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The motor fitness of primary school boys and girls

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THE MOTOR FITNESS OF PRIMARY SCHOOL BOYS AND GIRLS

by

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An Abstract

of a project submitted in partial fulfillment
of the requirements for the degree of
Master of Science in the School
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Project Advisor: Dr. Harold H. Morris

ABSTRACT

The purpose of this study was to assess the motor fitness level of boys and girls in the lower elementary grades and to differentiate the motor fitness level of boys and girls placed in a pre-first class with boys and girls placed in a regular first grade. The subjects (N=187) used in this study were from Perry Browne Elementary School in Norwich, New York.

The subjects consisted of 108 boys and 79 girls ranging in age from seven to 10 years of age. Each subject was tested in terms of their motor fitness level through balance, grip strength, run, flexibility in the back and wrist, and modified push-up items. Each subject was tested individually by one tester. Only one test was administered to each subject during a single test period.

The mean scores of each of the subjects on seven test items were computerized and analyzed along with the age, height and weight of each subject. A grand mean score was computed for each sex, grade classification and the year in which the subject began school, either 1971, 1972, or 1973. Analysis of variance tables were completed in order to illustrate the source of variation and if any effect resulted on each of the seven test items and on the

age, height and weight measurements.

As a result of the analysis of variance, the null hypothesis, that no significant difference in the motor fitness level of boys and girls placed in a pre-first grade with boys and girls place in a regular first grade, was rejected. The conclusion was made that regular first grade students performed better on six of the seven test items than the pre-first grade children. The exception was the 300-yard run test item in which the pre-first children performed better than the regular first grade students. Therefore, it was concluded that the difference in the motor fitness level of pre-first grade children and regular first grade children was statistically significant.

Ithaca College
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CERTIFICATE OF APPROVAL

MASTER OF SCIENCE RESEARCH PROJECT

This is to certify that the Research Project of

Margaret T. Ingersoll

submitted in partial fulfillment of the requirements for the degree of Master of Science in the School of Health, Physical Education, and Recreation at Ithaca College has been approved.

Research Project Advisor: _____

Candidate: _____

Chairman, Graduate Program in Physical Education: _____

Director of Graduate Studies: _____

Date: 8/27/76

THE MOTOR FITNESS OF PRIMARY SCHOOL BOYS AND GIRLS

A Research Project Presented to the Faculty
of the School of Health, Physical
Education and Recreation
Ithaca College

In Partial Fulfillment of the
Requirements for the Degree
Master of Science

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INTRODUCTION

Throughout the years, the necessity of educating each individual for optimum development and success in life has existed. Numerous advancements in the areas of science, industry, medicine and education indicate man's quest for knowledge as well as his ability to improve himself and his environment. For example, the changes made in styles of transportation, kinds of machinery, operational procedures in medicine and methodologies of educating people represent a combination of time, personnel, and knowledge necessary to bring about such accomplishments. Therefore, education is not only of paramount importance to every individual, but, necessitates constant evaluation and revision during the process for progress to be attained.

Various trends in history illustrate different emphases placed on education. The sequence of events throughout the years evoked people's awareness to the changes taking place and required their opinions to be formulated and expressed. These impressionable circumstances of the past include the effects of survival in the New World; the striving for freedom during the War of Independence and Civil War; the populations move to the cities for

wealth, prestige and a new life; the Depression that brought unemployment to some and fortune to others; and finally, the government's influence on education due to the school's being used to shape those people who would serve the national purpose and ignore those who rebelled against such procedures. Consequently, more and more emphasis and responsibility was placed on education so that every individual grew and developed to his fullest with the times and was successful as a result.

As times have changed, so have various emphases on education. The demands placed on education throughout progressed from the role of a social outlet in the 1600s to a way of developing an intelligent republic during the 1700s to a symbol of prestige during the 1800s and finally, in the rapidly changing times of the 1900s, an emphasis was placed on the quality of education through consideration of the individual child and how the ongoing process of education must consider the unique differences existing among individuals in order to facilitate growth and development.

In today's era, a child spends a minimum of twelve years of formal education. Within this span of time Kagan (17:5) illustrates:

> We want children to display certain behaviors in school, . . . we also insist that children learn the language and number skills that are pre-requisites for the study of technical vocations, as well as for the filling out of tax forms. In addition, we want every child to expect ultimate success in a problem if he invests reasonable effort. The child must come to

> believe that he will learn a new talent if he tries. Finally, we want children to be motivated to perfect their abilities and to develop new ones.

Combining the vast numbers of children to be educated with consideration given to the complexities existing within each child results in the need for extensive research to provide effective methods of educating the individual child. Such methods must include physical, motor, speech, emotional, social, and moral development within its educational objectives. Moreover, it is of the utmost importance to begin the educational process during a child's formative years which encompass kindergarten thru sixth grade.

Numerous ways and means of promoting growth and development in the elementary school child are included in mental, social, emotional, and physical concerns. More specifically, the importance of physical activity in early childhood gives the boy and girl the opportunity to develop control over the different muscles of the body through performance and knowledge of motor skills, which further enhances his self-esteem, his ability to interact with others, and his emotional well-being. Thus, the physical educator has a responsibility to develop the repertoire of skills and enhance his background for knowing "how" and "why" to facilitate successful performance.

In recent years, physical educators have become increasingly interested in understanding how children learn.

Bayley and Espenschade (27:562) have pointed out that:

> Attention has been focused primarily on studies of the early stages of neuro-muscular development, on studies of age changes and developmental sequences in motor coordinations and on the standardizations of tests of motor skills.

Seils (57:244) indicated that:

> The major portion of research work done in motor development has been confined to children under five years of age and to the pre-adolescent and adolescent level . . .

and concluded that "knowledge concerning the factors which influence motor performance of children during the primary school years is limited." Glassow (37:426) noted that "observation of motor performance of children in early school years are limited . . ." and that:

> Study of motor performance in early school years is needed not only for understanding children of these ages but for understanding motor development throughout the years of physical growth.

The progress that has been gained in the understanding of the factors underlying motor performance have been noted. The physical characteristics and motor traits considered to contribute to the learning of motor skills are body build; height and weight, strength, endurance, flexibility, balance, and coordination; reaction, movement and reflex times; and kinesthesis. However, further understanding of physical growth and motor performance and their relationships is needed. This knowledge would benefit the physical education teacher's ability to effectively

physically educate the school children through motor fitness measurement and/or evaluation of the pupils in school as well as substantiate the effectiveness or lack of effectiveness of a school's physical education program.

Statement of Problem

The purpose of this study was to assess the motor fitness level of boys and girls in the lower elementary grades and to differentiate the motor fitness level of boys and girls placed in a pre-first class with boys and girls placed in a regular first grade.

Scope of Study

The scope of this study included 108 boys and 79 girls ranging in age from 7-10 years in the pre-first, post-first, first, second, and third grades at Perry Browne Elementary School in Norwich, New York. The students were placed in their respective classes at the beginning of the school year according to reading ability and were tested during their physical education class period. Data were collected during a 12-week period in the Spring of 1975.

Major Null Hypothesis

There will be no significant difference in the motor fitness level of boys and girls placed in a pre-first grade with boys and girls placed in a regular first grade.

Minor Hypotheses

1. No significant differences will exist in the

motor fitness level of boys in the pre-first, and regular first grade levels.

2. No significant differences will exist in the motor fitness level of girls in the pre-first, and regular first grade levels.

3. No significant difference will exist in the motor fitness level of boys and girls in the pre-first grade with boys and girls in the regular first grade.

4. No significant difference will exist in the motor fitness level of boys and girls in the pre-first and regular first grade levels starting school in the years of 1971, 1972, and 1973.

Definition of Terms

In order to understand and clarify the meaning of terms used in this study, the following definitions are given:

1. Arm-flexion on the back. The test used to measure the subject's ability to place the hand as far up the back as possible in a hammer lock position while the subject stood at attention with the thumb and forefinger placed on the lateral crest of the ilium, the wrist straight, and the feet apart enough to give solid stance.

