motor-sensory responses to formation of motor patterns, and eventually motor skills. This more complex level of motor functioning is altered by the foundation of behaviors that preceded it and by a host of intrinsic variables; biological and environmental.

Selection of Components

The process of selecting components and test items for this study involved review of the studies which are herein discussed. The Charlop-Atwell (1980) motor scale for ages four through six was designed to measure gross motor coordination but not perceptual or fine-motor ability of four through six year old children. The five general motor abilities it purports to measure are: agility, balance, coordination, flexibility, and speed of movement.

Dobbins and Rarick's study (1975), Sloan's (1954) Lincoln-Oseretsky tests both list six motor proficieny measures, but they differ from one another. Examination of these factor analytic studies of motor performance plus numerous other tests such as: The Denver Developmental Screening Test (Sattler, 1982), Geddes' (1981) Psychomotor Inventory Profile, Folio and Dubose's (1974) Peabody Developmental Motor Scales, the Purdue Perceptual-Motor Survey (Roach and Kephart, 1966), Bayley's (1936) and Gesell and Amatruda's (1947) developmental scales, and finally, the Body Coordination Test developed by Kiphard and Schilling (1976) aided in the selection of eight factors for this survey instrument.

Guilford's (1958) factor analytic study isolated seven psychomotor factors: Fleishman's (1964) study found 10, but these factors

included physical fitness and endurance items. Marrotte's (1976) study of the Purdue-Oseretsky Vallet Test (POV) made use of 10 gross motor tasks which her factor analytic studies revealed to be most definitive for 9 to 12 year old children, plus 10 items chosen from the three test batteries which present a body-image development scale. Eight functioning areas were selected by the Liemohn and Knapcyzk (1974) study to be determinants of the motor abilities of developmentally delayed children. (These functioning areas were: upper extremity coordination, rhythmic ability, general muscular coordination, gross motor functioning, praxis, dynamic balance, maturation, and sex.)

The unities and dimensions of motor test items were studied by Marotte (1974) and Frederick (1977). This made it unnecessary to replicate the factor analytic studies of the measures that were chosen for the test items.

The items that were chosen are described here, along with the source and/or reason that specific items was perceived as an adequate means to measure the dimensions within each factor of the movement. To demonstrate muscular strength, the items selected were: the curl, standing broad jump, and straight arm hand. The curl is considered a measure of abdominal muscular endurance (Kalakian and Eichstaedt, 1982). The standing long jump for distance is a measure of leg power. Geddes (1981) proposed distances for the jump from 14 inches to 38 inches for ages three through five. The Basic Motor Abilities Test (Arnheim and Sinclair, 1975) used this item but gave no predicted distance for age groups. The straight arm hang was selected on the basis of statements by several authors; i.e., Kalakian and Eichstaedt

(1982), Diem (1978), and Sherrill (1980). All spoke of the value of hanging to strengthen the grip and to teach the child to manage his/her own weight, plus value as a means to improve and enhance upright posture.

The balance measures are divided into two categories: static and dynamic. Static balance measures include: the one-leg stand (on the preferred or dominant leg), the one-leg stand with eyes closed, and the one-leg stand on the non-dominant leg (the leg the child chose to stand upon first was assumed to be the dominant leg). Geddes (1981) predicted times from 1 to 5 seconds on the preferred leg to 4 to 15 seconds, with all of her items having the subject's eyes open. The Lincoln-Oseretsky (Sloan, 1954), item #32, asked the child to perform the one-leg stand with eyes closed.

For measurement of dynamic balance, the jump and turn around was selected by referring to the Lincoln Oseretsky (Sloan, 1954), item #19, and to Sherrill (1980). The forward walk on the balance beam came from the Purdue Perceptual Motor Survey (Roach and Kephart, 1966). Backward walking on the beam, which is much more difficult, was listed as a separate item. Support for the item of backward beam walking came from the Hamm-Marburg (Schilling and Kiphard, 1975), the Lincoln-Oseretsky (Sloan, 1954), and from Kalakian and Eichstaedt (1982). Ascending a stair not only is suggested as a measure of balance, but as a means of perceiving whether the child has achieved the more mature foot-over-foot pattern.

Gross body coordination and rhythm were the fourth dimensions to be assessed. The agility run for this measure was derived from study of the Basic Motor Abilties Test (Arnheim and Sinclair, 1975), and

from Kalakian and Eichstaedt (1982) (to run requires adequate strength, balance, and coordination). Hopping was a more discriminating and difficult item, as was backward beam walking. Selection of hopping was based upon the opinions of Cratty (1979), Geddes (1981), and the Purdue (Roach and Kephart, 1966) Scale. Tapping rhythmically was adapted from the Lincoln-Oseretsky (Sloan, 1954), items #6 and #8.

Limb-eye coordination items chosen were touching finger to nose, Lincoln-Oseretsky (Sloan, 1954), item #4; target throw, (Corbin, 1980; Geddes, 1981); and bounce and catch from Kalakian and Eichstaedt (1982). The bounce and catch measures limb-eye coordination without relying on the vagaries of trying to determine whether the ball was thrown too softly or too hard; also without concern as to whether the child was ready for the release of the ball (as they need to be when others make the throw).

Items for manual dexterity evaluation were fingertip touching as adapted from the Lincoln-Oseretsky (Sloan, 1954), item #5, and from Geddes (1981). Another manipulation item was building a tower of blocks from the Peabody Scales (Folio and DuBose, 1974). The third measure of manual dexterity was from the Lincoln-Oseretsky, item #20.

Locomotor function was defined as flexibility and agility. For a measure of flexibility, the sit and reach test was used. Arnheim and Sinclair (1975) labeled this as the back and hamstring stretch. The jump over a low object was related to the Purdue Scales (Roach and Kephart, 1966) jumping task, but adapted to be more suitable for the age level involved in the assessment.

The final items involved assessing body awareness. They were: imitation of movement, identificaiton of body parts, and going over,

under, and between. The first two body awareness items were selected as recommended by Sherrill (1980), and as used in the Purdue Scales (Roach and Kephart, 1966). The going over, under, and between was adapted for this age child from the Purdue Scales, taking into consideration suggestions by Geddes (1981) and Diem (1978).

The selected measures were based upon the numerous research studies and assessment instruments developed previously; however, it was necessary to adapt many items by adjusting how they were performed or altering the criteria for evaluation so as to make the measurement appropriate for three and four year olds.

Literature Related to Psychological Factors

Biological and environmental factors were discussed under the heading of factors that influence motor development. But psychological factors were in need of more detailed discussion as now follows. Included in this section is a discussion of self-esteem in the context that it relates to body awareness.

What affect might the psychological factors have on the continued development of the preschool child? Kiphard and Schilling (1976, p. 37) stated, "According to our findings, sensori-motor troubles predominate in early childhood." If the motor difficulties are not diminished by the time the child enters school, they may be replaced by emotional and behavioral problems (Briggs, 1975). "There are some child development authorities who believe that the way a child feels about task performance is even more important," Marotte (1976, p. 102) stated, "than the level of achievement itself." Briggs (1975) is one other authority that has published similar statements.

Marotte's (1976) study disclosed findings that positive body-image/self-esteem concepts aid the individual in performing better at learning new gross motor tasks. (The terms "self-esteem" and "self-concept" or "self-assurance" will be used interchangeably hereafter.)

How important is self-esteem to the child's future development? Briggs (1975, p. 3) avowed that, ". . . self-esteem is the mainspring that slates every child for success or failure as a human being." Riggs (1980), Werner (1975), Halverson (1971), Omwake (1971), and Espenschade and Eckert (1980) agreed that the child's positive self-image was a contributing component in the continuing successful development toward social interaction.

Espenschade and Eckert (1980) were especially articulate on the subject of the relationship between self-esteem and motor development. They stated that particular attention must be given to motor development and the role it plays in social development. For the child, this may provide a means for gaining approval from parents and for increasing their independence. The social development role involves parallel play with other children and sharing activities. These activities to promote social interaction can help the child in the future when their first experiences with bodily activities are successful. Diem (1978, n.p.) suggested that ". . . behavioral ability and movement intelligence" may be promoted by parents acting as partners in play activities, and by the provision of play areas and toys which encourage creativeness.

Werner's (1975) contribution to this theme consists of two affirmative remarks. He said that the child gained more confidence with each new skill learned. Then he stated that "Children who can

move well and are successful are more apt to be accpeted by their peers" (p. 184). His study also revealed that children became more tolerant and sharing as they gained in motor performance skill.

Learch, Becker, Ward, and Nelson (1974) voiced the concern that children need to be encouraged to explore on their own. What parents often do, however, is make fewer demands and try to make growing up easier by furnishing mechanical toys (or electrical toys) which remove ". . . many of the opportunities to explore, experiment, and touch, which they must have to form a stable perceptual-motor system" (Learch, Becker, Ward, and Nelson, 1974, p. 25).

There is a problem when parents and caretakers do not realize the child's motor development depends on their freedom to move. "Overprotection may hamper a child's motor development by instilling fear in the child of possible bodily harm by preventing practice during the maturation of particular abilities" (Espenschade and Eckert, 1980, p. 135). As a result of the protective caretaker behavior, the child may later participate less and exhibit retarded or deficient motor development. This lessened participation may, in turn, also influence the child's development of socialization skills.

Kalakian and Eichstaedt (1982, p. 91) reported that studies show negative parental attitudes coincided with low motor skills among children: "Such children are in need of significant psychosocial support because of the association between low motor skills and a fragile self-concept."

In the instance that the child may lag in development of motor skills, it is of vital concern that the child's needs be revealed through assessment and observation, combined with appropriate

interpretation. The program of activities and play must begin to help the child move toward self-actualizing and autonomous behavior.

Movement learning may occur in stages. These are stages that involve the initial and later movement patterns. The same stages are described by Sherrill (1980) as developmental and either mature or immature. During the initial or developmental stage the learner attempts to find the general motor organization that works to produce the outcome. This explains why skilled movement which meets the environmental demands is also considered to be mature, effective, and efficient movement. "Since the neuromuscular system is our sole medium of communication, its differentiation through training represents a major determinant of the individual's power to act and to react" (Jokl, as cited in Drowatsky, 1975, p. 266). This development, states Jokl, can contribute to enjoying access to a richer, more diversified life.

The program and activities recommended for specific tasks and those which advance the fundamental motor performance of three and four year olds will be discussed in Chapter V.

Literature Related to Methodology

Johnson and Nelson (1974) specifically addressed the issue of the need for research to develop assessment measures which would indicate children's motor and perceptual-motor performance. These same authors recommend that evaluation procedures be designed by modifying test items for motor and sensorimotor behaviors from tests already in use. In addition to the test items contained in the established tests; such as items which measure agility, balance, and strength, it is suggested

that measures of visual, auditory, and tactual status should be incorporated. Also recommended by these authors is the need to modify the way the tasks are scored.

Another consideration in designing the survey instrument was related to finding what Seaman and DePauw (1982, p. 167) call "commonalities." Rather than attempt to include items which measure the sensory abilities and the motor abilities separately, the educator is directed to explore the interactions and indications of a limited number of tasks. Beyond that, it is suggested that the observer/examiner should be prepared to ask the question, "Besides balance, the jump pattern, jumping ability, and muscular endurance, what other elements, parameter, or entity is entering into these performances?" (Seaman and DePauw, 1982, p. 258). If the performance is not satisfactory, is there a reason which may be the common element in all three instances? This reasoning shifts more responsibility to the examiner but aids in controlling the length of time and number of tasks required to measure the sensorimotor capability of the subject being tested.

Still other issues to consider in formulating the survey instrument were the number of trials, verbal versus visual presentation of items, and the rating criterion. Selection of the number of trials was based upon Seaman and DePauw's discussion relevant to reliability. The opinion was set forth that requiring more than one item for each component to be measured would provide more consistent responses. On this basis, two or more items were chosen to produce reliable measures for each of the eight motor performance components selected: (1) strength; (2) static balance; (3) dynamic balance; (4) gross body

coordination and rhythm; (5) limb-eye coordination; (6) manual dexterity; (7) locomotor function; and (8) body awareness.

These components, or factors, were selected after examining factor analytic studies that were the topic of recent research. The use of factor analyses was supported by Kerlinger (1973). Factor analysis was declared to be a means to identify the dimensions or factors behind many measures. It is also endorsed as a powerful method of establishing construct validity (Kerlinger, 1973). For these reasons the studies by Fleishman (1964), Liemohn and Knapczyk (1974), Frederick (1977), Marotte (1976), and Dobbins and Rarick (1975) were utilized to provide empirical support of the factors for this study.

The number of trials to be permitted for each test item was based upon the discussion of Seaman and DePauw (1982) in regard to reliability of tests. The opinion was expressed that using more than one item to measure each factor would provide more reliable assessment of motor behaviors. It was also indicated that the question of validity can be handled by combining verbal instructions with demonstration of the task.

Giving clear, specific directions and demonstrations of the test items will assist the understanding of the preschool subject being tested. McClenaghan and Gallahue (1978) argued that demonstrations should not be permitted, only verbal cues, because they give the child clues to mature movement and may invalidate the observation. Since preschool children are known to have limited language concepts, it becomes necessary to present the items in the manner which requires the least processing and interpretation by the subject. Giving both verbal cues and demonstration will help the child correctly discern

the behaviors that are being sought. Another aspect to aid understanding is to allow the subject to repeat the task if it is obvious that they do not understand the task after the first attempt.

Allowing multiple trials or repetition of the tasks by each subject on each task may eliminate poor performance and improve the consistency of the measures, according to Johnson and Nelson (1974). It is desirable, stated Drew (1980) that the subject's performance should not be limited by the task itself. To compensate for variation in responses to the tasks, the best of three trials of the task would be recorded. In case one subject had prior experience at performing the task, the response might be a more accurate measure if each subject had equal opportunity to practice rather than only one attempt to execute the task.

Criterion for Rating

The consistency of the measures may also be influenced by the criterion for rating. The inadequacy or lack of rating scales was a failure of many tests that were used for motor and/or sensorimotor performance measurement. Many scales in these previous tests allowed the observer to rate only "yes/no" or "pass/fail." Such reporting techniques are easy to use but do not produce numerical data which can be analyzed statistically. Nor do these other tests afford assessment of the quality of movement.

Examples of tests which eliminated qualitative measure in favor of timing every movement throughout the test are: The Fisher Motor Performance Test and Perceptual Motor Obstacle Course (Johnson and Nelson, 1974). These two tests measure the entire test performance by

how rapidly the subject can complete all the tasks. Even though the batteries appear to be well planned, it is theorized that reliability and validity for these two instruments can be questioned because the entire performance is based upon speed (Johnson and Nelson, 1974). The reliability coefficients were not printed for these tests.