2. Balance. The test used to measure the subject's ability to hold one foot lengthwise on a stick as long as possible up to 60 seconds.

3. Body build. An individual's physical structure.

4. Coordination. An ability to perform a skilled movement pattern; an ability to perform hand-eye and foot-eye tasks such as kicking, throwing, striking, etc.

5. Development. This refers to the relative stability which an individual achieves as a result of the processes of heredity and environment being taken together. It is a slow and continuous process progressing from the simple to more complex, requiring an increase in differentiation and integration of all aspects of the organism.

6. Growth. This refers to the physical and biological changes that naturally evolve in the development of an individual. An increase in size and structure.

7. Endurance. An individual's ability to maintain a moderate energy output over an extended duration of time.

8. Flexibility. The range of movement of a joint.

9. Grip Strength. The test used to measure the subject's ability to squeeze the dynamometer with the hand forming a sweeping arc downward and the elbow slightly bent.

10. Learning. The relatively permanent change in performance or behavioral potential resulting from practice or past experience in the situation.

11. Maturity. The end of growth and development. The completion of structural changes and attainment of capacity to function physically and mentally in a manner characteristic of normal adults.

12. Motor Ability. An indication of present

athletic ability. It denotes the immediate state of an individual to perform in a wide range of motor skills.

13. Motor Fitness. This refers to many of the qualities assumed to be included in physical fitness and motor ability.

14. Motor Skills. This refers to muscular movement or motion of the body required for the successful execution of a desired act with efficiency and effectiveness.

15. Motor Performance. A temporary occurrence, fluctuating from time to time because of many potentially operating variables.

16. Physical Fitness. The ability to perform a given task and having those physical qualified developed to the extent demanded by the task.

17. Push-ups. The test used to measure the subject's ability to lower the body toward the front edge of a wooden bench so that the upper chest touched the near edge of the bench, and then raise to a straight-arm position and the motion was performed as many times as possible.

18. Run. The test used to measure the subject's ability to run the length of the course (100 yards) three times in the style of a shuttle run.

19. Wells' Sit and Reach. The test used to measure the subject's ability to sit on the floor, with the knees straight while bouncing three times reaching forward along the measuring scale and on the fourth bounce, reaching as

far forward as possible and holding the position for two seconds.

20. Wrist Flexion and Extension. The test used to measure the subject's ability to move the fist upward and backward in an arc as far as possible while in a sitting position in a standard armchair with the back straight, the forearm resting on the chair arms, the fist doubled and extended beyond the chair arms, and the palm of the hand measured turned up with the instrument fastened to the thumb side of the fist.

Limitations

This study began with the decision that everyone had the chance to participate and selection of any one subject did not influence selection of other subjects. However, limitations resulted:

1. A loss of subjects resulted as four students moved away from school to attend school elsewhere.

2. A change of classroom teacher occurred during the time that the study was conducted.

Delimitations

1. Because of administrative feasibility and time, each of the test items was administered once. Therefore, one set of scores for each of the test items was recorded.

2. Subjects used in the study were taken from one school due to lack of time and the ability of the investigator to locate other subjects in a different school.

Therefore, the data collected refer to the subjects from one school only.

3. Conclusions drawn from the study refer to data collected from subjects located in one school only.

Chapter 2

REVIEW OF LITERATURE

The amount of research conducted in the area of motor performance and development has shown a diversity in the factors underlying motor performance and has repeatedly indicated a need for more research. Additional progress will aid in increasing the understanding of motor performance and thus, provide the direction needed for improving existing programs and for developing new and effective physical education programs in schools.

In order to provide successful physical education programs offered to boys and girls, physical education must first understand each child's abilities, needs and capacities. Through measurement and evaluation, the physical educator determines the effects of his teaching and the degree of progress achieved by his students.

This chapter gives an overview of the facts gathered by several authorities in the areas of motor learning and child development as they relate to physical education. Their knowledge and research work has promoted a better understanding of how children learn and how motor skills contribute to the child's development.

Through a review of the literature, consideration was first given to the various motor performance tests used

in different studies and what factors were found to test motor skills. Secondly, studies investigating differences in motor performance by different grade levels were reviewed. Thirdly, attention was focused on those motor performance studies that sought to compare boys and girls motor performances. Finally, the perceptual-motor area was reviewed in the literature in order to comprehend the relationship, if any, of a child's reading ability to motor performance.

Motor Performance Tests

The importance of assessing the abilities of individuals and groups is necessary to obtain the greatest benefits from physical activity programs. Numerous studies have indicated various factors underlying successful motor performances. H. H. Clarke (4:78) has stated that:

> One's level of motor ability in a wide range of activities is an integrated composite of such individual traits as strength, endurance, power, speed, agility, balance, reaction time, and coordination.

Furthermore, one's ability to perform well in one type of performance does not indicate that he or she will perform as well or poorly in another. Thus, consideration must be given to the specifics entering into motor performances in the measurement and/or evaluation.

In contrast, Lemcke (45) indicated that individuals who demonstrate ability in learning and performing a motor task are assumed to have certain characteristics that enable them to learn and perform the task. Also, that individuals

who possess higher levels of such components as strength, agility, keen vision, quick reflexes and the desire to succeed will be able to learn and perform motor tasks with greater ease. The author further suggests a more thorough knowledge of the learning process as it relates to the learning and performing of motor tasks as it will be of benefit to both pupils and teacher and implementation of this knowledge will enable pupils to learn motor tasks more efficiently, attain greater heights of skill, and gain more enjoyment from the whole learning-performance process.

The identification of three groups of studies needed to be used in research in motor ability testing was completed by Larson (43). The investigator indicated that the motor ability tests should be used to indicate present achievement as well as measure marked individual differences in motor ability. Included in these three groups of studies are (1) fundamental elements underlying control of voluntary movements, agility, balance, body coordination, rhythm, body structure, shiftiness and strength; (2) those fundamental skills in physical education, such as, running, jumping, vaulting, throwing, kicking, climbing, catching; and (3) the physical education sports skills, i.e., skills in gymnastics, skills in basketball, and skills in football. Larson stressed using the tests for classification purposes in physical education and that the tests prove valuable only in that they indicate ability in the basic elements underlying sport skills.

In the study conducted by Bookwalter (28), it was concluded that size and shape seemed to have an influence on physical performance. Results from the data on four test items of straddle chins, push-ups, squat thrust and vertical jump indicated that a comparatively high relationship existed between developmental level and physical fitness scores as the development level increased and scores decreased rapidly for the very large individuals.

McGraw (50), indicated the possibility that many distinct factors of motor learning exist and that success in a sport or even a separate activity in a sport would depend on a certain combination of several such factors rather than on one factor alone. Through factor analysis, the investigator isolated factors of physical abilities or measurements, factors of body size and factors of motor learning. The author further suggests more research relative to the nature of factors of motor learning and physical performance before definite decisions can be made as to the factor involved in learning gross bodily skills.

Another study utilizing factor analysis of the data was investigated by Phillips (51). The traits or factors isolated included agility, motor ability, balance, motor educability, power, back strength, leg strength, grip strength, foot strength, abdominal strength, arm and shoulder girdle strength, general strength, cardiovascular fitness and lung capacity.

DiNucci and Shore (66) identified and selected eight components as appropriate measures for use in a motor fitness test battery for 238 boys in the lower elementary grades. The eight factors identified in the analysis of data collected on subject's scores on 30 test items were cardiovascular endurance, muscular strength, muscular endurance, speed, flexibility, power, agility and balance.

In summary, motor performance tests have exhibited a diversity of factors underlying motor performance. Clarke (4) considered the importance of measuring and/or evaluating the specifics entering into motor performances while Lemcke (45) indicated that individuals possess certain characteristics enabling them to learn and perform motor tasks. Larson (43) contributed three groups of studies in research in motor ability testing for the purpose of classifying students and indicating the ability in the basic elements underlying sports skills. Bookwalter (28) concluded from the study, that size and shape seemed to have an influence on motor performance. McGraw (50) found that several factors of motor learning contribute to successful performance in a sport or a separate activity in a sport. In addition, Phillips (51), DiNucci and Shore (66) subjected data to factor analyzation in their respective studies and identified traits or factors underlying motor performance. Included in the factors were endurance, strength, speed, flexibility, power, agility, balance and cardiovascular fitness.

Differences in Motor Performance by Different Grade Levels

Numerous studies have indicated improvement occurring in advancing grade levels on motor performances. One research study reported in 1960 by Ruth B. Glassow (36) found that motor performance scores improve during childhood. Approximately 125 girls ranging in age from 6-14 years were measured on running ability, jumping and throwing ability. The results of the study indicated that within seven groups of girls, each individual tended to remain in the same relative position in her grade, especially in the run and jump. However, evidence for the throw was less conclusive than for the run and jump. The investigator concluded that early development of motor coordination is essential for later success and that inherent native motor ability may determine the limit of achievement during the growing years.

The relationship existing between the sequence of physical growth and the sequence of development in gross motor performance was studied by Seils (57). The data was gathered on measures of physical growth and gross motor performance on 510 primary-grade children in the public schools of four Massachusetts communities. Results of the investigation indicated that the:

> scores of motor performance provided increments from grade to grade . . . and higher mean growth measures were evidenced by both sexes at successive grade levels (57:252).

In addition, certain patterns of physical growth and gross motor performance of first, second and third grade children were portrayed.

> The running and side-stepping test scores of girls show a moderately high relationship with skeletal maturity, the stick test lengthwise of both boys and girls and the pendulum-controlled striking test scores of girls show a very low relationship with the measure of skeletal maturity. The remainder of the test scores show slight tendency to correlate with the measure of skeletal maturity (57:255,256).

Therefore, the findings of this study suggest that the relationships between skeletal maturity and motor performances although they are not great may be lent more significance.

In a study conducted by Rarick (52), the influence of such factors as size, strength, physique and maturation, as well as previous experience in motor activities, have all been shown to play a definite role on the level of motor achievement gained by young children. Included in this study were 172 third grade children tested in the following areas of motor performances: running, jumping, throwing, striking, catching, agility, and balance. The summary and conclusions in this case-study were:

> Boys and girls in the group of superior performers tended to be on the whole, taller, heavier, and stronger than children in the inferior group, and during the period of early childhood, the inferior group showed a preference for fine manipulative activity of a passive nature; whereas the superior group, even at an early age, leaned toward gross motor skills (52:151).

The mean scores were collected over a two-year period on 67 boys and girls in the fourth, fifth, and sixth

grades in a study completed by Latchaw (44). The students were then tested on basketball wall pass, volleyball wall volley, vertical jump, standing broad jump, shuttle run, soccer wall volley, and softball repeated throws. Latchaw (44) concluded that a significant difference resulted from grade to grade for each sex and for each test. Also, mean scores for boys in each grade and for each test were higher than the mean scores for girls in the same grade.

In summary, research has shown as the grade level advances, improvement is found in motor performance. Glassow (36) indicated that motor performance scores improve during early childhood. Seils (57), Rarick (52), and Latchaw (44) similarly summarized in their respective studies that significant increments resulted from grade to grade on motor performance tests.

Sex Difference in Motor Performance

The body of research concerning sex differences in growth and their effect on motor performance is extensive. Corbin (5) discussed the development of strength, balance, speed, and coordination occurring partly as a function of time; "a child automatically gets better in these requirements of skillful performance as a result of growth and appropriate experience" (5:155). However, Corbin (5:156) remarked:

> there is great overlapping in performance, and sex differences per se in growth have very little effect on the potentialities for skill learning at the early age levels. It appears that boys and girls can learn motor

> skills about equally well. The observable differences in the way boys play, the importance they attach to their motor achievements, and their skill in moving are at least partly due to sex typing and socially induced motivation

Glassow (37) noted similar abilities between boys and girls in learning motor skills. In a study using 350 subjects in grades K-8 during a two year span, data were collected on the subjects' performances in the run, standing broad jump and the overhand throw and the strength measures of eight muscle groups. An experimental and control group were used and the author found that a positive affect of the experimental program on development of strength of four muscle groups of the lower extremity was evident; that the training program did not differentially effect strength development in two sexes and that the experimental program relative to developing strength in the lower extremities was most effective at younger age levels, for significant treatment effects occurred consistently more often here than at the older age levels.

In contrast, Keogh (42), concluded from his study that boys were two years ahead of girls in mean score performance on throwing for distance and had a similar advantage in accuracy. However, the mean performance scores on jumping and running tests displayed a pattern essentially equal at ages six and seven, and one favoring at ages eight and nine. Also, that performance of seven year old girls was similar to eight year old girls and the girls performed

better on the cable jump and 50 foot hop while the boys were better on the side-step. For the girls at age nine, the beam walk mean differences were better, but all other beam balance and beam walk comparison were non-significant and also, the grip strength mean scores favored boys by approximately one year, except at age eleven. The author concluded that:

> there will be an increase in mean motor performance scores at successive ages during middle childhood for both boys and girls and is expected that boys and girls will not differ markedly in performance scores at earliest elementary school age except in certain skills which tend to be sex dominant, such as throwing for boys and hopping for girls. Finally, it is expected that boys will be more skilled than girls in most performance acts by age eight or nine (42:10).

An attempt to discover sex differences in a manner of throwing was one of the purposes of the study investigated by Wild (63). The author used 32 children ranging in age from 2-12 years. The results of the study showed:

> the comparison of the girls' performances with those of the boys indicated sex similarity in the basic growth pattern of the age and sex differences in the performance of that pattern (63:23).

In addition, the author concluded that:

> maturational factors are believed to be operative as the basic type patterns of throwing develop; learning, particularly after six years, greatly influences the skill pattern individuating out of and upon the basic growth stage; it may be the factor accountable for differences in performance, especially those evident between the sexes (63:24).

Baumgartner (2) has generalized the performance of boys and girls tested on running, jumping and throwing. The author asserted that boys' average performance improves

steadily through age 18, while girls' average performance improves until about age 13 and then either levels off or decreases.

Additional consideration has been given to motor performance in girls and boys. Hupprich (40) had indicated that the predominant trend is for girls, as they approach 12 years of age to increase in flexibility and thereafter show a gradual decline. In a different study conducted by Henry and Nelson (39), results showed the 10-year old differs from the 15-year old in being slower in motor performance of the type measured. On the average, he learns more than the older boy before the plate at the same rate.

Further progress in the comparison of boys and girls skill levels was shown by Espenschade (33). Girls were reported to tend to excel in hopping, skipping, and galloping while boys were superior in jumping and throwing from the ages of two to seven years. Espenschade (33:151) noted that:

> boys tend to double their grip strength between the ages of six and while an increase of 359% is shown between six and eighteen years of age, a similar study of the grip strength of girls reveals an increase of only 260% during the years of 6-18 with the discrepancy being largely attributed to their lessened increase in strength during the adolescent years.

Another investigation of the influence of age and sex on the amount and rate of motor learning was completed by Bachmann (26). Results of the data collected on 320 subjects ranging in age from six to 26 years showed the learning scores for both sexes improving significantly during the 10-

trial practice period for both stabilometer and the ladder climb tests. In addition, the females showed a significant age effect in the learning score on the stabilometer. On the ladder task, only the males showed a significant age effect in the learning score. Furthermore, the males progressively become worse as the age increases from seven to 17, but do not change significantly thereafter. Females become significantly poorer between age seven and age 13, but they improve significantly between ages 13 and 19. At older ages, their performance is again poorer. Finally, results clearly indicated that with respect to the rate of learning, there is no age effect and no sex differences in either of the two motor skills.