Johnson and Nelson (1974) noted the limited, specific nature of the instruments mentioned and spoke to the importance of assessing the quality of performance. To remedy the situation, it was recommended that scoring scales be developed with ratings which combined numerical and qualitative measures. This design would permit selected items to be scored on the basis of time and distance.

Although rating scales are easy to construct and use, they have intrinisic weaknesses in that the rater must make a judgment. To avoid the pitfalls of the halo effect, or errors of severity or leniency (judging too harshly or too easily), the rater must also attempt to overcome any bias in order to insure the validity of the measures recorded.

The recording of scores is accomplished on a record sheet designed for this survey so that one column permits placing a circle around the selected rating. A second wider column allows space for comments; i.e., remarks about the quality of movement behaviors, or for noting time and/or distance measures. A copy of the record sheet is found with the test instrument in Chapter IV. The combined approach to recording rating criterion increases the value of the ratings (Kerlinger, 1973).

Collection of Data Related to the Survey

To fulfill the intent of developing a practical and useful testing instrument of motor performance, several statistical tools were used. The methods of managing the data collected by the survey were planned for exploring the effectiveness of the survey instrument.

The t statistic allows the researcher to determine whether any correlations that happened were valid. If the correlation is found to be substantial, the inference is that the hypothesis is supported, ". . . or that the observed phenomenon represents a significant departure from what might be expected by chance alone" (Popham, 1967, p. 140). The use of the t-test requires the assumptions that the population is normally distributed and that the sample data have been randomly drawn (Seaman and DePauw, 1982).

The other statistical purpose for the correlation was for testing whether the measurements will produce a quality assessment. "Correlations are used by test makers to express the reliability and validity of ready-made tests" (Kerlinger, 1973, p. 144).

To compare the test items by the repeated measures (test, then retest) of the same group design, the central tendency and variability were computed and analyzed. Kerlinger (1973, p. 119) declared these to be "The most important tools of behavioral data analysis." The means and standard deviations gathered for this test may be used to compare individual performance and may be useful in simplifying complex measures (Kerlinger, 1973). The study will look at the magnitude of the difference between the means and the variability of the scores on the survey items.

All computations were made with the assumption that the sample was representative. Representative was defined by Kerlinger (1973, p. 23) to mean "typical of a population." That definition is further continued to explain that ordinarily it means to represent the characteristics of the population sample, so that the representativeness is contingent on the close approximation of the variables relevant to the research. Those variables may be explained as sex, age, and socio-economic characteristics of the sample used in the research.

In relation to the size of the population sample, Kerlinger (1973) stated that a random sample of 30, drawn from 100 children, had a greater probability of selecting a mean close to the population mean than it does of not achieving a sample close to the population. The number of subjects for this study was n=30, and may not be sufficient to establish accurate predictions for norms. However, the number was sufficient for the purposes of exploring reliabilities and validity of the measures used in the survey. It may also permit predictions of whether separate norms will be required for males and females on some performance test items.

To collect data and interpret that data for the accurate assessment of the child's current performance capacity, the examiner must assume the responsibility for making careful observations. The examiner must also engage in cautious judgment so as to limit the amount of bias in the measurement results.

Literature Supporting the Method

Test Construction Principles

Seefeldt (1971) stated that there is a need for scientific

research to provide information which identifies the maturity level of motor development and which suggests the activities and programs that teach fundamental movement skills. Johnson and Nelson (1974, p. 309) state: "A comprehensive motor performance test battery would theoretically represent all the factors that enter into various types of physical performance" (p.23). Stating that this would be beyond the scope of any one test and would be impractical as well, Johnson and Nelson speak in support of developing test batteries designed with a specific purpose in mind. The one specific purpose for the survey in this precise study concerns measuring the motor capacity (". . . one's inborn ability to learn complex motor performance; . . ."") (Johnson and Nelson, 1974, p. 43) of preschool children, ages three years old and four years old. These same authors indicate motor performance tests may be useful as:

1. Tools for diagnosis of weakness or motor performance requiring practice.

2. Prognostic tools to suggest what motor performance skills have not developed.

3. A form of motivation to encourage the child's continued development and to promote a realistic understanding of what the capabilities of the child actually are.

Johnson and Nelson's (1974) suggestions for test criteria selection and the construction of assessment instruments were most useful in guiding the development of the survey.

Inherent in the decision to construct any test or survey there are specific criteria and processes for making decisions about the framework. This study had predetermined requisities: one, ease of

administration; two, time efficient and inexpensive materials; and three, ease of comprehension. Other questions of concern for test construction were listed by Johnson and Nelson (1974). The first three were duplicates of the three criteria just mentioned, but their criteria continued with the following:

4. Can the test be used as a drill during practice sessions?
5. Does the test require several trained testers?
6. Can the test be easily and objectively scored?
7. Is the test challenging and meaningful?

In regard to these questions, the authors felt it essential to add that ". . . conditions of the test giving should regard student enjoyment" (Johnson and Nelson, 1974, p. 46). They continued by saying that educators might find this an excellent occasion to create more rapport with a student, ". . . through encouragement and individual attention" (p. 50). Other suggested methods for constructing tests included these steps:

1. Determine the skills or factors to be measured by analyzing the physical qualities in question.
2. Determine the items that will measure the desired qualities or factors.
3. Establish procedures for administration and scoring of the survey.
4. Determine the reliability of each test item.
5. Compute the objectivity of each item of the test.
6. Establish validity.
7. Revise the test in light of the findings.
8. Construct norms.

The guidelines for constructing a valid, reliable, and objective test were given careful consideration while conducting this study.

To respond to the question of reliability, a test-retest approach was suggested by Sheehan (1971). The only disadvantage quoted for this method was the time span between tests that must be considered. For this particular performance evaluation, a time of six to seven days was predicted as overcoming the problem of too short or too long a time lapse (Sheehan, 1971). The degree of consistency between the test-retest would also permit review of the test objectivity.

Further investigation of the survey's reliability and validity were conducted by utilizing correlational procedures. The item to item relationships were examined and subjected to further analysis by use of t-tests. The t-tests could then reveal whether any significant differences existed between the variables. The third criterion sought was objectivity. This last issue might be more difficult to control with young children, as it is for exceptional students. Singer (1975) explained that young children are less task oriented and exhibit difficulty attending to available cues selectively. Such a lack of perseverence can interfere with information processing and motor performance.

Reasons given by Seaman and DePauw (1982) for the reduced objectivity of tests for the exceptional have been based upon the facts that rating on quality of movement may not be as objective. Also, the authors credit differences in raters conducting examinations, and rapport between rater and subject as creating difficulties for the objectivity of test results. These elements which impact on performances: (1) familiarity with tasks; (2) motivation; and (3) positive

reinforcement, were mentioned in the assumptions in Chapter I. The first element, familiarity, was not controlled in this study. Reinforcement, the second element, remains an interactive force that varies between any examiner and subject. Assuring that the test instructions are clear and specific will help to prevent this element from adversely affecting the subject's responses (Johnson and Nelson, 1974).

CHAPTER III

METHODS AND PROCEDURES

Design of the Survey and Data Collection

The procedures and methods that were employed in this research project had to, first, be directed at developing the survey, and second, directed toward investigating the extent to which that measuring instrument accomplished the stated purposes for which it was designed. The survey was designed to assess the preschool child; specifically, the three and four year old child. The responses to the survey would reveal the progress of the child's developing motor capabilities.

To accomplish both purposes of the project, it was necessary to conduct a comprehensive review of test construction guidelines of similar tests in print, and then to formulate a survey that incorporated valid, reliable, and objective measurement techniques.

"An evaluating device can only be valid, reliable, and objective if it is utilized properly" (Johnson and Nelson, 1974, p. 53). Giving emphasis to this thought, great care was exercised in not only developing the instrument for assessment, but in defining the administration, observation, and interpretation procedures which are extremely important for the desired outcome. Very comprehensive descriptions were recorded to explain the methods employed for data collection and how the results for this particular study were treated.

This chapter contains an explanation of the methods employed to select the factors and items for the motor performance evaluation of preschool children. The cautious selection of the factors and the items to measure those factors is explained. Administration of the survey and methods to interpret the data are described as well. The final description in this chapter is of the statistical methods used to analyze the data.

It was necessary to establish the components, or factors, which would reveal pertinent information about three and four year old children's motor ability in a brief testing session. The testing varied from 20 minutes to 30 minutes during some of the retest administrations. This time did not include the time required to become acquainted and to establish rapport with the subject. The time for establishing a working relationship varied greatly, anywhere from 2 to 10 minutes per child.

The factors were chosen after extensive review and study of previous analytic studies. This review revealed that certain factors were most consistently found to describe motor abilities. A synthesis of these studies produced the factors: (1) strength, (2) dynamic balance, (3) static balance (4) gross body coordination and rhythm, (5) limb-eye coordination, (6) manual dexterity, (7) locomotor function (i.e., flexibility and agility), and (8) body awareness. For these eight components, the items chosen not only revealed the motor development, but the physiological stage of development of subjects of this age.

In order to determine the items, or tasks, that are appropriate measures of three and four year old children, factor analytic studies were examined to discover the most commonly accepted factors for

defining the significant aspects of motor abilities. Factors that were selected as the parameters for this study were: Upper extremity coordination, gross motor function (locomotor function), agility and flexibility, dynamic and static balance, body awareness, and sex and chronological age. The studies analyzed to select these dimensions were discussed at more length in the review of literature.

To determine the length of the survey instrument it was necessary to consider the time available to preschool educators and parents for testing, as well as the time the child might be expected to attend to the tasks. Other considerations in the formulation of test items were the subjects' ability to understand and the need to assure the continued interest and motivation of the subjects, plus the age factor and the time involved to complete the test.

Table III displays the factor structure that was hypothesized for this study. The multiple items which were selected to measure each factor are listed next to the factors they are represented to measure.

Criteria for Item Selection

The basis for selection of test items for three and four year old children included: (1) the items should not be too easy or too difficult, yet should demand effort and afford some challenge; (2) the items should stimulate interest and provide motivation (other related studies found difficulties inherent in maintaining the child's attention throughout testing; especially if length exceeded 30 minutes in total testimg time); (3) the time required to accomplish completion of the assessment affects the accuracy of the instrument; (4) the

TABLE III

FACTOR STRUCTURE FOR PERFORMANCE ASSESSMENT
DEVELOPED BY THIS STUDY

Factor 1 - Strength	- curl
	standing long jump
	straight arm hang
Factor 1 - Static Balance	- one leg stand (dominant leg)
	one leg stand (dominant leg, eyes closed)
	one leg stand (non-dominant leg, eyes open)
Factor 3 - Dynamic Balance	- jump and turn around
	walk on beam forward
	walk on beam backward
	ascending a stair
Factor 4 - Gross Body Coordination	- agility run (speed)
	hopping
	tapping rhythmically
Factor 5 - Limb-Eye Coordination	- touching finger to nose
	target throw
	bounce and catch
Factor 6 - Manual Dexterity	- touching fingertips
	building a tower of blocks
	putting matches in a box
Factor 7 - Locomotor Function	- sit and reach
	jump over a low object
	going over, under, around, and between
Factor 8 - Body Awareness	- imitation of movement
	identification of body parts

choice of equipment or paraphernalia for the testing should aid in stimulating the child's interest and participation; and (5) the items selected should relate information regarding the mastery level of the subject in skills performance. This information may then be incorporated in the planning of activities and programs for the subject. The items for evaluation should reveal how the subject performs at running, jumping, throwing, body and limb-eye coordination, and manual dexterity, and should reveal the subjects' body awareness. The data from the assessment should therefore provide information relevant to the subjects' strengths and weaknesses in motor performance.

Remarks or comments made to the subjects must be reinforcing and encouraging. An example of such positive reinforcement was demonstrated in the instruction guidelines of Sloan's (1954) Lincoln-Oseretsky Test Manual. Lockhart (1980) also endorsed positive comments as being essential to the learning process, and remarked that overly anxious, discouraged children will not learn readily or perform well.

Items for evaluation of the motor performance of the three and four year old child were selected from various authorities' suggestions and from test batteries that were developed by some of the following: Arnheim and Sinclair (1975) (Basic Motor Abilities Test), Corbin (1980), Cratty (1979, 1980); Diem (1978), Flinchum (1975), Geddes (1981) (Geddes Psychomotor Inventory Profile), Kalakian and Eichstaedt (1982), Lockhart (1980), Sherrill (1981), the Lincoln-Oseretsky Test (Sloan, 1954), the Peabody Developmental Motor Scales (Folio and DuBose, 1974), the Purdue Perceptual-Motor Survey (Roach and Kephart, 1966), and the Hamm-Marburg Test by Schilling and Kiphard

(as cited in Arnheim and Sinclair, 1975). Anastasi (1976), Sattler 1982), and Seaman and DePauw (1982) were reviewed to determine whether there might be any current survey or battery which would include all the items selected as valuable for the assessment of three and four year old children. No one test instrument already produced met the specific requirements for assessing motor performance of this age group. The specifications were selected with an awareness of the objectives set forth by several authorities in assessment. Eichstaedt, Moreau, and Cross (1980, p. 11) implored that ". . . professionals discontinue the practice of selecting activities which have no relationship to individual objectives" when the criteria for test items is being determined.

To keep the test of practical length it was necessary to exclude a few components; namely, the striking and kicking skills. Those retained were deemed the most essential for evaluation of efficient motor performance of three and four year old children. This reasoning was supported by Seaman and DePauw (1982). They stated that in developing or selecting a test, ". . . the expected attention span for the age of the child should be a consideration" (p. 257). The test should still have enough items so as to yield valid information.

Raw data of scores from the test that was administered will be computed with the Pearson product moment correlation to measure the strength of relationship between two variables, the test items. This statistic was chosen to compare the data from the test to the data collected during a retest of the same group of children. Each item from each test was correlated using the product moment correlation to explore the degree of relationship between the items. It would be

useful to determine whether the means between the two groups are similar.

A t-test will be used to examine the differences of the values of the coefficients of correlation. For a sample the size of 30, in order to compute and test the r correlation, it was converted to rho= and compared to Student's t for n=2 degrees of freedom.

$$t = \frac{r}{\sqrt{(1-r^2)/(n-2)}}$$

Test Administration

The test was administered individually with only examiner and subject in the room. There were exceptions to this rule when the child expressed concern about unfamiliar circumstances and requested that the parent remain. In such cases, a chair was provided when the parent could sit as an unobtrusive observer. The getting acquainted time for the first test included a brief explanation about the apparatus and the room for the assessment. A few moments were well spent in description of the stopwatch and what purpose it served for the procedure. This seemed to lessen preoccupation with the stopwatch as an unknown to the subject.

The order of the test items was continually rotated in a way so as to prevent order effect. The balance beam could be first or last and ascending the stairs was generally given last, or next to last. The remainder of the items were administered in varied order each

time. In a test facility with stairs as an integral part of the building, the subject need not be informed that the stair ascent is an item, but merely allowed to precede the examiner up the stairs as evaluation is made. For all other items, careful demonstration and verbal cues were given immediately prior to performance of the test item.

The room was arranged prior to the subject's entrance, except that balls, match stick container, and blocks were in a box. The subjects often cooperated by recovering or returning the balls or blocks to and from the box. In this way they became more involved and the objects provided less distraction to other procedures while they were out of sight in the box. The box also served as storage for test objects between sessions. A stopwatch was worn on a lanyard and the score sheet was contained on a clipboard with pencil attached. Marking could be carried out immediately after the item performance or, as on ascent of stairs and beam walking, the score could be recorded as soon as the child departed.

Observation and Interpretation

To assist the test administrator in making judgments about what is skilled and unskilled or immature movement, the terms and descriptions which follow were abridged from Sherrill's (1980) descriptors.

Administration of the test and recording of the data will not suffice to reveal the correct information unless the appropriate observations and interpretations are made. Keogh and DeOreo (1980, p. 96) argued for ". . . focusing upon control rather than maximum performance in assessing the motor development of young school children."

Does the child control movements sufficiently to achieve a sequence, or to perform increasingly more complex motor skills? The movements should not be merely complete but should be controlled and executed in a mature manner.

So that mature behavior may be recognized, the observer/examiner must have some knowledge of human motor development. There are certain "developmental milestones" that the test administrator should recognize as they are examining the young child. Such explicit explanations as those which are listed help the observer to understand and interpret the child's movement responses.

Issues of Reliability and Validity

Two or more items were provided for each factor chosen so as to vary the information attained from each motor performance component. This measure and a test-retest procedure were incorporated in an effort to insure the reliability of the survey instrument. To prevent an order effect, items were administered in a varied order with each subject.

Concern for the validity resulted in attempts to determine that the items measured the motor abilities they purported to measure. Further effort was made to select only items that were appropriate for three and four year old children. Also, care was taken to establish the instrument in line with guidelines for test construction by Cratty (1979), Johnson and Nelson (1974), and Seaman and DePauw (1982).

Scoring the Survey

For the purpose of this study, the raw scores from the measurement

of 17 items were related as computed by the rating scale. The remaining seven items were analyzed in relation to the actual time or distances measured. This separate treatment of data permitted a different perspective of the validity of these variables as performance evaluators. Support for using multiple scoring techniques was found in the study of the Charlop-Atwell Motor Scale (Charlop and Atwell, 1980). Two separate procedures were used in that scale. All items were scored by subjective measure and by objective measures, then scores were combined and recorded as a total scale. The researchers for that study admitted that there was a low correlation coefficient between subjective subtest and objective subtest (.56, $df = 199$, $p < .001$). They took this to mean that they were measuring related but somewhat different aspects of gross motor coordination.

The criteria for objectivity were served by making the instructions as clear, consistent and precise as possible. Careful explanation and demonstration were considered essential in order to assure the understanding and replicable performance of the young subjects. Finally, efforts were made to establish rating criteria or standards that were specific, so different evaluators would have consistent results with the instrument. These rating criteria were: a five, for excellent performance; four, for good; three, for average; two, indicates little success; and one, for no measurable success but an attempt was made. When no attempt and no success were made, that was noted by the letters "NC," indicating no cooperation. Space was also provided on the score sheet for subjective, related comments.

Recording Scores for the Survey

The results for this study were recorded in two categories. The first category was a rating scale from 1 to 5, where 5 was the desired, mature, efficient movement and 1 was the least satisfactory performance.

The second category was manifested as time or distance achieved on seven test items: (1) straight arm hang, (2) one leg stand, (3) one leg stand with eyes closed, (4) one leg stand on non-dominant leg, and (5) the agility run. These categories were measured by timing. The last two of these seven items were distance measures: (6) standing long jump and (7) sit and reach. The tower of blocks was timed, but accuracy, not speed, was emphasized. The remaining tasks were rated on the scale from 1 to 5.

The classification of movement patterns needs some guidelines to help the observer to classify the movement as either mature or immature. The following descriptions from Sherrill (1980) will serve as guides to defining the young child's movement:

1. Inconsistency. Variation in trial to trial in preferred hand or foot, balance force, and other motor characteristics.

2. Perseverance. Inability to stop at the appropriate time and/or to perform a prescribed number of movements without overflow.

3. Mirroring. Inability to transpose right-left visual cues to his own body; failure to separate own directional movements from those of a leader.

4. Assymetry. Deficit in bilateral coordination evidenced when two limbs are supposed to contribute equally to force production or balance.

5. Loss of Dynamic Balance. Inability to maintain postural control of the body in relation to gravity.

6. Falling After a Performance. An idiosyncrasy exhibited after completion of a specified motor task.

7. Extraneous Motion. Excessive and/or irrelevant motions that tend to disrupt the temporal organization of a skill (added, unnecessary movement).

8. Inability to Maintain Rhythm or Pattern. Tendency to progressively accelerate or diminish the pace until the child's movements do not match those of the leader.

9. Inability of Control Force. Inability to generate the correct amount of force to execute a motor task.

10. Inappropriate Motor Planning. A catchall category for problems of sequencing related to the interaction of rhythm and force in complex tasks.

Other suggestions by Keogh and DeOreo (1980) for viewing motor behavior were: (1) watch the child rather than watching what the movement produces, (2) watch the parts of the child's body that are involved rather than trying to view the entire movement, (3) look for similarities and differences in the way the body is used, (4) note what the child is doing rather than what the child is not doing, and (5) analyze the motor task involved to note what should be observed, what is mature, efficient movement performance.

The test administrator should recognize the anticipated motor responses and motor patterns that should have developed by age three or four.

Halverson (1971, p. 18) wisely emphasized that ". . . we have to know what is possible; we have to know the child and we have to know the movement." The observation should be based upon the study of the characteristics of motor behavior and how they are altered by maturation and experience. The observer must understand how various environmental influences effect change in movement behaviors.

Even though the stages of growth and development may be predicted in broad terms when working with children, the child educator should work with each particular child in that particular situation. The examiner must observe and respond to individuals and not expect strictly scheduled behaviors to always be present at specific times. The child is learning to respond differently in varied situations. The ability to decide what elements to attend to and which might be ignored are acquired only through considerable practice. Adults often expect children to make analyses and produce responses that meet adult criteria. The young subjects' motor performance should be compared to movements that are characteristic for the age level and not compared to the practiced, polished, adult motor behavior. "Beginners make many extraneous movements, but with practice the unnecessary movements are eliminated until the highly skilled performer is a model of movement efficiency" (Drowatsky, 1975, p. 69). The refined and skilled behaviors that should appear in later years must be based upon the neuromuscular maturation and the opportunity during the early years to develop the foundations in gross movement patterns.

Physical educators who work with young children would benefit from familiarity with the Peabody Developmental Motor Scales (Folio and DuBose (1974) and the Denver Developmental Screening Test (DDST) (Sattler, 1982). For child care personnel not acquainted with this information, the characteristics and the patterns of development of young children described by Skinner (1979) and Fait (1978) are the most comprehensive and widely accepted descriptors of motor behaviors that should be observed in young children at certain age levels.

The early child educator needs to carefully analyze the motor patterns that are formed. From ages two to five, when motor patterns are being formed, it is important to reinforce mature, as opposed to immature, patterns. Changes that should be watched are changes in arms, legs, and head movements during activity. What changes in movement can be termed mature and which are immature movements?

The movement behaviors that might be expected of three through four year old children are herein discussed. They can run well, change direction, walk, throw, jump, climb stairs in an alternating foot pattern, and coordinate the use of hands and feet, or hands and eyes, or feet and eyes. Their neurophysiological development parallels the opportunity and practice that has allowed them to develop the motor ability to perform in an expected fashion.

The Population Sample

The population for this study was limited to a small university community; i.e., Stillwater, Oklahoma. The subjects were chosen from preschools and home care children, ages three to four years and eleven months. Other than the preschools and parents contacted about

participation, contact was made with a children's dance school. Those who agreed to participate were six preschool directors, a dance school director, and parents of seven home care children. Many of the home care children were contacted through the dance school or through contacts at the university.

The preschool directors who agreed to participate were most cooperative. Six day care/preschool centers distributed 90 of the total 150 forms. The home care participants were contacted by telephone. Parents who consented for their child's participation signed the authorization forms on the first scheduled testing data (Appendix A). The preschool directors were revisited several times to gather the signed authorizations. These forms explained the intent of the study and gave information regarding contacting the researcher.

The first 30 forms returned, or agreed to be returned by telephone, composed the sample for this survey. Efforts were made to include a wider sampling; however, some directors declined to be included, or as with the Headstart organization, they were not in session for those ages needed during the summer months. The directors and individual parents who did consent to be involved were most congenial and interested. Schedules were arrived at which were agreeable to all concerned with the study.

The samples were systematically drawn from the children within the specified age range of three years to four years and eleven months. The samples were variously collected from the six participating institutions and by telephone scheduling until the 30 subjects were extracted. The authorization forms and telephone conversations

explained the intent and purpose of the study to the parent or guardian of the child. A copy of this form appears in Appendix A.

The sample was then divided into groups, by sex, and by age. There were 9 males and 21 females. Subject division by ages was 12 three year olds and 18 four year olds. All subjects had no known handicapping conditions.

In order to comply with the lunch and nap schedules of the subjects and preschools involved, testing times were from 8:00 a.m. until 11:30 a.m.; and from 2:30 p.m. until 5:00 p.m. Non-preschool children's schedules were determined by times that were acceptable and convenient for parents who provided transportation.

Healthy, safe conditions were maintained for the subjects in the testing room at all times. If fear or uncertainty was expressed by the subject, the item causing this reaction was delayed until later in the process after an item that resulted in a more success-oriented attitude had been administered.

The total number of items administered were 24. All items were performed by all subjects, except one home care subject. That subject refused to attempt some items initially. After a brief play break and success at less difficult tasks, more cooperation was gained. Subjects who refused to cooperate without a parent's presence also appeared at times to be distracted by that presence. The restest situation was more successful for these three subjects. These children were more at ease and less anxious about performing the tasks during the second occasion. The anxiety during first testing and lessened anxiety plus the prior experience of executing the tasks must

have had some effect on the data that was generated. This will be discussed further in Chapter IV.

The test site was a playroom measuring approximately 35 feet by 35 feet. Wrestling mats covered nearly three-quarters of the floor's surface. Two smaller areas of approximately three feet by four feet and three feet by six feet were located at the base of the stairway and had tile and carpet coverings, respectively. The tasks for the assessment were so planned as to not require an entire gymnasium. The testing could, in fact, be conducted in a smaller area than the space used for this study.

The mats which covered the floor were not added but were a feature of the room prior to testing. It might be conjectured that the children were more at ease about running and jumping by an awareness of the cushioned floor covering.

Stairs which led to the testing site consisted of a flight of eight steps and a landing that turned to the right, then eight more steps led down to the testing room. Thus, the descent and ascent of the subjects could be observed as the subjects arrived and departed. It was not necessary to make them aware that this behavior was being observed and recorded as it would be if moveable stairs were brought in for the test.

In order that equipment need not be moved about unnecessarily, the balance beam remained in its location in the hallway at the top of the stairs. The beam was 10 feet long, 4-1/2 inches wide, and the walking surface was a height of 8 inches from the floor. Due to its location, the beam walking was administered either first or last in the testing

sequence. The order of administering items was constantly rotated so as to eliminate an influence from the order of assessment.

An illustration of the arrangement of the test site floor plan can be viewed in Appendix B. The hanging bar that was used for the straight arm hand was securely bolted to the storage room door frame. (Should a bar not be available, a commercially produced expandable bar is adjustable to fit most standard door sills and can be placed at any height; thus, any preschool facility can include this test item.)

The standing long jump required only a small area with a tape measure fastened in place with masking tape at each end. The starting point, from which the subject jumped, was held secure by one and one-half inch wide blue tape. The distance is recorded and rated as defined by the Geddes' (1981) Psychomotor Inventory.

The same blue tape that marked the long jump marked where the subject sat to demonstrate factor seven's sit and reach line. From this seated position, the subject reaches toward his/her toes. The distance can be measured on the tape to the furthest point the fingertips reached.

Still in the same seated position, with knees bent and feet on the floor, the subject was asked to curl by lifting head and shoulders and reaching toward the knees as many times as can be repeated in 30 seconds.

Static balance items; the one leg stand on the dominant leg and non-dominant leg, then on the dominant leg with eyes closed, were administered consecutively. Instructional cues given with the demonstration were that the subject should pretend to be a bird that stands on one leg as long as possible. Then they were asked to stand on the

opposite leg, again as long as possible. Finally, the subject was asked to close the eyes and repeat the one leg stand on the first leg used. For each leg stand a time was recorded. These balance items and the following jump and turn around can be given at any location in the test site area. The jump and turn around is based upon the jump and about face item from the Charlop-Atwell Motor Scale (Charlop and Atwell, 1980). The subject was given instructions and the demonstration was made. "Jump into the air off of both feet and spin around to land facing the same direction from which the jump began, landing on both feet" were the exact instructions given. Whereas the Charlop-Atwell Scale required only a 180 degree turn for four points; this test asked for an attempt at a full 360 degree revolution for five points. Less than three-fourths of a revolution was given a four point value. Three attempts were permitted on this item, and the best of the three scores was recorded.

A blue tape line also marked the starting line for the agility run which was set up much like a shuttle run. The subject, in response to the signal "go," ran 10 feet at an angle to the right and ran around the object used as a marker, then returned to the starting line. Without any hesitation, as was demonstrated, the subject continued to run onward around the second object and back to complete the run at the original starting position. Each marker/object was placed 10 feet apart and 20 feet from the line so as to form a triangle which covered in the running pattern totaled 40 feet. The triangular design arrangement negated the necessity of having a larger room or area to conduct this running item.

This triangular pattern also permitted the examiner to observe the turning and stopping control which the subject had developed. Subjects were permitted to repeat the run if they wished. The examiner reminded the subject that he/she was being timed and/or demonstrated once again if the child seemed unable to execute the item within a reasonable time on the first attempt. A time of more than 15 seconds would indicate the child either could not understand the time concept involved or the subject could not execute sharp enough turns at this stage in his/her development.

It should be noted here that the objects about which the subjects turned were two bowling pins that had been painted and decorated. One pin was blue with girlish features painted on the face and orange yarn attached for hair, which made it resemble a Raggedy Ann doll. The other pin had a black felt hat and hair which caused some children to describe this marker as a "witch" or "Dracula." This feature of the test promoted conversation and interest from the child, usually as soon as they entered the room. Discussion of these objects was therefore helpful in stimulation of some rapport with the subjects.