Concerning sex differences in motor performance, it is Singer's (22:149) opinion that:

> in most physical and motor measures, both boys and girls compare favorably with boys holding a slight edge until approximately the age of 12 or 13. Body size and strength has much to do with athletic accomplishments. During adolescence, boys generally grow larger and demonstrate a greater magnitude of strength, and as these differences between sexes become more apparent, so do motor performances.

In addition, Singer (22:160) generalized that:

> sex differences in motor performance become more apparent with increasing age. Boys typically accelerate in motor performance during the teen years while girls level off and even demonstrate decline in performance.

In summary, research concerning sex differences in growth performance is extensive. Different investigators have specified certain abilities in motor performance.

Corbin (5) and Glassow (37) remarked that among males and females accordingly boys and girls can learn motor skills about equally well. In contrast, Keogh (42) found that boys superseded girls in mean performance on throwing for distance and had a similar advantage in accuracy. Sex similarity in the basic growth pattern of the age and sex differences in the performance of that pattern was concluded in the study by Wild (63). Improvement in running, jumping, and throwing performances was shown by Baumgartner (2) to improve steadily through age 18 for boys and through age 13 for girls. Hupprich (40) indicated that girls flexibility increases as they approach 12 years of age and thereafter, show a gradual decline. Other investigators, Henry and Nelson (39) showed that the difference between 10-year old and 15-year old was that the 10-year old was slower in motor performance of the type measured. However, he learns more than the older boy before the plateau at the same rate. Espenschade (33) indicated that girls are favored in performance of hopping, skipping and galloping while boys perform better in jumping and throwing. Meredith (33) pointed out that boys achieve a higher percentage of grip strength improvement than girls. Bachmann (26) showed that no age effect and no sex difference in either of the two motor skills tested on the subjects used in his study resulted. Finally, Singer (22) summarized that boys typically increased in performance until the late teens, whereas girls decline in performance in the early teens and the gap in performance between the sexes widens.

Perceptual-Motor Training and Motor Performance

The relationship between reading abilities and motor performance must be considered in order to better understand the individual child. Singer (58:1323) indicated that, "the degree to which cognitive abilities, motor abilities, and physical characteristics interrelate with a human being has yet to be ascertained." Singer's study included 52 sixth graders and 46 third graders. The Lorge-Thorndike test, Metropolitan Achievement test, grip strength, elbow, hip extension, flexion strength, choice reaction time apparatus, balance using stabilometer, Finger reproduction test, bounce ball in the basket, Minnesota rate of manipulation test, and pursuit-rotor were tests used for gathering scores for intelligence potential and academic achievement and perceptual-motor abilities. As expected, results showed that perceptual motor, physical and cognitive variables were not greater in third grade children than in sixth grade children. Also, individual abilities are fairly well task-specific even with youngsters in third grade. In addition, the data refuted any relationship existing between intelligence and abilities to balance and perform coordinate tasks. Furthermore, those tasks that are more perceptually motor oriented do not correlate any higher with intelligence tests than do simple motor tasks and physical characteristics with intelligence tests.

Singer (59) also concluded from another study that

achievement scores on tests of motor performance do not correlate highly for the same individuals; nor is there usually a significant relationship between motor tests and intellectual tests. However, the author stated that intellectual growth can be stimulated through the achievement of simple motor patterns.

Lipton (46) utilized 92 subjects from four first grade classes randomly selected and divided into control and experimental groups. The data gathered from the study showed that the experimental program which emphasized directionality of movement produced significantly greater gains in perceptual-motor development, visual perception and reading readiness than the conventional curriculum which did not have this emphasis.

Similar results were found in the study investigated by DeGroat (65) in which a significant difference was found between reading scores in favor of the experimental group as compared to the reading scores of a class which had participated in traditional elementary physical education activities. Hence, the author indicated that perceptual-motor training produces favorable performance of various motor skills and improved reading ability.

Another viewpoint of the advantages gained by perceptual-motor training of children was given by Cratty (6:159). In the author's opinion, "perceptions about body size and the location of body parts, and the child's

self-concept is related to what he can do with his body." This related to the child's expected performance in a specific task or how he feels about himself in a variety of performance situations. Similarly, Edgar (68) asserted that gains in development are related to experience with environment and that sensory-motor experience itself is related to adaptive behavior and to general cognitive development. Furthermore, Kephart (22:140) stated that:

> we may be teaching motor activity through physical education in order to promote reading . . . 15 to 20% of all children suffer from learning disorders; they have difficulty in learning. Children need generalized motor experiences; they need to explore in order to have the background necessary for later success in school work.

These motor generalizations include balance and posture, propulsion and receipt, locomotion and contact, and manipulation. Referring to high degrees of skills in many motor performances, Kephart (22:140) stated:

> What is desired is a minimum ability in a wide range of activities . . . and varied motor experiences is more effective than overconcentration on one skill in contributing to the cognitive processes.

Further progress gained by McCulloch's (49) study supported instruction using perceptual-motor training rather than solely having standard physical education programs. Results showed that "significant gains favoring the experimental group are presumed to be due to the experimental procedure, however, further experimentation is warranted." In a study investigated by Seiderman (56), methods used on two

different subjects included development of gross-motor and fine-motor skills, form-perception techniques, and visual-motor coordination. Results indicated that the children were achieving above their present grade levels while before both children were functioning below grade level when first examined. Finally, the positive relationship between intelligence and perceptual-motor ability and academic achievement was found in the study completed by Skubic (60) using 86 fourth grade boys and girls of normal intelligence.

Essentially, more evidence pertaining to school-age children is needed in reaching any definite conclusions concerning a relationship, if any, between reading ability and effective motor performance. Various authorities have suggested that physical education programs including perceptual-motor training produced favorable results. That is, gains in perceptual-motor development, visual perception, and reading readiness were significant rather than in conventional physical education programs which did not have this emphasis. Lipton (46), DeGroat (65), McCulloch (49), Seiderman (56), and Skubic (60) all have indicated favorable performance of various motor skills and improved reading ability as a result of perceptual-motor training. However, Singer (59) purported that there usually is not a significant relationship between motor tests and intellectual tests. Furthermore, the investigator's study resulted in finding those tasks that are more perceptually motor oriented do not

correlate any higher with intelligence tests than do simple motor tasks and physical characteristics with intelligence tests.

Finally, Cratty (6) and Edgar (68) have given emphasis to perceptual-motor training of children in order to enhance the child's knowledge of himself and improve his self-concept. This aids in the child's performance as he or she has a background of experience to cope with future expected performances. Kephart (22) contributed that children needed generalized motor experiences; they need to explore, in order to have the background necessary for later success in school work and that varied motor experiences contribute to the cognitive processes.

In summary, motor performance tests have exhibited a diversity of factors underlying motor performance--that is, coordination, age, height, weight, physical growth, maturity, balance, body build, strength, endurance, flexibility, and the rate of learning a motor skill effectively and efficiently. In addition, motor ability tests serve the physical educator by classifying students and indicating their ability in the underlying sports skills. Extensive reviews of the literature have shown that improvement on motor performance tests occurred from grade to grade. Other investigators have stated that boys and girls can learn motor skills about equally well. However, in general, sex differences on motor performance is evident. Boys continually advance in motor

performance while girls improve very slightly or even worsen. Numerous studies have indicated that physical education programs including perceptual-motor training produces favorable results. In some studies, the experimental group's reading scores were significantly different from the control group's reading scores experiencing traditional physical education activities. It is accepted that intellectual growth can be stimulated through the achievement of simple motor patterns; however, further evidence is needed to understand the extent of relationship, if any, existing between intelligence and abilities to perform various motor skills.

In conclusion, the knowledge gained from the many studies and investigations examining the area of motor learning and performances is of great value to physical education teachers. A better understanding of how children learn exists as well as how motor skills contribute to the child's over-all development is realized. However, the necessity for substantiating existing knowledge remains as does the emphasis for additional research work to develop new theories for effective use in school physical education programs.