Hopping commenced from the same blue tape as used in the agility run. The subject was invited to hop like a bunny for nearly eight feet. The next instructions were to "Hop on one leg, as far as you can as though the bunny had a sore leg." Then, "Can you hop on the opposite leg now?" Often more encouragement was needed to hop on the non-dominant leg.

The jump over a low object utilized a Nerf football which the child could place on the blue tape line and jump over from a standing two foot jump to a two foot landing. The feet should be brought up

high enough to clear the object, but not excessively high. Jumping over without excessive height and without feet being brought around rather than over the object and a two foot landing with knee flexion was the behavior sought. The standing two foot jump from the floor was demonstrated. Feet brought in a circular pattern around rather than up and over the object would be considered an immature pattern. The object over which the subject jumped was a sponge Nerf football (a sponge block or rectangle might have served as well). The use of a soft object prevents fear or anxiety which a box or stick to jump over might cause. The high point of the ball was 8 inches, with the other dimensions being 10 inches in length and 8 inches in height. The ball was placed so the points were parallel to and not perpendicular to the subject.

The target throw was utilized to examine stages in the overarm throw. The target was a commercially purchased, 14 by 16 inch flat, thin, foam article designed for the trowing of velcro-covered balls. The balls used for the subjects' throw were tennis balls. The velcro balls were too small to be easily controlled by children of this age. Tests of the overarm throw for subject under the age of six must be modified. The target was taped to the wall at a height of 40 inches. This testing article with a green frog on a yellow background was again of interest to the young subjects. Children of this age have a keen interest in animals and bright colors, so this was a basis for planning equipment choice. Throwing at the frog was perceived as more playful than a plain target might have been. A blue tape line marked where the subject stood.

Bounce and catch was selected as preferable to a thrown ball for catching. An aerial ball was considered too difficult to consistently measure catching performance at these ages. The same holds true of a ball bounced to the child. By dropping the ball to bounce and then catch, the child controlled the time, force, and speed, if they had developed that performance ability. The subjects' concept of the variables involved in catching is evaluated and not the examiner's ability to control the throw to the subject. A mature catch would be seen as a ball grasped by the fingers pointing forward. The ball should not have been trapped, smothered, or corralled by the arms and body.

The next items were conducted while the subject was seated opposite the examiner. The box lid for storage of supplies served as the surface for tapping rhythmically, building a tower of blocks, and putting matches in the container. The sequence of these items was varied from subject to subject.

Going over, under, around, and between involved the subject starting on a signal from the examiner at a point designated, and was timed with a stopwatch. The subject was required to stop and start, crawl under a stick, turn in a prescribed direction around the chair, step over the stick, and circle the other chair to return to start. This task not only called upon the subject to coordinate many movement behaviors, but to recall what occurred next in the sequence. This performance afforded an opportunity to evaluate subjects' concepts of the terms "over," "under," and "around." The performance also provided clues to subjects' perceptions of objects and space with reference to the obstacles involved in the task.

Fingertip touching involved touching thumb to little finger on the same hand and then moving from finger to finger toward the thumb and back out toward the little finger. This was first demonstrated slowly and then repeated more quickly. It was observed whether the subject could continue the task while eyes were diverted toward the examiner. The task was conducted with subjects standing opposite the examiner.

Imitation of movement also required the subject to be positioned opposite the examiner and mimic or repeat the arm positions that the examiner displayed. Subjects were permitted to mirror or parallel the movements.

Body identification for the purpose of exploring body awareness was conducted by the subject being instructed to touch the given body parts. Most subjects recognized and pointed to the most common verbal cues for body parts, such as eyes, nose, and ears. Some body parts were less easily pointed to, such as shoulder or chin.

The entire testing procedure was planned so as to stimulate and challenge three and four year old children. It was hoped the measures could be conducted as fun, playful activities which therefore kept the subjects' interest.

Components such as striking and kicking or riding a tricycle were not included. They were omitted in the interest of adhering to a time frame conducive to affording consistent data for the factors selected for assessment. More detailed, exact procedures and descriptions of rating criteria were included in the instrument as it is displayed in Chapter IV.

Analysis and Treatment of the Data

The data from the motor performance of subjects studied was analyzed by the Oklahoma State University Computer Center. The program utilized was the Statistical Package for the Social Sciences (SPSS), which was designed by Nie, Hull, Jenkins, Steinbrenner, and Bent (1975).

The eight factors selected as determinants of the preschool child's motor performance were: strength, static balance, dynamic balance, gross body coordination and rhythm, limb-eye coordination, manual dexterity, flexibility and agility, and body awareness. The decision to use these factors to assess the motor performances of preschool children was based upon the synthesis of previous factor analytic studies. It was therefore not necessary to make use of the factor analytic process for the purpose of this study.

The relationship between the eight factors represented by the 24 items was explored by the Pearson product-moment correlation of coefficients. The statistical significance of these measures was converted to and compared to t table values to reveal the magnitude of the relationship between variables. The formula for Student's t was used to compute and test the values derived from the data (Nie et al., 1975). The null hypothesis that ρ equals some specified value other than zero was examined to determine the validity of the measures tested.

Normative data was computed for the items which assessed each subjects' performance. The means and standard deviations for each of the items for 30 cases was also calculated. The larger the difference

between means, the greater will be the value of t. The larger the t value, the less the probability is that the difference between means is a function of mere chance (Popham, 1967).

The data from the intercorrelation will be displayed in a matrix of correlation coefficients to indicate the strength of the relationships being compared. Means and standard deviations are displayed in tables which show performances for each item of the survey. These displays will help to explore the extent to which the variations in one variable were linked to variations in another (Leedy, 1980).

Summary

This chapter reviewed the procedures utilized to develop an assessment instrument for the motor performance of three and four year old preschool children. Criteria for the instrument were that it should prove easy to conduct, be inexpensive, and that it must provide pertinent information from a brief testing session. To meet these criteria, eight factors were chosen as being most indicative of the data sought. The variables, or items, selected to generate the information had to be accepted as: (1) measuring the movement behaviors of the three and four year old subjects; (2) simple enough for investigators to administer and interpret without being trained in assessment methods; and (3) challenging, yet fun, and related to activities the subject might be taught for the development of more complex motor skills.

The discussion included specific administrative procedures for each test item, scoring methods, and a description of the selection of the population sample and test site. The final issue addressed in

this chapter was the method used to analyze the data from the survey. The statistical treatment for analyzing the data generated was explained.

CHAPTER IV

ANALYSIS AND SYNTHESIS OF DATA

Data Collection for the Survey

The survey that was developed and administered for this study generated data related to three and four year old children's motor performance. The children's motor performance capacity was indicated by measuring eight selected motor components. The eight components, also termed "factors," were: strength, static balance, dynamic balance, gross body coordinations, manual dexterity, locomotor function, and body awareness. More than one item was chosen to evaluate the subjects' performances on each of the eight factors, for a total number of 24 items.

After coding the data form, the responses were analyzed using the Statistical Packages for the Social Sciences (SPSS) (Nie et al., 1975), at the Oklahoma State University Computer Center.

The correlation coefficient, r, was tested for the purpose of this study by conversion to Spearman's rho, or ρ. This latter correlation could then be compared with Student's t for n-2 degrees of freedom. The t-test was used to establish whether a significant difference exists among the means and standard deviations that were computed for the two groups (in this case the same group tested twice). The t statistic was used to examine the difference in the two

tests; first by sex, then by age. The value for the significance level was $\alpha = .05$ for a two-tailed test.

Motor Develpment Survey for Three and Four Year Old Children

General Instructions

The examiner should be certain to become familiar with the procedures for administering the test items before any actual testing is conducted.

When the subject to be tested arrives, a few moments should be used to become acquainted with the subject. At this time the examiner may briefly explain to the subject that he/she will be asked to perform several fun activities; i.e., the tasks, and that the examiner will demonstrate each task. Explain to the subject that some tasks will be timed and show the subject the stopwatch and explain how it is used. Also, explain the two tasks which require measurement and direct the subject's attention to that area of the test site.

The examiner should:

. Allow the subjects to view the test site and answer any questions they may have about the equipment being used.

Likewise, the examiner must:

. Be cautious to repeat any instruction or demonstration that the subjects do not fully comprehend.

All materials except the chairs, bamboo pole, and balance beam will fit within a box for easy transport and storage. The dimensions of the box are: 17-1/2 inches in length, 11-1/2 inches wide, and 13

inches deep. With a sturdy box; for example, a produce box, the lid can be covered with contact paper and serve as a table-like surface for items #18 and #19 of the survey to be administered.

Time Required to Administer the Survey

The time required to administer the survey is approximately 30 minutes.

Equipment and Materials List

1. Record the results on one record sheet per subject, using the rating system for scoring all test items.
2. Pencil for recording and a clipboard to hold paper and pencil.
3. Stopwatch.
4. Vinyl tape measure, which is secured in place on the floor of the test site throughout the test admininstration; for the standing long jump, and sit and reach items.
5. Blue (or any bright color) floor marking tape.
6. Masking tape.
7. A 20 foot retractable tape measure with which to measure the distances for test items.
8. One eight inch rubber playground ball.
9. Three regulation size tennis balls.
10. One 14 by 18 inch target to hang upon the wall.
11. Two 5 by 10 feet mats, such as tumbling mats.
12. Two bowling pins, or substitute cones.
13. Twelve wooden kitchen matchsticks, with the striking end removed.

14. A plastic, 4-1/2 by 5 inch container in which to place the matchsticks.

15. One balance beam (8 feet in length and 4 inches in width on the walking surface, which is 8 inches off the floor).

16. One box of six wooden blocks (1-1/4 inch square dimensions).

17. One bar (as for chinning), which is at a height to allow the subjects to fully extend their bodies.

18. Two folding chairs and one, three foot long, bamboo pole.

19. One Nerf football, 8 inches by 10 inches in dimension.

Task 1. Curl

Facilities and Equipment. A mat and a stopwatch.

Procedures. The subject lies on his/her back on the mat, in the bent knee position, with feet flat on the floor (or mat surface). Slowly the subject lifts head and shoulders toward the bent knees and then lowers back to the outstretched position. The examiner demonstrates.

Scoring. The score is the number of completed curls in 30 seconds. The criterion score is based upon the best performance of three trials. Four or more completed curls by the three year old subject rates a 5 on the scale; four year old subjects must complete six or more curls to earn a 5 rating.

The following are scoring guidelines used by this investigator:

Criteria = Number of Repetitions		Rating
Three Year Old	Four Year Old	
4	6	5

Three Year Old	Four Year Old	Rating
3	5	4
2	4	3
1	3	2
0 (an attempt)	2	1

Task 2. Standing Long Jump

Facilities and Equipment. A blue tape line on the floor and a tape measure. A vinyl tape measure taped in place perpendicular to the blue tape line and extended to its full length.

Procedures. The subject is asked to stand behind the blue tape line with feet parallel, facing the outstretched measuring device. Instructions are that the subject should jump as far as possible and land on both feet. The examiner demonstrates. With the tape already in place and reading from zero at the takeoff point, the examiner need only note the landing point and record the distance.

Scoring. The score recorded is the best of three jumps for distance. Record the distance in inches of the body part (feet, hands, hips, etc.) that touches the floor nearest to the starting line.

Criteria. Thirty-nine inches or more is an excellent jump.

Distance of (in inches)	Rating
33-38	5
27-32	4
21-26	3
15-20	2
9-14	1

Task 3. Straight Arm Hang

Facilities and Equipment. Any bar of sufficient height from the

floor so that the subject's feet do not touch the floor when he/she is hanging fully extended. The subject may require an assist to reach the bar. The examiner demonstrates and then times the subject with the stopwatch from the time the grasp on the bar is secure until the release from the bar.

Procedures. The subject is instructed to grasp the bar with both hands in an overhand grip and to hang on for as long as possible. The arms are in an extended position.

Scoring. The score is recorded as the time, to the nearest tenth of a second, that the subject hangs onto the bar until the release of the bar.

Criteria (in seconds)	Rating
13 to 20	5
9 to 12	4
5 to 8	3
1 to 4	2
0	1

Task 4. One Leg Stand (Dominant Leg)

Facilities and Equipment. A stopwatch.

Procedures. The subject is asked to raise either leg and maintain his/her balance as long as possible without hopping. The preferred leg should be noted and the subject is required to use the same leg on repeated trials of the task. The time until the subject can no longer balance on one leg is recorded to the nearest tenth of a second. The raw score in seconds, or the ratings, may be used according to the examiner's preference. The verbal directions are: "Now

please pretend you are a bird that stands on one leg for as long as possible." The examiner demonstrates. Time to the nearest tenth of a second.

Criteria (in seconds)	Rating
6 to 10	5
2 to 5	4
1 to 1.5	3
.5 to .9	2
less than .5	1

Task 5. One Leg Stand (Dominant Leg)
Eyes Closed

Facilities and Equipment. A stopwatch.

Procedures. The same procedures and the same leg as was used in Task 4 are utilized in this task; the exception is that the subject is requested to close his/her eyes before performing the one leg stand.

Scoring. Record the time on the stopwatch, from the time eyes are closed and the leg is lifted, until balance is no longer maintained. Time to the nearest tenth of a second.

Criteria (in seconds)	Rating
3 to 6	5
1.5 to 2	4
.5 to 1	3
.4	2
fails to maintain balance when eyes are closed	1

Task 6. One Leg Stand (Non-Dominant Leg)

Facilities and Equipment. Stopwatch.

Procedures. The same instructions as were given in Task 4, with the instructions being: "Now we shall pretend you are a bird that can stand only on the other leg, with your eyes open." Note that the subject stands on the opposite leg from the one used in Tasks 4 and 5.

Scoring. Same criteria and rating as for Task 5.

Task 7. Balance Beam Walk - Forward

Facilities and Equipment. A four inch wide beam, eight feet in length, which is supported on the floor by wooden brackets so as to hold it at a level of eight inches off the floor.

Procedures. The subject is instructed to walk in a heel to toe fashion, placing one foot in front of the other, from one end of the beam to the other. The subject may require a supporting hand to start, but should not be given support for the walking task (except during a trial, which is not scored). The examiner demonstrates. The subjects may remove their shoes.

Scoring.

Criteria	Rating
Alternating feet:	
6 steps or more	5
4 steps or more, with only 1 step off to the floor	4
3 steps, nor more than 2 times off the beam	3
2 steps and 3 times stepped off	2
takes only 1 step on the beam before stepping on and off repeatedly	1

Task 8. Balance Beam Walk - Backward

Facilities and Equipment. Same as for Task 7.

Procedures. Beginning at the end of the beam where Task 7 ended, the subject is instructed to step upon the beam and cautiously proceed to step backward, in a toe-to-heel fashion, continuing until six steps are accomplished. The examiner demonstrates.

Scoring.

	Rating
Subject alternates 4 steps or more	5
Subject moves fewer than 4 steps and either steps off or slides the feet	4
Fewer than 3 steps; more than 2 times off to the floor and/or slides the feet most of the distance	3
Only 2 steps backward, slides remainder or steps off 3 times	2
Subject fails to step alternating feet behind, rather turns sideways or slides until told he/she has completed the item; or steps off more than 4 times	1

(The subject in both Tasks 7 and 8 may need to be reminded to take the walk deliberately and not to be rushed. Up to three trials may be permitted.)

Task 9. Ascending the Stair

Facilities and Equipment. If stairs are not available in the facility, a moveable stairway might be implemented. A flight of at least eight steps is preferred.

Procedures. The child is instructed to precede the examiner up the stairs. If the moveable stairway is used, it should have a railing for safety considerations. Also, the child may need to climb up and down more than once to give the examiner ample observation time.

Scoring.

	Rating
Subject climbs, alternating feet, without stair rail	5
Subject climbs, one step at a time, alternating feet, using the rail	4
Subject steps, always leading with the same foot; not alternating	3
Subject leads with the same foot and clings to rail	2
Subject will climb only when hand is is held by an adult	1

Task 10. Jump and Turn

Facilities and Equipment. A mat of 10 by 10 feet dimensions, or two 5 feet by 10 feet mats, placed parallel to one another and secured so as to insure the safety of the subject.

Procedures. The subject is instructed to jump into the air and turn about as far as possible before attempting to land on his/her feet. The demonstration exhibits a 360 degree turn.

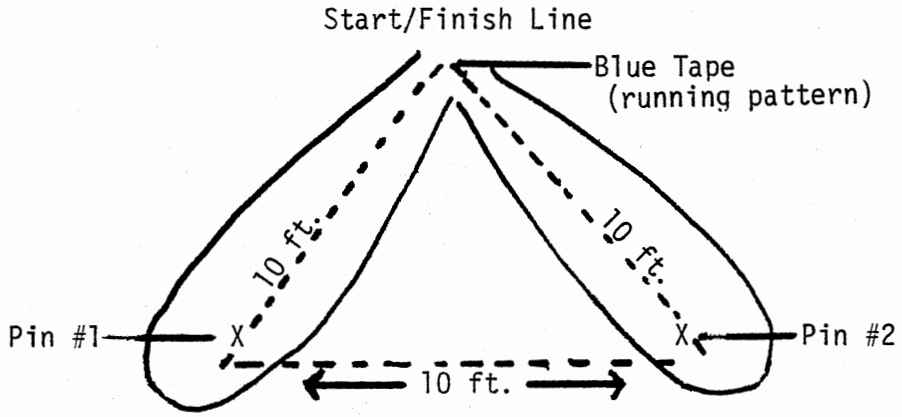
Scoring.

	Rating
Past 180 degrees toward 360 degrees, lands on feet	5
Past 180 degrees, fails to land erect on feet	4
Completes only 180 degree turnto land on feet	3

Scoring	Rating
Turns 180 degrees, but fails to land on feet	2
Turns less than 180 degrees, and fails to land on his/her feet	1

Task 11. Agility Run

Facilities and Equipment. Stopwatch and two bowling pins, each decorated in separate, distinctive fashions by painting and/or gluing fabric to the object. (Plain colored cones might be substituted for the bowling pins.) A single tape line designates the start and finish line. A tape measure is used to measure the distance of 10 feet between the pins and the start/finish line. Pattern:



Scoring. Subject is timed to the nearest 1/10th of a second for the completed run from the signal to go, until the return to the finish line. The examiner demonstrates the pattern by turning small, close circles about the pins. Observe how the child maneuvers the turns and record the time for the best of three trials.

Time in Seconds	Rating
10 to 11.7	5
11.8 to 12.5	4
12.6 to 13.3	3
13.4 to 15.0	2
15.1 to 16.8	1

Task 12. Hopping

Facilities and Equipment. The same tape line as was used for the agility run and a shorter tape line of masking tape, eight feet from the blue tape line.

Procedures. The subject is instructed to first hop on both feet, "like a bunny rabbit"; then, after reaching the second tape marker, "hop on one foot as though the bunny had a sore foot." It is assumed the subject will choose to hop first on the dominant foot. Then, after the hop back toward the blue tape, the examiner instructs the subject to now pretend the bunny's other foot is sore and hop on the opposite foot. This is a difficult item for many children of this age, so the subject may need some verbal encouragement; such as the statement, "I know this is not easy, but just do the best you can." The examiner demonstrates.

Scoring.

Both Feet	Dominant Foot	Non-Dominant Foot	Rating
6-8 hops	3	2	5
4-5 hops	2	1	4
2-3 hops	1	1/2 hop & 1/2 skip	3
0-1 hops	0 (appears to be more a skip than a hop)	0	2
no successful attempt	no success	no success	1

Task 13. Tapping

Facilities and Equipment. The top of the storage box which serves as the container for materials is used for the tapping task.

Procedures. The subject is requested to be seated on one side of the box, while the examiner is seated on the other side. The examiner then uses the surface of the box to demonstrate the finger tapping tasks. As though placing fingers on a piano keyboard, one finger at a time follows the placement of the thumb on the tapping surface. After the thumb is tapped on the surface, each finger is consecutively placed as the movement continues outward toward the smallest finger. The tapping maneuver of the thumb and fingers is repeated three times, with a gradually more quickening pace for each repetition. A second part of the tapping involves the examiner tapping a one-two, then a one-to-three beat with the first index finger. The subject is asked to duplicate the rhythm established by the examiner.

Scoring.

	Rating
Subject can smoothly replicate the demonstrated task, and can copy the rhythm without hesitation	5
Subject is slow to respond to the task or can only duplicate the rhythm in a halting fashion	4
Subject can repeat the first part of the task, but cannot sustain the rhythm	3
Subject can copy the first part of the task, but not the second part	2
Subject can neither manipulate the first task of tapping, nor the rhythmical part two of the task	1

Task 14. Touching Finger to Nose

Facilities and Equipment. Any location in the room. No equipment.

Procedures. The subject is instructed to stand facing the examiner and extend the arms sideward at shoulder height. Next, instructions are for the subject to close his/her eyes and, first with one hand and then with the other hand, bring fingertips in so as to touch the nose three times, alternating hands each time. Demonstration by the examiner includes a reminder that the head should remain still and eyes should remain closed.

Scoring. Three attempts are allowed to touch the index fingers to the nose.

Criteria	Rating
Without moving the head nor opening his/her eyes, the subject touches his/her nose three times	5
Subject touches his/her nose twice, with eyes remaining closed and head still	4
Subject touches his/her nose but moves the head from side to side in the direction of his/her fingers	3
Subject fails to touch without opening his/her eyes	2
Subject both turns his/her head and opens eyes	1

Task 15. Target Throw

Facilities and Equipment. Three tennis balls; a vinyl target with the dimensions of 14 inches wide by 18 inches in length is attached to the wall. The bottom margin of the target is 34 inches from the floor. (The target was represented as a green frog, but other animals or a smiling face might be substituted for the frog.) Masking tape at a distance of seven feet from the wall marked the restraining line for the subject.)

Procedures. The subject is asked to stand behind the tape restraining line and throw three times at the target. A second trial of three throws is allowed if the examiner requires more time to view the subject in the motion of throwing. The examiner demonstrates.

Scoring. The examiner looks for a mature throwing pattern: the ball is brought backward over the shoulder, the arm is next brought forward and downward to release the ball, some body rotation, and shift of weight followed by stepping forward with the foot that is in opposition to the throwing arm. A few four year old children may step forward in opposition to the throwing arm. Very seldom will the three year old exhibit stepping in opposition, but he/she may rotate the body in the direction of the throw.

Criteria	Rating
The thrown ball makes contact with any part of the frog, and a mature throwing pattern is demonstrated for each of the three throws	5
Subject's thrown ball hits the target two out of three times, and body weight is shifted, but no stepping in opposition to the throwing arm	4
Subject hits the target, but fails to shift the body weight or rotate	3
Subject hits the target only two times from a stationary position (immature throwing pattern)	2
Subject hits the target only once or fails to hit the target and demonstrates the need for practice in mature throwing; i.e., no rotation, no step in opposition, and early or late release of the grasp on the ball	1

Task 16. Bounce and Catch

Facilities and Equipment. One eight inch, rubber playground ball and a floor surface from which the ball will rebound.

Procedures. The subject is asked to hold the ball with both hands, then lift the ball to shoulder height and release his/her grasp. As the ball rebounds from the floor, the subject regrasps it with his/her fingers and hands. Repeat for a total of three trials. The examiner demonstrates.

Scoring.

	Rating
Subject bounces and recovers the ball three out of three times with re-grasping movements	5
Subject regrasps the ball two out of three times	4
Subject succeeds in catching the ball only by trapping it within the forearm and against the body	3
Subject catches the ball only once by trapping it against the body	2
Subject fails to trap or catch the ball for any of the trials	1

Task 17. Fingertip Touching

Facilities and Equipment. None. Count seconds by saying, "One thousand-one; one thousand-two," etc. (or may use stopwatch).

Procedures. The subject is asked to touch all the fingers of one hand in succession with the thumb of the same hand, beginning with the little finger. Then the subject is asked to reverse the order. The examiner demonstrates. Allow three trials.

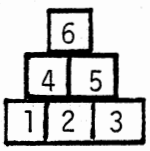
Scoring. The best of three trials is scored. The subject should be capable of touching each finger and reversing the order in under six seconds.

	Rating
Subject accomplishes the touching first in one direction and then reverses the direction, but requires more than six seconds	4
Subject can accomplish the task the first direction, but not in reverse	3
Subject can only accomplish the task very slowly and with extreme concentration; or touches some fingers more than once	2
Subject is haltingly slow and can touch finger in one direction only, or repeats the touch of some fingers more than once	1

Task 18. Tower of Blocks

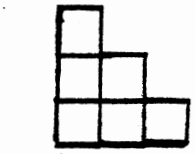
Facilities and Equipment. Six wooden blocks and the storage box surface. Stopwatch.

Procedures. The subject is seated opposite the examiner so as to use the table-like surface made from the box cover. Six blocks are placed on the top surface and the following instructions are given: "Please watch while these blocks are made into a tower. Now please try to make a tower that looks just like mine." The blocks are disassembled and placed in front of the subject. The examiner times how long it takes the subject to assemble the tower. Block #6 is the last block put into place. The tower looks like the following:

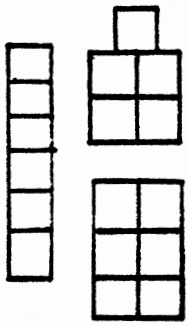


Scoring.

	Rating
Blocks assembled very much the same as demonstrated in less than 10 seconds	5
Blocks assembled as demonstrated, but time exceeds 10 seconds	4
Blocks in a tower, but top two rows are off center as in (a); in less than 10 seconds or the reverse	3
Blocks assembled as in previous criteria, but longer than 10 seconds	2
Blocks are stacked one on top of another in a single fashion as shown in (b), or not all blocks are used	1



(a)

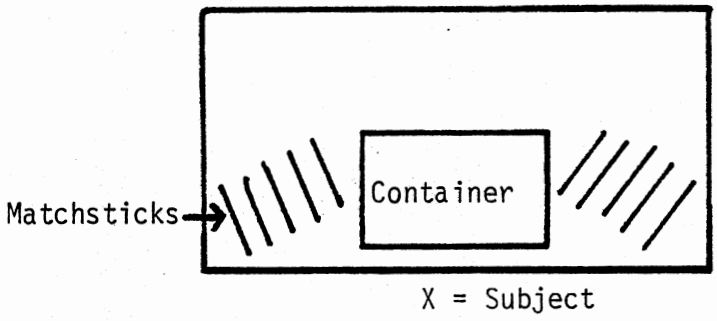


(b)

Task 19. Matchsticks in the Box

Facilities and Equipment. The storage box surface, and a four and one-half inch by five inch plastic container that is two inches deep. Twelve matchsticks that have the striking end cut off. Stopwatch.

Procedures. The plastic container in front of the subject approximately three inches from the edge of the surface nearest to the subject. Six matches are placed at approximately one-half inch intervals next to each other, fanning outward on either side of the plastic container. Example:



The subject is asked to observe as the examiner demonstrates. When the signal is given to "go," the subject begins with both hands, picking up the matchsticks that are the greatest distance from the

container. One matchstick in each hand from each side is lifted and placed into the container, not thrown. With each successive pick up, the hands are brought in closer to the next matchsticks until all sticks have been placed in the container. The examiner times, with the stopwatch, from the signal "go" until all sticks are placed in the box. If more than one stick at a time is picked up in one hand, the examiner reminds the subject, "one stick per each hand for each pick up."

Scoring

Criteria (in seconds)	Rating
0 to 12	5
13 to 20	4
21 to 30	3
30 to 40	2
40 or more	1

Task 20. Sit and Reach

Facilities and Equipment. A mat with tape measure secured to it by masking tape. A blue tape line on which the subject will sit. (The same area used for the standing long jump serves for this task.)

Procedures. The subject is told to assume a sitting position with legs together and knees straight, feet slightly apart. Bend and reach foward with one hand on top of the other as far as you can reach and hold that position for the court of one thousand-one, one thousand-two, one thousand-three. The best distance achieved for three trials is recorded. The examiner stands to one side of the subject so as to view the reaching distance on the tape, and simultaneously, watches that the subject starts with hips placed on the blue tape line.

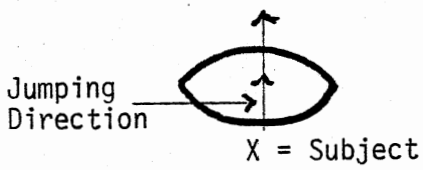
Scoring. Record the best distance reached. Score may be compared by distance alone or converted to the rating.

Criteria (in inches)	Rating
26 to 30	5
21 to 25	4
16 to 20	3
11 to 15	2
10 or less	1

Task 21. Jump Over Low Object

Facilities and Equipment. On the mat surface, anywhere in the testing area; a Nerf football or foam block of similar dimensions; the football is 10 inches in length and measures a height of eight inches from the jumping surface.

Procedures. The subject is asked to show the examiner how he/she can jump over the ball. The examiner demonstrates by jumping over the football that has been placed so the pointed ends parallel the subject's shoulders.



Scoring: The demonstration should have shown the subject a two foot take-off and a two foot landing. The feet should not be lifted excessively high or to the side around the object being jumped.