Chapter 3

PROCEDURES

Introduction

A selection of measures suitable for assessing the motor fitness level of children in the lower elementary grades was taken from a test battery developed from the test data computed in a study by DiNucci and Shore (66). These investigators factor analyzed the data and as a result, a test battery was developed that consisted of seven administrating feasible test items. The test items used were balance on stick lengthwise, grip strength, modified push-ups, arm flexion on back, 300-yard run, Wells' sit and reach and wrist flexion and extension.

The use of genetic or developmental research was used to describe the population of boys and girls tested in terms of the motor fitness level scored for balance, grip strength, run, flexibility on the back and the wrist, and modified push-ups. The testing was administered for the purpose of indicating the direction of the boys and girls growth in motor fitness. The cross-section technique was used by the investigator because this technique provided the advantage of gathering data promptly, that is, measurements of motor fitness were taken at one time rather than waiting for the subject's to advance in years.

The data for the study were gathered by obtaining measures of physical growth and motor fitness on 108 boys and 79 girls in the Perry Browne Elementary School in Norwich, New York.

Each subject was tested individually by one tester. Only one test was administered to each subject during a single test period.

The purpose of this chapter is to present the selection of measures used to assess the motor fitness level of boys and girls in lower elementary grades. In addition, the research method used, description of population, sample, sources of data, methods of data collection, organization of data, design of the study and methods of data analysis are given.

Description of Population

The study of the motor fitness level of boys and girls ranging in age from seven to 10 years used the population of students in pre-first, post-first, first, second and third grades enrolled in Perry Browne Elementary School situated in Norwich, New York. The city of Norwich is small in area and population, with most of the residents employed by a pharmaceutical company, a hospital, shoe factory, and the Norwich City School system.

Description of Sample

The subjects who participated in the study were 108 boys ranging in age from seven to 10 years in the pre-first, post-first, first, second, and third grades and 79 girls ranging in age from seven to 10 years in the pre-first, post-first, first, second, and third grades enrolled in Perry Browne Elementary School. The subjects were drawn from physical education classes already established prior to the start of the school year. All subjects were tested during a 12-week period in the Spring of 1975.

Source of Data

The motor fitness test batteries devised in the investigation conducted by DiNucci and Shore (66), "The Construction of a Motor Fitness Test Battery for Boys in the Lower Elementary Grades," were used. The battery of motor fitness tests included balance, grip strength, modified push-ups, arm flexion on the back, 300-yard run, Wells' sit-and-reach and wrist flexion and extension. This test battery was selected because it was administratively feasible, that is, directions were simple to explain to the subject, equipment required was accessible and it did not require an extensive amount of time to give so as not to interfere with the regular class-instructed physical education program. In addition, each of the seven motor fitness test items carried significant factor loadings in the study previously completed

by DiNucci and Shore (66). The variables and their factor loadings were: grip strength, .732; 300-yard run, -.883; Wells' sit-and reach, .857; balance on stick, lengthwise, .781; arm flexion on the back flexibility, -.717; and modified push-ups, -.756. Existing norms were provided by the study computed by DiNucci and Shore (66) which enabled the investigator at the present study to compare the results of the data gathered.

Instrumentation

A battery of motor fitness tests was used as the instrument of measuring the student's motor fitness level. The motor fitness tests used included balance, grip strength, modified push-ups, 300-yard run, Wells' sit-and-reach, and wrist flexion and extension, arm flexion on the back. Instructions for administering each of the seven test items are included in the Appendix.

Methods of Data Collection

The year each subject began school and whether the child was placed in a pre-first, or regular first grade was recorded. The subjects were given an identification number in a consecutive manner, 01, 02, etc. Sex, age, height and weight of each child participating in the study was recorded. The subject's age was determined in number of months from date of birth through January, 1975. Height was recorded from the school records in terms of total number of inches

and the nearest quarter inch, and weight was recorded from the school records measured to the nearest one-quarter of a pound. Scores attained in each of the seven motor fitness test items were recorded. Children were tested individually by one tester for each of the seven test items as previously described. The tester was the physical education teacher at Perry Browne Elementary School. In a few instances, the subjects experienced interference with their performance and were retested as a result. This occurred on approximately ten occasions. The child took the tests in the following order: balance, grip strength, modified push-ups, arm-flexion on the back, 300-yard run, Wells' sit-and-reach, and wrist flexion and extension. Only one test was administered to the entire class during a gym period. This procedure was followed until all testing was completed.

Organization of Data

Every subject's year entered in school, whether placed in a pre-first, or regular first grade class and identification number was keypunched on the computer. In addition, each of the subject's scores on the seven different motor fitness test items were keypunched as well as age in terms of total number of months, height in total number of inches and weight in total number of pounds.

Design of the Study

This investigation took the form of a 3x2x2 factorial arrangement. Three different years, 1971, 1972, 1973, two different grade classifications, pre-first and regular first grade, and two different sexes, male and female, formed 12 different treatment combinations.

Methods of Data Analysis

The mean and standard deviation was computed for all subjects in the study, then, the mean and standard deviation for three groups were computed according to the year the child entered school, either 1971, 1972, 1973; then, the mean and standard deviation for six groups were computed according to whether the subject was placed in a pre-first class or regular first grade according to the year the child entered school, and finally, the mean and standard deviation for twelve groups were computed according to sex of the subject in a pre-first class or regular first grade and according to the year the child entered school. Mean scores on 187 subjects tested on seven-test items were subject to analysis via a computer. The age, height and weight of each subject was also used in analyzing the data.

Tables were constructed to illustrate the mean score of males and females in pre-first, regular first grade levels, for the years 1971, 1972 and 1973 on each of the seven test items and age, height, weight measurements. A

grand mean score was computed for each sex, male and female, for the pre-first and regular first grade classifications and for each year the students began school, 1971, 1972, and 1973.

Analysis of variance tables were constructed to illustrate the source of variation and if any effect resulted on each of the seven test items and on the age, height and weight measurements. All tests of significance were made at the .05 level.

The profiles of mean scores were graphed for the purpose of illustrating the significant interaction resulting from the year, class, and sex cell means. Inspection of the profiles indicated the performances of the pre-first and regular first grade subjects and sex of the subjects starting school in the years 1971, 1972, and 1973.

Summary

The subjects who participated in the study were 108 boys and 79 girls enrolled in Perry Browne Elementary School. The subjects were scored on seven-test items and age, height, and weight measurements were also recorded.

The investigation was designed as a 3x3x2 factorial arrangement of treatments. An analysis of variance was completed for each of the seven-test items and for the age, height, and weight measurements. Significant interactions were evaluated on various test items and measurements. All tests of significance were made at the .05 level.

Chapter 4

ANALYSIS OF THE DATA

This investigation assessed the motor fitness level of boys and girls in the lower elementary grades and differentiated the motor fitness level of boys and girls placed in a pre-first class with boys and girls placed in a regular first grade. All subjects were tested on balance, grip strength, push-ups, arm flexion on the back, 300-yd run, sit-ups and wrist flexion and extension. The mean scores of the 187 subjects for each of the tests are listed in the Appendix.

To accurately assess the motor fitness level of the students and differentiate the motor fitness level of boys and girls placed in a pre-first class with boys and girls placed in a regular first grade, a 3x2x2 factorial-design with no repeated measures was employed. Three different years, 1971, 1972, 1973, two different grade classifications, pre-first and regular first grade, and two different sexes, male and female, formed 12 different treatment combinations. Mean scores on all subjects tested on seven test-items, were the data subjected to analysis. Age, height and weight of each subject were also used in analyzing the data.

The presentation and analysis of the data has been organized under the following headings: (1) analysis of males and females in pre-first and regular first grades 1971; (2) analysis of males and females in pre-first and regular first grades 1972; (3) analysis of males and females in pre-first and regular first grades 1973; (4) summary.

Analysis of Pre-first and Regular First Grade Subjects--1971

As listed in Tables 1-5, the mean balance time for male pre-first children beginning school in 1971 was 22.33 and 14.15 for female pre-first children, 1971. Mean timesof 35.76 and 39.09 were recorded for the male regular first grade children beginning school in 1971 and female first grade children, 1971 respectively. Thus, the students placed in a regular first grade scored better times than those students placed in pre-first grade. Similar results are shown for the grip test, push-ups, and sit-ups. That is, both male and female students in a regular first grade scored better than the pre-first children. However, the arm flexion on the back test resulted in a mean score of 229.75 for male pre-first while male regular first grade subjects scored less with a score of 205.79. The female scores were comparable with 187.50 for pre-first and 190.00 for a regular first grade subjects. The 300-yard run test provided better scores for the male pre-first subjects with a mean score of 77.04 seconds and 91.76 seconds for the male

Table 1.

Mean Scores, Grand Mean Scores for Pre- and Regular First Grade Subjects on Balance and Grip Tests

Item	Classification	Sex	1971	Sex	1972	Sex	1973	$\bar{X}$	Grand $\bar{X}$
Balance	Pre-	M_{12}	22.33	M_{12}	17.65	M_{15}	15.93	18.43	19.99
		F_2	14.15	F_4	18.13	F_7	17.14	16.98	
	Regular	M_{33}	35.76	M_{23}	25.57	M_{13}	11.18	26.28	26.97
		F_{26}	39.09	F_{32}	19.69	F_8	22.79	27.70	
									Male = 23.44
									Female = 29.22
		Total $\bar{X}$	34.14	Total $\bar{X}$	21.16	Total $\bar{X}$	15.95		
Grip	Pre-	M_{12}	16.33	M_{12}	15.00	M_{15}	10.47	13.66	12.90
		F_2	10.00	F_4	13.50	F_7	9.14	10.61	
	Regular	M_{33}	17.67	M_{23}	14.48	M_{13}	12.69	15.69	14.85
		F_{26}	15.77	F_{32}	13.63	F_8	9.75	14.00	
									Male = 14.94
									Female = 13.44
		Total $\bar{X}$	16.56	Total $\bar{X}$	14.12	Total $\bar{X}$	10.79		

Table 2

Mean Scores, Grand Mean Scores for Pre- and Regular First Grade Subjects on Push-ups and Arm Flexion Tests

Item	Classification	Sex	1971	Sex	1972	Sex	1973	$\bar{X}$	Grand $\bar{X}$
Push-up	Pre-	M_{12}	13.92	M_{12}	13.42	M_{15}	9.81	12.20	11.81
		F_2	8.00	F_4	13.25	F_7	9.86	10.61	
	Regular	M_{33}	21.88	M_{23}	20.09	M_{13}	8.46	18.75	17.94
		F_{26}	18.50	F_{32}	18.59	F_8	6.50	17.08	
									Male = 16.39
									Female = 16.02
		Total $\bar{X}$	18.98	Total $\bar{X}$	17.90	Total $\bar{X}$	8.81		
Arm Flexion	Pre-	M_{12}	229.75	M_{12}	150.08	M_{15}	146.20	173.10	169.26
		F_2	187.50	F_4	200.75	F_7	124.71	157.76	
	Regular	M_{33}	205.79	M_{23}	251.48	M_{13}	153.15	211.10	210.60
		F_{26}	190.00	F_{32}	236.81	F_8	168.38	210.07	
									Male = 197.37
									Female = 201.46
		Total $\bar{X}$	217.30	Total $\bar{X}$	224.88	Total $\bar{X}$	148.92		

Table 3

Mean Scores, Grand Mean Scores for Pre- and Regular First Grade Subjects on 300-yard Run and Wells' Sit and Reach Test

Item	Classification	Sex	1971	Sex	1972	Sex	1973	$\bar{X}$	Grand $\bar{X}$
300-yard Run	Pre-	M_{12}	77.04	M_{12}	77.82	M_{15}	66.89	73.37	73.59
		F_2	96.50	F_4	81.50	F_7	63.74	74.24	
	Regular	M_{33}	91.76	M_{23}	76.45	M_{13}	78.37	83.98	88.20
		F_{26}	117.23	F_{32}	77.50	F_8	73.13	92.66	
									Male = 80.15
									Female = 89.59
		Total $\bar{X}$	98.54	Total $\bar{X}$	77.43	Total $\bar{X}$	71.00		
Wells Sit and Reach	Pre-	M_{12}	4.25	M_{12}	7.50	M_{15}	6.20	6.00	5.90
		F_2	5.50	F_4	4.75	F_7	6.14	5.61	
	Regular	M_{33}	8.97	M_{23}	4.83	M_{13}	6.54	7.13	6.38
		F_{26}	8.00	F_{32}	3.66	F_8	5.63	5.60	
									Male = 6.72
									Female = 5.60
		Total $\bar{X}$	5.01	Total $\bar{X}$	4.74	Total $\bar{X}$	6.18		

Table 4

Mean Scores, Grand Mean Scores for Pre- and Regular First Grade Subjects on Wrist Flexion and Extension and Age

Item	Classification	Sex	1971	Sex	1972	Sex	1973	$\bar{X}$	Grand $\bar{X}$
Wrist Flexion and Extension	Pre-	M_{12}	110.83	M_{12}	76.83	M_{15}	65.20	82.81	80.86
		F_2	117.00	F_4	72.25	F_7	64.57	74.99	
	Regular	M_{33}	114.18	M_{23}	94.13	M_{13}	91.69	103.25	109.82
		F_{26}	129.46	F_{32}	113.19	F_8	91.75	116.69	
									Male = 95.87
									Female = 109.83
		Total $\bar{X}$	119.14	Total $\bar{X}$	98.56	Total $\bar{X}$	78.04		
Age	Pre-	M_{12}	117.75	M_{12}	104.92	M_{15}	91.53	103.71	102.84
		F_2	119.00	F_4	106.25	F_7	91.43	100.23	
	Regular	M_{33}	116.39	M_{23}	102.39	M_{13}	89.38	106.63	106.86
		F_{26}	115.50	F_{32}	103.69	F_8	93.50	107.10	
									Male = 105.58
									Female = 105.97
		Total $\bar{X}$	116.36	Total $\bar{X}$	103.62	Total $\bar{X}$	91.23		

Table 5

Mean Scores, Grand Mean Scores for Pre- and Regular First Grade Subjects on Height and Weight

Item	Classification	Sex	1971	Sex	1972	Sex	1973	$\bar{X}$	Grand $\bar{X}$
Height	Pre-	M_{12}	50.92	M_{12}	49.15	M_{15}	46.00	48.48	48.25
		F_2	50.10	F_4	48.32	F_7	46.40	47.56	
	Regular	M_{33}	52.13	M_{23}	49.33	M_{13}	47.88	50.52	50.09
		F_{26}	51.07	F_{32}	49.33	F_8	46.12	49.64	
									Male = 49.78
									Female = 49.29
		Total $\bar{X}$	51.49	Total $\bar{X}$	49.36	Total $\bar{X}$	46.66		
Weight	Pre-	M_{12}	60.96	M_{12}	58.33	M_{15}	48.90	55.51	55.19
		F_2	60.00	F_4	61.63	F_7	48.36	54.23	
	Regular	M_{33}	68.52	M_{23}	59.10	M_{13}	53.02	62.15	60.99
		F_{26}	66.56	F_{32}	56.43	F_8	48.69	59.46	
									Male = 59.95
									Female = 58.60
		Total $\bar{X}$	66.34	Total $\bar{X}$	57.90	Total $\bar{X}$	50.01		

regular first grade subjects. The female pre-first subjects also scored better with a mean score of 96.50 seconds while the regular first grade female's mean score was 117.23 seconds. Mean times of 110.83 on the wrist flexion and extension test for pre-first male children was better than the mean score of 114.18 for male regular first grade children. Female pre-first's meansscore was 117.0cwhile the female regular first grade mean score was 129.46.