Criteria	Rating
Feet easily cleared the object and the subject performed a two foot take-off and landing	5

Criteria	Rating
Feet clear the object, but the subject exhibits excessive knee lift and/or unsteady landing (off balance)	4
Subject cleared the jump, but brought the feet around rather than over the object	3
Subject performed a one foot rather than a two foot take-off and landing	2
Subject brings the feet around, not over the object at a height that would have failed to clear the object	1

Task 22. Imitation of Movement

Facilities and Equipment. Any location in the testing area. No equipment. If arm positions are not memorized, a chart might be useful to serve as a reminder for the examiner.

Procedures. The subject is instructed to stand at a distance of four feet, facing the examiner. Next, the subject is asked to watch closely and copy the arm position of the examiner. Subjects are told that this task is like "Follow the leader." The examiner must closely observe the subject's movements to ascertain if visual cues are translated into a motor pattern. (See Figure 1 for a stick figure illustration.)

Scoring. The subject may mirror or parallel the arm movements. Most frequently, the mirroring will be observed; for example, when the examiner moves the right arm, the subject moves the left arm. Observation is for the purpose of determining that the subject identified which arm should move. If the subject started, then stopped and changed direction or arm movement; or, if tenseness is obvious prior to the movement, the subject is experiencing difficulty copying the

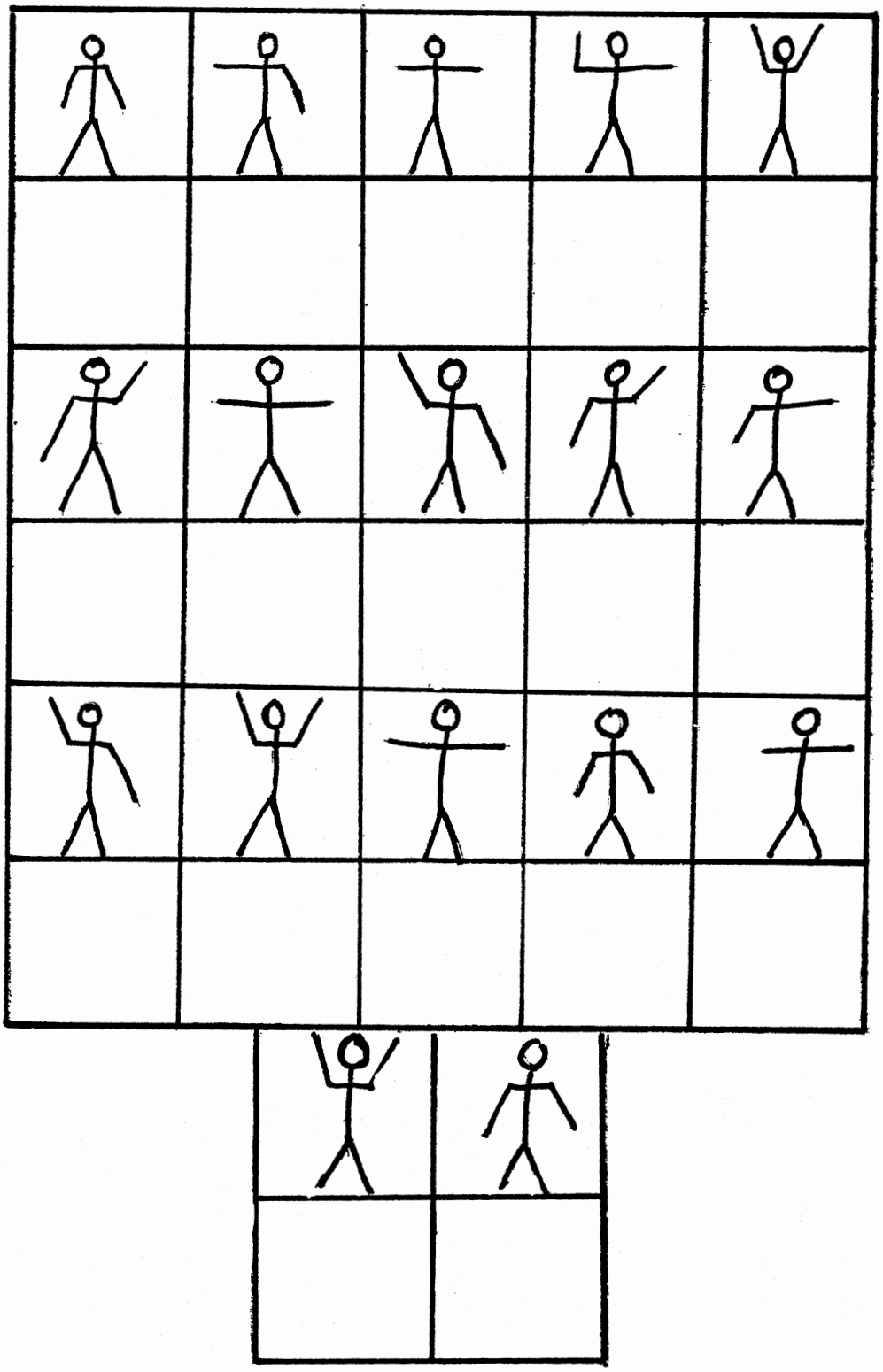


Figure 1. Imitation of Movement

movements. If the subject begins by mirroring, but changes to parallel the movement, he/she may be experiencing weak laterality. Many subjects of the preschool age may tire after 16 positions have been completed. The examiner should note at what point the subject ceases to follow the movements.

Criteria

	Rating
Subject follows all moves well, by mirror or parallel	5
Subject completes only 15 positions, or exhibits problems, as discussed above	4
Subject follows at least through position 12, but is slow and indecisive about arm changes	3
Subject ceases to follow at position 8 or 9, and/or shows other difficulties discussed above	2
Subject only briefly attempts to follow the examiner; i.e., six or fewer positions	1

In the last three cases, the questions the examiner would be asking would be: (1) Can the subject not translate visual cues into a neuromuscular action? and (2) In each case, were more problems occurring with bilateral, unilateral, or centralateral arm position changes? (Only one trial is given for Task 22.)

Task 23. Identification of Body Parts

Facilities and Equipment. Any location in the room. No equipment.

Procedures. The subject is asked, "Can you show me where your nose is? Point to it, please." The examiner continues to request the

subject to point to: eyes, ears, toes, knees, an elbow, and the mouth. Less familiar body parts are: shoulder, chin, and cheek.

Scoring.

Criteria	Rating
Subject points to all parts without any hesitancy	5
Subject identifies all but one part	4
Subject identifies all but two parts and shows some hesitancy	3
Subject fails to identify three parts	2
Subject has difficulty identifying four or more parts	1

Task 24. Go Over, Under, and Between

Facilities and Equipment. Two chairs, one 30 inch bamboo pole, a mat, and the stopwatch. The pole is suspended between the chairs, resting on the seat portion. The chairs are side by side, with 25 inches of space between them.

Procedures. The subject is asked to observe closely as the examiner demonstrates: Standing behind the blue tape line, the subject runs when given the signal "go." He/she runs to the chairs with the pole stretched between them and crawls under the pole, between the chairs. Next, in a standing position, he/she turns to the right, circles the chair, and steps over the pole. Then, he/she turns left around the second chair and runs quickly past the line where the task began. (If subjects do not know right and left, the examiner merely says while demonstrating, "Turn this way" and circles right. The next turn, the examiner says, "Now turn the other way.")

Scoring

	Rating
Subject completes the course without hesitation (time is from 10 to 17 seconds)	5
Subject forgets the direction of the turn and/or has difficulty stepping over the pole (time is from 18 to 25 seconds)	4
Subject goes wrong direction and must be told what comes next in the course (time from 26 to 30 seconds)	3
Subject knocks off pole and/or circles a chair more than once and must be told what occurs next (time from 31 to 35 seconds)	2
Subject exhibits total confusion about following the series of directions and must be talked through the course (more than 35 seconds)	1

Analysis and Interpretation of the Data

The data to be interpreted for this study was collected; first, by administering the informal survey instrument that preceded this section. Secondly, the data that was generated by the survey were computed to explore the statistical significance of the results. The motor performance survey was analyzed by comparing the relationship of the variables and by examining the central tendencies and divergence. By subjecting the data that were generated to a t-test, it was determined what differences had inferential validity.

Finally, the hypotheses that were examined by the research procedures were discussed. The hypotheses to be studied were concerned with differences between:

1. Test and retest scores produced on 24 items.
2. Motor development patterns of the subjects.

SUMMERS
MOTOR PERFORMANCE SURVEY RECORD

Name_____Sex____Birthdate_____

Examiner_____Date_____Prefers hand/foot_____

Motor Items	Score	Comments	Time*
1. curl	1 2 3 4 5		
2. standing long jump	1 2 3 4 5		
3. flexed arm hand	1 2 3 4 5		
4. one leg stand	1 2 3 4 5*		
5. one leg, close eyes	1 2 3 4 5*		
6. one leg, non-dominant	1 2 3 4 5*		
7. beam walk, forward	1 2 3 4 5		
8. beam walk, backward	1 2 3 4 5		
9. ascend stairs	1 2 3 4 5		
10. jump and turn	1 2 3 4 5		
11. agility run	1 2 3 4 5*		
12. hopping	1 2 3 4 5		
13. tapping	1 2 3 4 5		
14. touch finger to nose	1 2 3 4 5		
15. target throw	1 2 3 4 5		
16. bounce/catch	1 2 3 4 5		
17. fingertip touching	1 2 3 4 5		
18. tower of blocks	1 2 3 4 5		
19. matches in box	1 2 3 4 5		
20. sit and reach	1 2 3 4 5		
21. jump over low object	1 2 3 4 5		
22. imitate movement	1 2 3 4 5		
23. identify body parts	1 2 3 4 5		
24. go over, under, and between	1 2 3 4 5		

Note: Circle the rating and/or record the time or distance and comments. It is recommended that examiners use the rating systeme for all test items to produce a consistent score for each subject tested.

3. Male and female subjects' performance on the items.

4. Subjects' age and motor performance as measured by the survey.

5. Items selected as tasks to represent the eight motor performance factors for this study.

To compare variables that were utilized as test items, scores for each task were computed rather than composite test scores for each subject that was tested. The individual treatment of the data made it possible to view the performance items separately and compare the responses in light of sex and age differences.

Separate response values on the 24 items were recorded to permit analysis of the variable to variable comparisons. To gain more understanding of the different categories of performance, 17 items were calculated by the rating scale criteria and the seven remaining items were analyzed in relation to the actual time or distance that was recorded as the response to the item.

The empirical value of scores which combine continuous and discrete data is that such measures permit more varied inferences to be drawn. This process allowed quality of movement behaviors to be measured, rather than only quantity and speed of performance.

Presentation of the Data

Table IV shows the means and standard deviations for three year old children first, and next, four year old children are shown on each of the initial test items. The table is divided into the categories of the rated scores, and then, the scores by time or distance items. The total 30 cases were divided into 12 three year olds and 18 four year olds.

TABLE IV

MEANS AND STANDARD DEVIATIONS FOR THREE AND FOUR YEAR OLD CHILDREN ON TEST ITEMS

Test Items	Three Year Olds		Four Year Olds		Probability
	Mean	S.D.	Mean	S.D.	
Curl	3.333	1.435	4.333	0.594	0.013
Balance Beam, Forward	4.000	0.953	4.1667	0.924	
Balance Beam, Backward	2.7500	1.138	3.2222	1.114	
Stair Ascent	4.4167	0.669	4.4444	0.705	
Jump Turn	3.3333	0.888	4.2222	0.808	0.008
Hopping	2.7500	0.622	4.1667	0.985	0.000
Tapping	3.0000	0.853	3.8444	0.938	0.009
Touch Finger to Nose	3.3333	1.371	4.1111	0.832	
Target Throw	3.7500	0.866	4.0000	0.767	
Bounce and Catch	2.8333	0.924	3.8333	1.403	
Fingertip Touch	2.9167	0.996	4.1111	0.758	0.001
Tower of Blocks	2.9167	1.443	4.1667	0.756	0.005
Matches in Box	3.2500	1.422	3.9444	0.725	
Jump Low Object	3.8333	1.267	4.2778	0.895	
Imitative Movement	3.4167	1.051	3.9444	1.305	
Identification of Body Parts	4.9167	0.289	4.7222	0.461	
Go Over, Under, and Between	3.3333	0.698	4.3889	1.155	

TABLE IV (Continued)

Test Items	Three Year Olds Mean	Three Year Olds S.D.	Four Year Olds Mean	Four Year Olds S.D.	Probability
Standing Long Jump	4.000	0.853	4.000	0.840	
Straight Arm Hang	9.883	3.399	12.4111	5.601	
Leg Stand, One Leg	2.233	1.335	2.9556	2.274	
Leg Stand, Eyes Closed	1.517	0.727	1.5167	0.732	
Leg Stand, Non-Dominant Leg	1.517	0.830	2.2278	1.289	
Agility Run	12.842	1.807	12.1667	1.662	
Sit and Reach	23.450	2.550	25.4444	2.406	

Note: The items on the first page of this table were rated on the scale of 1 to 5; the above items were scored by time or distance measure. Subjects who were three year old children (N=12); subjects who were four year old children (N=18).

This discussion will first deal with the comparison of three and four year old children's means on the items that were measured. The higher means were recorded for four year old subjects on these tasks: curl, straight arm hang, one leg stand, one leg stand on non-dominant leg, balance beam walk-forward, balance beam walk-backward, stair ascent, jump and turn, hopping, tapping, touch finger to nose, target throw, bounce and catch, fingertip touching, tower of blocks, matches in a box, jump over low object, sit and reach, imitation of movement, and over, under, and between.

The items which had equal or higher means for three year old subjects than for four year old subjects, respectively, were: leg stand-eyes closed (μ = 1.5167 vs. 1.5167), agility run (μ = 12.8417 vs. 12.1667), and identification of body parts (μ = 4.9167 vs. 4.7222).

Interestingly, there were two items which had means which were identical for both age groups. They were: the standing long jump (μ = 4.000) and the one leg stand-with eyes closed (μ = 1.15167).

Items which showed unusually high appearing figures for means are the items which were timed or measured for distance; i.e., the straight arm hang, agility run, and the sit and reach. The difference in recording raw data and rating for the item responses is assumed to be the reason for the range in these means.

For three year old children, the smallest standard deviation was for identification of body parts; and for four year old children, the smallest was the curl.

Regarding Table V, the retest items indicate scores having higher means for four year old children on: (1) the curl; (2) straight arm

TABLE V

MEANS AND STANDARD DEVIATIONS FOR THREE AND FOUR YEAR OLD CHILDREN ON RETEST ITEMS

Retest Items	Three Year Olds		Four Year Olds		Probability
	Mean	S.D.	Mean	S.D.	
Curl	3.833	0.937	4.0556	1.110	
Balance Beam, Forward	3.9167	0.900	4.2222	0.878	
Balance Beam, Backward	3.0833	0.996	3.3333	0.907	
Stair Ascent	4.3333	0.651	4.5556	0.616	
Jump Turn	3.9167	1.084	4.2222	0.732	
Hopping	3.4167	0.793	4.1111	1.323	
Tapping	3.0833	1.084	4.0556	1.056	0.021
Touch Finger to Nose	3.9167	0.669	4.1667	0.985	
Bounce and Catch	3.5833	1.564	3.9444	1.056	
Fingertip Touch	3.6667	0.985	4.0556	0.938	
Tower of Blocks	3.4167	0.900	4.3889	0.850	0.001
Matches in Box	3.9167	0.996	4.2222	0.732	
Jump Low Object	4.3333	0.778	4.5000	0.618	
Imitative Movement	4.1667	0.937	4.5556	0.616	
Identification of Body Parts	4.6667	0.651	4.8889	0.323	
Go Over, Under, and Between	3.7500	0.622	4.5000	0.707	0.006

TABLE V (Continued)

Retest Items	Three Year Olds Mean	Three Year Olds S.D.	Four Year Olds Mean	Four Year Olds S.D.	Probability
Standing Long Jump	4.1667	0.937	4.0000	1.029	
Straight Arm Hang	12.4750	4.015	15.3667	8.191	
Leg Stand, One Leg	2.2750	1.432	2.4889	1.185	
Leg Stand, Eyes Closed	1.1667	0.311	1.6889	0.548	0.006
Leg Stand, Non-Dominant Leg	1.6917	0.699	2.2722	1.326	
Agility Run	11.7750	2.245	11.4833	2.178	
Sit and Reach	22.9583	2.244	26.3833	2.489	0.001

Note: The items on the first page of this table were rated on the scale of 1 to 5; the above items were scored by time or distance measure. Subjects who were three year old children (N=12); subjects who were four year old children (N=18).

hand; (3) leg stand with eyes closed; (4) non-dominant leg stand; (5) balance beam forward; (6) balance beam backward; (7) stair ascent; (8) jump and turn; (9) hopping; (10) touch finger to nose; (11) tapping rhythmically; (12) target throw; (13) bounce and catch; (14) tower of blocks; (15) matches in a box; (16) sit and reach; (17) jump over low object; (18) imitation of movement; and (19) go over, under, and between. Items that resulted in higher means for the younger subjects on the retest were: (1) standing long jump, and (2) agility run.

On the retest analysis, the smallest standard deviation was for the eyes closed, one leg stand. Four year old children showed the smallest standard deviation on identificaiton of body parts.

As might be predicted, the older children, the four year olds, had better showings on the strength, both balance factors, and two gross body coordination tasks--limb-eye coordination, and manual dexterity--but only on one locomotor and body awareness task.

The youngest children, the three year olds, performed equally as well as the older, four year olds on the standing long jump. This was interpreted as indicating that leg strength in the two age groups does not alter greatly.

One surprising result was that the younger children had slightly higher mean scores on the agility run. The older children might have been expected to perform best on this task.

The scores for subjects on individual items are shown in Tables VI and VII for the purpose of comparing sex-related differences. The columns are divided into two groups: One group showing male subjects' means and standard deviation; the other showing female subjects' comparable values.

TABLE VI

MEANS AND STANDARD DEVIATIONS FOR MALE AND FEMALE SUBJECTS, ON TEST

Test Items	Male - Group 1		Female - Group 2	
	Mean	S.D.	Mean	S.D.
Curl	3.8889	1.364	3.9524	1.024
Balance Beam, Forward	3.8889	1.054	4.1905	0.873
Balance Beam, Backward	2.7778	1.394	3.1429	1.014
Stair Ascent	4.4444	0.527	4.4286	0.746
Jump Turn	4.1111	0.601	3.7619	1.044
Hopping	3.4444	1.014	3.6667	0.155
Tapping	3.2222	1.093	3.7143	0.956
Touch Finger to Nose	3.8889	1.269	3.8095	0.814
Bounce and Catch	3.5556	1.014	3.3810	1.322
Fingertip Touch	3.5556	1.130	3.6667	1.017
Tower of Blocks	3.3333	1.500	3.8095	1.123
Matches in Box	3.6667	0.866	3.6667	1.197
Jump Low Objects	4.5556	0.726	3.9048	1.136
Imitative Movement	3.8889	1.364	3.6667	1.426
Identification of Body Parts	4.7778	0.441	4.8095	0.421
Go Over, Under, and Between	4.222	0.667	3.8571	1.153

TABLE VI (Continued)

Test Items	Male - Group 1		Female - Group 2	
	Mean	S.D.	Mean	S.D.
Standing Long Jump	4.3333	0.707	3.8571	0.854
Straight Arm Hang	11.9333	6.632	11.1714	4.189
Leg Stand, One Leg	2.6556	2.441	2.6714	1.783
Leg Stand, Eyes Closed	1.7222	0.902	1.4286	0.627
Leg Stand, Non-Dominant Leg	1.6111	0.885	2.0857	1.261
Agility Run	12.5000	1.907	12.3667	1.695
Sit and Reach	24.6556	1.905	24.6429	2.912

Note: The items on the first page of this table were rated on the scale of 1 to 5; the above items were scored by time or distance measure. Subjects who were in Group 1, Males (N=9); subjects who were in Group 2, Females (N=21).

TABLE VII

MEANS AND STANDARD DEVIATIONS FOR MALE AND FEMALE SUBJECTS, ON RETEST

Retest Item	Male - Group 1		Female - Group 2	
	Mean	S.D.	Mean	S.D.
Curl	4.2222	0.833	3.8571	1.108
Balance Beam, Forward	4.0000	0.866	4.1429	0.910
Balance Beam, Backward	3.2222	0.527	3.2381	0.944
Stair Ascent	4.4444	0.527	4.4762	0.680
Jump Turn	4.2222	0.833	4.0476	0.921
Hopping	3.8889	0.928	3.8095	1.289
Tapping	3.2222	1.202	3.8571	1.108
Touch Finger to Nose	3.8889	0.601	4.1429	0.964
Bounce and Catch	4.2222	0.833	3.6190	1.1396
Fingertip Touch	3.5556	0.833	4.0476	0.973
Tower of Blocks	3.7778	0.833	4.0952	1.044
Matches in Box	4.1111	0.601	4.0952	0.944
Jump Low Object	4.3333	0.707	4.4762	0.680
Imitative Movement	4.4444	0.726	4.310	0.805
Identification of Body Parts	4.7778	0.441	4.8095	0.512
Go Over, Under, and Between	4.5556	0.527	4.0476	0.805

TABLE VII (Continued)

Retest Item	Male - Group 1 Mean	Male - Group 1 S.D.	Female - Group 2 Mean	Female - Group 2 S.D.
Standing Long Jump	4.4444	0.726	3.9048	1.044
Straight Arm Hang	15.1000	6.302	13.8286	7.246
Leg Stand, One Leg	2.5111	1.610	2.3571	1.137
Leg Stand, Eyes Closed	1.5000	0.536	1.1471	0.540
Leg Stand, Non-Dominant Leg	2.3889	1.302	1.8905	0.232
Agility Run	11.0444	2.922	11.8381	1.795
Sit and Reach	24.3000	2.870	25.3190	2.939

Note: The items on the first page of this table were rated on the scale of 1 to 5; the above items were scored by time or distance measure. Subjects who were in Group 1, Males (N=9); subjects who were in Group 2, Females (N=21).

Table VI, the initial test computations for the nine males and 21 females, indicates that, as a whole, females performed better than males on balance items. One exception to this showing was the one leg stand with eyes closed. On this item, the mean average of 1.72 for males on the test was a better showing than the mean of 1.42 for females. This same pattern was repeated on the retest where the males' mean was 1.50, as compared to 1.114 for the females' mean.

It cannot be conjectured on the basis of this limited data as to why males' performances on the eyes closed, static balance task was better than the females' performances. This would merit further study with larger numbers of subjects to determine whether the trend is consistent. It can be suggested, however, that conducting balance tests only with eyes open may result in biased information being gathered when subjects of both sexes are being tested.

For the standing long jump, whereas no age-related difference was indicated, there was a sex-related difference which showed that males' performance was better. The difference was not significant, but was approximately the same in test and retest means: test-males (μ = 4.33) versus females (μ = 3.85); retest-males (t = 4.44) versus females (t = 3.90).

Values of the means for the agility run varied on the test and retest. Initial test values were greater for males, but the retest mean was greater for females. None of the values was of statistical significance, however, as far as sex differences were concerned.

Because no significant differences were revealed in relation to the sex of the subjects for the test items, it was concluded that the test was of equal value for both sexes.

The general findings for items on Tables VI and VII were that the males' performances resulted in higher means on all except the following items: Fingertip touching, tower of blocks, identification of body parts, tapping, hopping, and walking the balance beam forward and backward. The fact that these items are scattered throughout the test in the factors further substantiates that the test includes tasks which give opportunity to measure the motor performances of both sexes. Even the strength measure of the curl had means which were similar, so that it was decided that the status of both sexes in that component could be predicted.

Reporting the Correlation Data

The correlations were conducted for the purpose of exploring the question of relationship between the phenomena. The correlation coefficients provide an estimate as to the strength of the relationship. Weaker relationships are indicated by coefficients that are closer to zero. The weaker coefficients that were produced by this study were: t = -.0350, for the body identification item; t = 0.1902, for the one leg stand on the non-dominant foot; t = 0.223, for the jump over low object; and t = 0.2961, for touching finger to nose. The highest values for t were for: jump and run, t = 0.7237; balance beam walk, forward, t = 0.7475; and the balance beam walk, backward, t = 0.8088. The remainder of the items indicated only moderate systematic comparisons, as is shown in the correlation coefficients displayed in Table VIII.

Correlation coefficients for items that tested to be statistically significant, p = .361, in the variable to variable comparison

TABLE VIII

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENT

Variable	1	2	3	4	5	6	7	8	9	10
1. Curl	.3881 P=0.017									
2. Standing Long Jump		.5930 P=0.000								
3. Straight Arm Hang			.5932 P=0.000							
4. One Leg Stand				.3247 P=0.040						
5. One Leg Stand, Eyes Closed					.3296 P=0.038					
6. One Leg Stand, Non-Dominant Leg						.1902 P=0.157				
7. Balance Beam, Forward							.7475 P=0.000			
8. Balance Beam, Backward								.8088 P=0.000		
9. Ascending a Stair									.3177 P=0.044	
10. Jump and Turn Around										.7237 P=0.000

TABLE VIII (Continued)

Variable	11	12	13	14	15	16	17	18	19	20
11. Agility Run	.3388 P=0.034									
12. Hopping		.5585 P=0.001								
13. Tapping Rhythmically			.4649 P=0.005							
14. Touching Finger to Nose				.2961 P=0.056						
15. Target Throw					.3758 P=0.020					
16. Bounce and Catch						.3907 P=0.016				
17. Touching Fingertips							.3791 P=0.019			
18. Building a Tower of Blocks								.5373 P=0.001		
19. Matches in a Box									.4480 P=0.007	
20. Sit and Reach										.4792 P=0.004

TABLE VIII (Continued)

Variable	21	22	23	24
21. Jump Over Low Object	.3683 P=0.023			
22. Over, Under, Around, and Between		.5349 P=0.001		
23. Imitation of Movement			.2323 P=0.108	
24. Identification of Body Parts*				-.0350 P=0.427

*Nonsignificant.

Note: df = 28; P = .361; α = < .05.

for the test and retest were, as reported here, from the highest to the lowest:

Balance Beam, forward = .8088	Balance Beam, backward = .7475
Jump, Turn Around = .7237	Straight Arm Hang = .5932
Standing Long Jump = .5930	Hopping = .5585
Tower of Blocks = .5373	Over, Under, Between = .5349
Sit and Reach = .4790	Tapping = .4649
Matches in Box = .4480	Bounce and Catch = .3907
Curl = .3881	Jump, Low Object = .3683

The lowest correlation coefficient the data produced was the identification of body parts, which was a negative correlation, -.0350. This item was therefore considered to be the weakest measure for this study. Identification of body parts has been used in many motor tests throughout the past years, but this data does not support the item as tenable for use with the ages invovled in this research.

The reliability analysis for the test was computed on the two different bases for scoring the test items. The first category was the rating scale of 1 to 5 which recorded responses on 18 test items (the standing long jump was converted to the rating for computation with these measures). The reliability coefficient for these items for 30 cases was: alpha = 0.90995.

The second category was the values that were recorded by time or distance measure. For these six items the reliability coefficient was alpha = 0.28196. The great difference in the two alpha figures is explained by the fact that such coefficients are generally not based upon actual time and distance measures. It would be possible to

compute these values strictly on the rating for the purpose of other research projects.

Hypotheses Testing

The first hypothesis was concerned with learning whether there were significant differences between the test and retest scores on the 24 items. Sixteen of the 24 items were supported by the statistics data as being reliable measures. Eight items were weak and could therefore be questioned as being inappropriate items for measuring the motor performances of three and four year old subjects.

The data likewise supported the second hypothesis that most of the test items measure differences in the motor development of the preschool child. There do not appear to be major developmental differences in the subjects other than the abilities that are related to sex and age, and maturation.

The fact that no significant differences were seen in the test performance by the subjects in regard to sex would indicate that most items will not require separate norms for male and female subjects. As was noted in Table VI, males made better showings than females on items involving strength and running or jumping. Females performed better than males on items measuring balance, manipulation, locomotor function, and body coordination. Using the curl for an abdominal strength measure helped to compensate for items such as the straight arm hang, which may have had some sexual bias in favor the the male subjects.

Hypothesis three addressed the differences between the male and female subjects' performances. In general, male subjects had higher

mean scores than did female subjects. The arm hang and standing long jump were found to be adequate items for measuring both male and female subjects in regard to arm strength and leg power. The curl was judged to be an adequate measure for abdominal strength of both sexes of the ages concerned in this study.

Age-related differences were significant for the subjects' performance of the test items. The statistical data showed differences in the hopping; tapping; one leg stand; tower of blocks; sit and reach; and go over, under, and around test items.

The final hypothesis was concerned with differences in the test items and whether they were adequate to measure the various components for which they were selected. It was shown that the majority of the items were adequate performance measures. Seven items were of questionable reliability and validity. The young age and short attention span of the subjects may have resulted in the weaker showings on these particular items. Another possible explanation could be that the learning effect may have entered into the difference scores recorded for the test and retest sessions.

The motor performance survey that was developed for this research and the scoring criteria used by the researcher are included in the first section of this chapter. It may be that the scoring on the weaker items mentioned above should be adjusted in consideration for level of development of the younger subjects.