The mean age, height, weight scores indicated that the male pre-first children were one month older, two inches shorter, eight pounds lighter than the male regular first grade children. The female pre-first children's mean scores showed that they were four months older, one pound lighter, and six inches shorter than the female regular first grade children.

Analysis of Pre-first and Regular First Grade Subjects--1972

As listed in Tables 1-5, the mean scores for the balance test were better for the male and female regular first grade children beginning school in 1972 than the pre-first male and female children beginning school in 1972. Similar results are noted on the push-ups, arm flexion on the back, 300-yard run and wrist flexion and extension. However, the mean score of 15.0 for male pre-first children on the grip test was better than the mean score of 14.48 for male regular first grade children. The female regular first

grade's mean score was better with 13.63 and 13.50 for the female pre-first grade children. Mean score of 7.50 sit-ups for the male pre-first children was better than the regular first grade's mean score of 4.83. The female pre-first grade's mean score of 4.75 was also better than the female's regular first grade children's mean score of 3.66.

The mean age, height, and weight scores indicated that the male pre-first children were two inches taller, 0.57 pounds lighter and weighed one pound less than the male regular first grade children. The mean age, height, and weight scores showed that the female pre-first children were three months older, one inch shorter, and weighed five pounds more than the female regular first grade children.

Analysis of Pre-first and Regular First Grade Subjects--1973

As listed in Tables 1-5, the mean scores for the grip test were better for the male and female regular first grade children beginning school in 1973 than the male and female pre-first grade children beginning school in 1973. Similar results are noted for the arm flexion on the back test, and the wrist flexion and extension test. However, the balance test provided a better mean score of 15.93 seconds for the male pre-first children while the mean score for the male regular first grade children was 11.18 seconds. The female regular first grade children's mean score was 22.79 seconds and 17.14 seconds for the female pre-first grade

children. The mean score on the push-ups test was 9.87 for male pre-first grade children and 8.46 for male regular first grade children. A mean score of 9.86 was gained by the female pre-first subjects and 6.50 for the female regular first grade children. The male pre-first children scored better on the 300-yd run with a mean score of 66.89 seconds and 78.37 seconds for the male regular first grade children. The female pre-first's mean score was 63.74 seconds and 73.13 seconds for the female regular first grade children. A mean score of 6.20 sit-ups was the better score for the male pre-first children than the male regular first grade's mean score of 6.54. The female pre-first grade children's mean score of 6.14 was better than the mean score of 5.63 sit-ups for the female regular first grade children.

The mean age, height and weight scores indicated the male pre-first children were two months older, one inch taller and weighed four pounds less than the male regular first grade children. The female pre-first grade children's mean scores showed that they were two months younger, 0.28 inches taller and weighed 0.33 pounds less than the female regular first grade children.

As listed in Table 1, the grand mean balance score for males was 23.44 as compared to a grand mean score of 29.22 for female. The overall grand mean score for regular first grade children starting school in the years 1971, 1972, was 26.97 as compared to a lower score of 19.99 for those

children placed in a pre-first grade. Students starting school in 1971 performed better on the balance with a grand mean score of 34.14 and the grand mean values of 21.16 and 15.95 in 1972 and 1973 respectively.

In order to assess the effects of the source of variation on each of the seven-test items and on age, height weight, the data were subjected to an analysis of variances (Table 6). No significant F ratio was obtained for the balance test item.

As listed in Table 1, the grand mean grip score for males was 14.94 as compared to a grand mean score of 13.44 for females. The overall grand mean score for regular first grade children starting school in the year 1971, 1972, and 1973 was 14.85 as compared to a lower score of 12.90 for those children placed in a pre-first grade. Students starting school in 1971 performed better on the grip test with a grand mean score of 16.56 and the grand mean values of 14.12 and 10.79 in 1972 and 1973 respectively.

As indicated in Table 7, the obtained F ratio for year was 14.36, with 2 and 175 degrees of freedom, an F value of 3.05 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the year the subjects started school was considered to have had an effect on the grip test.

Table 6

Analysis of Variance of the Means of Balance Score for Years, Classification and Sex

Source of Variation	Sums of Squares	df	Mean Squares	F
Year (Y)	1858.85949	2	929.42968	1.95231
Class (C)	1614.94271	1	1614.94260	3.39228
Sex (S)	4.43986	1	4.43986	0.00933
YC	1372.87610	2	686.47398	1.44189
YS	489.55951	2	244.77966	0.51417
CS	164.39087	1	164.39087	0.34531
YCS	447.97318	2	223.98657	0.47049
Error	83311.87809	5	476.06761	
Total	89564.91981	16		

Table 7

Analysis of Variance of the Means of Grip Score for Years, Classification, and Age

Source of Variation	Sums of Squares	df	Mean Squares	F
Year (Y)	384.87370	2	192.43677	14.36883*
Class (C)	61.82703	1	61.82703	4.61649*
Sex (S)	149.85452	1	149.85452	11.18931*
YC	53.22579	2	26.61288	1.98713
YS	32.76914	2	16.38457	1.22340
CS	8.15453	1	8.15453	0.60888
YCS	34.47457	2	17.23727	1.28707
Error	2343.71422	175	13.39265	
Total	3068.89450	186		

*Significant difference at the .05 level.

175 degrees of freedom, and F value of 3.90 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance the null hypothesis was rejected and the class the subjects started school was considered to have had an effect on the grip test.

The obtained F ratio for sex was 11.18. With 1 and 175 degrees of freedom, an F value of 3.90 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the sex of the subject was considered to have had an effect on the grip test.

As listed in Table 2, the grand mean push-up score for males was 16.39 as compared to a grand mean score of 16.02 for females. The overall grand mean score for regular first grade children starting school in the years 1971, 1972, and 1973 was 17.94 as compared to a lower score of 11.81 for those children placed in a pre-first grade. Students starting school in 1971 performed better on the push-up test with a grand mean score of 18.98 and 17.90 and 8.81 in 1972 and 1973 respectively.

As listed in Table 8, the obtained F ratio for year was 6.88. With 2 and 175 degrees of freedom, an F value of 3.07 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the year the subjects started school was considered to have had an effect on the

Table 8

Analysis of Variance of the Means of Push-up Score for Years, Classification, and Age

Source of Variation	Sum of Squares	df	Mean Squares	F
Year (Y)	1321.35448	2	660.67700	6.68858*
Class (C)	449.30774	1	449.30761	4.54871*
Sex (S)	113.54365	1	113.54364	1.14950
YC	599.08354	2	299.54174	3.03251
YS	65.41767	2	32.70883	0.33114
CS	0.37279	1	0.37279	0.00377
YCS	20.82560	2	10.41280	0.10542
Error	17285.96457	175	98.77692	
Total	19955.87004	186		

*Significant difference at the .05 level.

push-up test.

The obtained F ratio for class was 4.54. With 1 and 175 degrees of freedom, an F value of 3.92 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the class the subjects started school was considered to have had an effect on the push-up test.

As listed in Table 2, the grand mean arm flexion on the back score for males was 197.37 as compared to a grand mean score of 201.46 for females. The overall grand mean score for regular first grade children starting school in the years 1971, 1972, and 1973 was 210.60 as compared to a lower score of 169.26 for those children placed in a pre-first grade. Students starting school in 1971 performed poorer on the arm flexion on the back test with a grand mean score of 217.30 and 224.88 and 148.92 in 1972 and 1973 respectively.

As listed in Table 9, the obtained F ratio for year was 6.90. With 2 and 175 degrees of freedom, an F value of 3.07 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the year the subjects started school was considered to have had an effect on the arm-flexion and extension test.