The test, as shown in the first section of this chapter, was administered to preschool children with some significant results. The inferences that could be drawn from the data were discussed. Further conclusions and recommendations are to be found in the final chapter.

One additional note about test administration as was discussed in this chapter is that the child of this age will perform best in a room without distractions. The test should therefore be given the child on a one-to-one basis with the examiner as the only observer so as to ensure the validity of the results.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The primary purpose of this study was to develop a motor performance survey for assessing the motor capacity of three and four year old children. An additional purpose was to administer the survey as a method of exploring the validity and reliability of the testing instrument. Several related issues had to be examined before the factors and items could be selected which were most appropriate for meeting test construction criteria.

Five major questions concerning motor performance of preschool children were subjected to statistical testing. The data generated by the study were analyzed to determine whether the problems were adequately addressed. Utilizing the knowledge gained from research, an assessment instrument was presented which can be useful to the preschool educators and parents. This instrument was intended to fill the gap that exists between the testing of infants and pre-kindergarten evaluations.

The collection of information about the child's performance capability will provide valuable assistance to preschool educators and parents in regard to planning programs and activities geared to the child's needs. The fact that early learnings are vital building blocks for future learning was discussed in the review of literature.

It is not sufficient to leave to chance the young child's need for early stimulation.

Although the need for early stimulation of the child has received a great deal of agreement recently, very few instruments have been developed to specifically give indications to parents and preschool educators about children's primary motor development. Those instruments that do measure motor functioning of preschool children are most often too expensive, too time consuming, and too difficult to administer and interpret. Generally, these measurement instruments are complex and require the administrator to have special training.

This research study gave careful consideration to the design of an assessment instrument that could be used by the practitioner of individual who is working with the child. In designing the measurement tool for these purposes, every effort was made to create a reliable, valid, and objective test. Test construction criteria were closely followed. Special concerns for testing young children meant keeping the test brief in deference to their short attention span and including test items that would motivate their interest.

Time efficiency is also of vital concern to the persons who would administer the test. It would not be possible to test many children with a test that was so lengthy that it was neither time efficient nor cost effective. This survey can be completely administered in a time period from 25 to 30 minutes for each subject.

The test-retest correlation and the t-test for age and sex-related differences that were computed give the indication that most of the survey items are valid and reliable measures for the subject that were included in the study.

Findings

The findings are discussed in reference to the components and items of the survey. Each factor and the items that represent that factor will be discussed separately hereafter.

The three items that measured strength were found to be capable of predicting the behaviors they were designed to measure. Arm, leg, and abdominal strength can be measured by the straight arm hang, standing long jump, and curl.

Static balance measures were the one leg stand for dominant and non-dominant foot, and the one leg stand with eyes closed. Results indicate that these measures did not promote significant correlations. It is of interest to note again here that the eyes closed leg stand showed better mean scores for males; whereas, all other balance measures showed stronger performance scores by females.

Dynamic balance items, jump and turn around and balance beam walking, both forward and backward, were adequate measures for the subjects in this study. The ascending the stair item did not show a sufficiently high correlation. It would be considered a weak test item.

The gross body coordination tasks, hopping and tapping, produced sufficiently strong correlation coefficients, but the agility run did not. The weak showing of the latter item might be taken to indicate the need for revision or substitution for that item.

Limb-eye coordination was measured by touching finger to nose, target throw, and bounce and catch. The first of these three items was shown to be an inadequate measure for subjects of this investigation.

All three items that were used to measure manual dexterity were declared reliable after conducting the statistical testing. Touching fingertips did not indicate as strong a measure as did building a tower of blocks and putting matches into a box.

Flexibility and agility of locomotor movement were measured by sit and reach, jump over a low object, and going over, under, and between. Correlational data supports the reliability of these measurement items for this survey.

The last factor of body awareness showed that neither imitation of movement nor identification of body parts were sufficient to produce reliable measures for these young subjects. In fact, identification of body parts was found to produce a very weak, negative correlation coefficient.

Conclusions

The results of this study seem to indicate that the majority of the items are moderate to strong as the test-retest correlation shows. The Summers Motor Performance Suvery is a good test of the motor capacity of three and four year old children which requires a relatively brief time to administer.

The items that are judged to be weak by the correlation coefficients are: identification of body parts, non-dominant leg stand, imitation of movement, and leg stand with eyes closed and open. These items should be replaced by other items if a duplicate study with larger sample population confirms these items to not be the most valid for children of these ages. Body awareness items require further investigation to find more appropriate measuring techniques.

Some advantages of the test were found to be that most items showed no significant sex or age differences. This statement means that only one set of norms would be required. The test is relatively inexpensive and easy to administer. Average testing time was less than 30 minutes per subject.

The data resulting from this survey can be useful in helping educators and parents to make decisions about programs and activities for their children. The examiner may use the knowledge gained from the survey to discover what motor behaviors the child has accomplished. The educator may discover whether the child needs more demonstrations, more practice, more time to mature, or more motivation so that they may learn the motor behaviors that are essential to their development.

Recommendations

The five items that resulted in weak correlation may need to be replaced by items which can be predicted to successfully measure the same factors. Reliability studies would then need to be conducted to determine that those replacement items were eliciting and measuring the intended behaviors.

It would be of interest to have factor analytic studies conducted for these survey items and for any items which may be proposed to substitute for the original tasks. To test the consistency of the survey, the items should also be subjected to item difficulty and item discrimination evaluation.

A third recommendation is that the study be replicated with a larger and more varied sample population. It would be of interest to

the researcher to have the study duplicated in a variety of preschools and in different regions of the country with different races and ethnic groups.

As an outcome of the third recommendation, it would be helpful to establish norms for the preschool age child. Norms would assist the educators and parents to interpret the child's scores in relation to scores of other children.

Recommendation four deals with demonstration of test items. If the examiner is not accustomed to demonstration of motor patterns and skills, it might be preferable to have the items demonstrated by an individual who is competent. The demonstrations could then be video taped for the examiner to reuse as a consistent model for the subject being tested.

It is also recommended that this survey should be compared to other similar motor performance measures for preschool children. An extensive effort was made to acquire access to the Charlop-Atwell test (Charlop and Atwell, 1980) so as to compare the results of that test with this survey. This would have provided an additional check on this instrument. All efforts to gain access to the necessary information for comparison studies were unsuccessful.

The sixth recommendations involves implementation of the data from the survey. Individuals who work with preschool children and make use of the assessment should be prepared to change or revise programs and activities for the benefit of the child.

A final recommendation is that the rating system should be used to score all test items. Distance and time measures should be converted to the rating system for consistent scoring.

If the educator or parent is uncertain about programs and activities for the needs of the child, they should consult such noted authorities as:

M. Riggs, Movement Education for Preschool Children. Reston, Virginia: American Alliance for Health, Physical Education, Recreation and Dance, 1980.

P. H. Werner, A Movement Approach to Games for Children. St. Louis: C. V. Mosby Co., 1979.

E. L. Schurr, Movement Experiences for Children: Curriculum and Methods for Elementary School Physical Education. New York: Appleton-Century Crofts, 1967.

L. Diem, Children Learn Physical Skills, Volumes 1 and 2. Washington, D.D.: American Alliance for Health, Physical Education, and Recreation, 1976.

J. A. Seaman and K. P. DePauw, The New Adapted Physical Education: A Developmental Approach. Palo Alto, California: Mayfield Publishing Co., 1982.

It is further recommended that motor performance behaviors which appear to be dramatically behind those that are expected for the child's age and maturation should be given further attention by referral of the child for testing by a specialist in motor testing.

The final remarks in regard to this research and the survey that was developed are directed to comments about motivation. This investigator found that it is especially essential when testing preschool children for the child to be motivated and encouraged. Otherwise, the child may refuse to cooperate with the examiner even if that examiner is a person that cares for the child daily. Comments from parents and

preschool instructors concerning this instrument indicate taht the children tested for this study found the experience pleasurable and they were, in all cases, even more willing to take part in the retest. A test with items the child did not enjoy performing presumably would be of diminished validity and reliability.

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APPENDIXES

APPENDIX A

PARENT/GUARDIAN AUTHORIZATION FORM

Parent's Authorization Form

I am Frankie Summers and as a doctoral student at Oklahoma State University, my study involves children's motor performance. My research seeks to measure the motor performance of three and four year old children.

It is hoped such information as the survey provides may be helpful to the preschool and parents. Should you wish your child to participate, please return the form signed and with the information related to age, weight, and sex of the child. The name will be drawn at random from the returned forms. This means your child may or may not be drawn to take part in the study. Your cooperation will be greatly appreciated. The child will be encouraged to enjoy this process as a fun activity of performing items they might be involved in throughout a normal play session.

On two separate occasions during the first two weeks of August at the Stillwater YMCA, I shall spend a few moments getting acquainted with the child. The actual performance of the motor activities should take approximately 20 to 40 minutes. An example of the activities the child would be doing include: balance on one leg, balance while moving, running, hopping, flexibility and coordination skills, and ability to change direction quickly will be assessed. A code number will be used so that the child's name will not be recorded. The results may be requested by the individual's parent or guardian.

Child's Name _____ _____
Last First Middle Male Female

Date of Birth _____ _____
Month Day Year Weight (currently)

In signing this form you, the parent or guardian, do give your consent for the child above named to participate in the research project explained above. Should any further information be required, please contact Frankie Summers, phone number 624-2917. It is understood that the child's identity will not be revealed in any document which may result from this research. It is also understood that the child may terminate participation in this study should they wish to. Your cooperation and questions will be welcome.

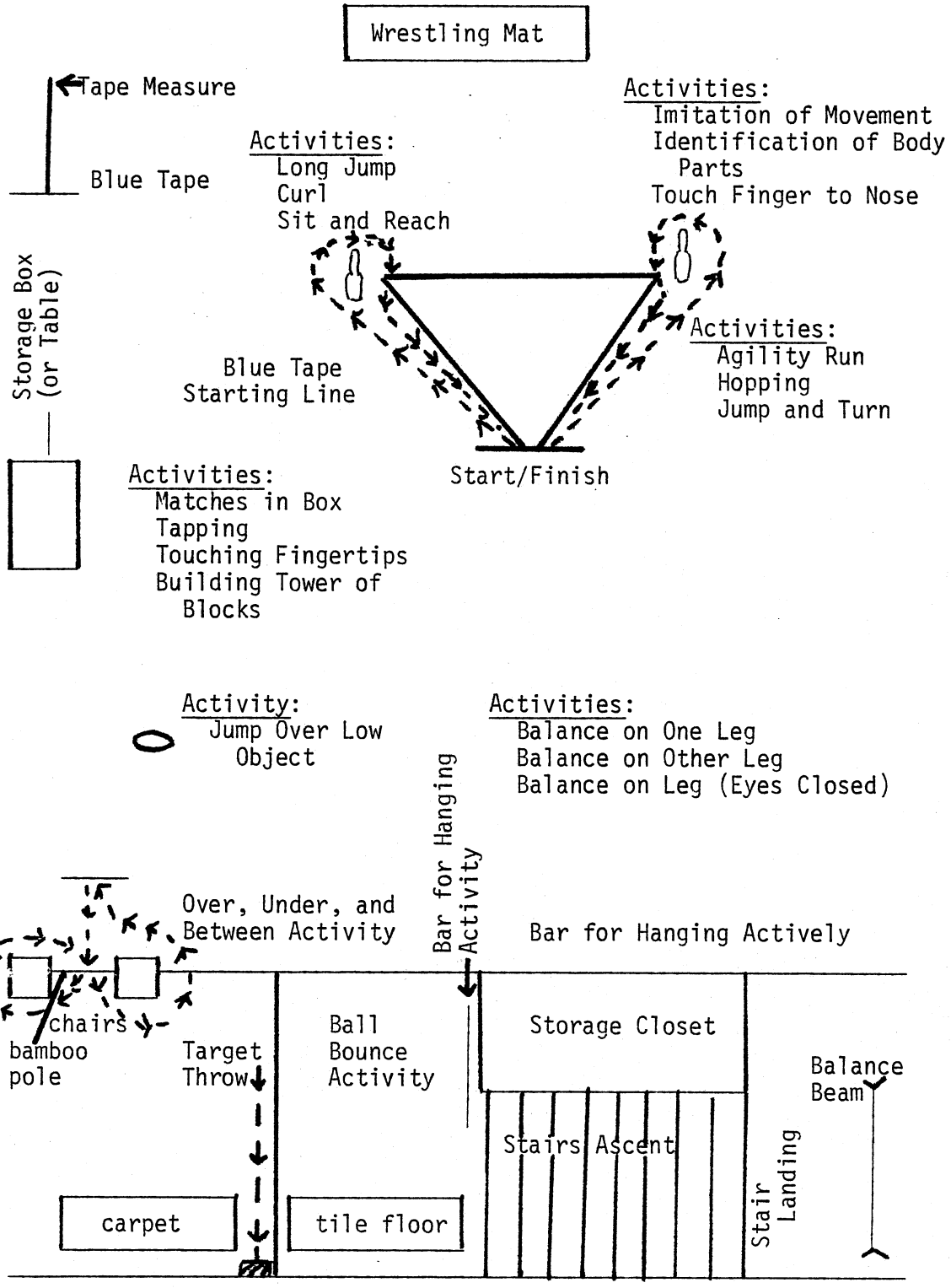
Signed _____
(Parent or Guardian)

Date _____

APPENDIX B

TEST SITE FLOOR PLAN

Floor Plan for Test Site



VITA

Frankie Carmichael Summers

Candidate for the Degree of

Doctor of Education

Thesis: A STUDY TO DEVELOP A MOTOR PERFORMANCE SURVEY OF THREE AND FOUR YEAR OLD CHILDREN

Major Field: Higher Education

Biographical:

Personal Data: Born in Higgins, Texas, March 4, 1943, the daughter of Mr. and Mrs. Ray Carmichael.

Education: Graduated from Higgins High School, Higgins, Texas, in May, 1960; received Bachelor of Science degree from Northwestern Oklahoma State University in 1964; did graduate work at Colorado State University in 1977; received Master of Education degree from Central State University in 1980; completed requirements for the Doctor of Education degree at Oklahoma State University in May, 1983.

Professional Experience: Instructor of physical education for public school children, grades four through twelve, at Syracuse, Kansas, 1964-65, and at Lakin, Kansas, from 1965-68; also coached track and gymnastics while at Lakin. Taught private gymnastics, adult women's exercise classes, and rhythmic aerobics from 1969 through 1976. Appointed to faculty of Oklahoma State University on a federal grant for Adapted Physical Education, 1981-82.

Professional Organizations: American Alliance for Health, Physical Education, Recreation and Dance; Oklahoma Health, Physical Education and Recreation; Council of Exceptional Children; Kappa Delta Pi; Phi Epsilon Kappa.