As listed in Table 3, the grand mean 300-yard run score for males was 80.15 as compared to a grand mean score of 89.59 for females. The overall grand mean score for

Table 9

Analysis of Variance of the Means of Arm Flexion Score for Years, Classification, and Sex

Source of Variation	Sum of Squares	df	Mean Squares	F
Year (Y)	85175.30820	2	42587.62500	6.90880*
Class (C)	18862.95685	1	18862.95300	3.06005
Sex (S)	544.28739	1	544.28735	0.08830
YC	24817.3063	2	12408.65200	2.01300
YS	8397.08262	2	4198.53900	0.68111
CS	3.18051	1	3.18051	0.00052
YCS	14665.38500	2	7332.69140	1.8955
Error	1078745.94183	175	6164.25390	
Total	1231211.44854	186		

*Significant difference at the .05 level.

regular first grade children starting school in the years 1971, 1972, and 1973 was 88.20 as compared to a lower score of 73.59 for those children placed in a pre-first grade. Students starting school in 1971 performed poorer on the 300-yard run test with a grand mean score of 98.54 seconds and 77.43 seconds in 1972 while the best grand mean score was attained by those students starting school in 1973 with a grand mean score of 71.00 seconds.

As listed in Table 10, the obtained F ratio for year was 16.53. With 2 and 175 degrees of freedom, an F value of 3.07 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the year the subjects started school was considered to have had an effect on the 300-yard run test.

The obtained F ratio for class was 6.09 with 1 and 175 degrees of freedom, an F value of 3.90 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the class the subjects started school was considered to have had an effect on the 300-yard run test.

The obtained F ratio for sex was 4.00. With 1 and 175 degrees of freedom, an F value of 3.90 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the sex of the subjects was considered to

Table 10

Analysis of Variance of the Means of 300-yard Run Score for Years, Classification, and Sex

Source of Variation	Sum of Squares	df	Mean Squares	F
Year (Y)	9567.65922	2	4783.82810	16.53835*
Class (C)	1763.31568	1	1763.31560	6.09603*
Sex (S)	1157.27013	1	1157.27000	4.00084*
YC	1737.91462	2	868.95727	3.00410
YS	2759.05994	2	1379.52970	4.76922*
CS	1.12310	1	1.12310	0.00388
YCS	82.31491	2	41.15746	0.14229
Error	50619.94838	175	289.25659	
Total	67888.60598	186		

*Significant difference at the .05 level.

have had an effect on the 300-yard test.

The obtained F ratio for year x sex was 4.76. With 2 and 175 degrees of freedom, an F value of 3.07 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the interaction of year and sex of the subjects was considered to have had an effect on the 300-yard run test.

Profiles of the mean scores for 300-yard run and sex of the subjects are illustrated in Figure 1. The profiles indicated a better performance of female subjects starting school in 1971 and 1972 than male subjects starting school in 1971 and 1972. However, the male subjects starting school in 1973 performed slightly better than the female subjects starting school in 1973. The investigation of the profiles also indicated that the best performances for both male and female children resulted from those children starting school in 1973 and that a decline in performance of both sexes resulted in the years 1971 and 1972.

As listed in Table 11, the obtained F ratio for year, class was 4.40. With 2 and 175 degrees of freedom, an F value of 3.07 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and interaction of year and class the subjects started school was considered to have had an effect on the Wells sit and reach test.

As listed in Table 3, the grand mean Wells' sit and

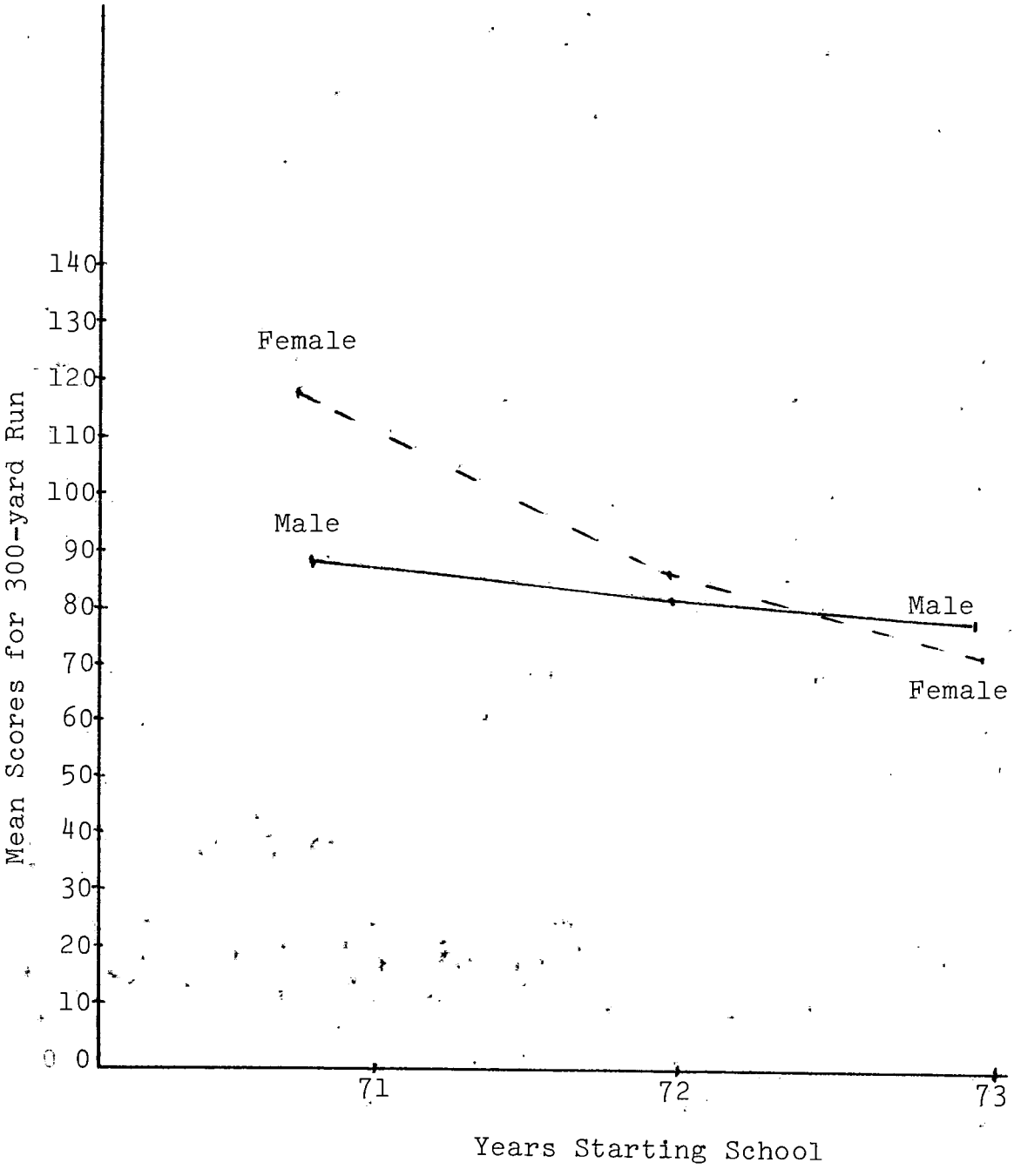

Figure 1

Profiles of Mean Scores for 300-yard Run and Years Subjects Started School

Table 11

Analysis of Variance of the Means of Sit and Reach Score for Years, Classification, and Sex

Source of Variation	Sum of Squares	df	Mean Squares	F
Year (Y)	37.07364	2	18.53680	1.42631
Class (C)	7.27787	1	7.27787	0.55999
Sex (S)	14.44230	1	14.44230	1.11126
YC	114.49155	2	57.24576	4.40477*
YS	19.32073	2	9.66036	0.74332
CS	1.52050	1	1.52050	0.11699
YCS	15.05136	2	7.52568	0.57906
Error	2274.35571	175	12.99632	
Total	2484.52366	186		

*Significant difference at the .05 level.

reach score for males was 6.72 as compared to a grand mean score of 5.60 for females. The overall grand mean score for regular first grade children starting school in the years 1971, 1972, and 1973 was 6.38 as compared to a lower score of 5.90 for those children placed in a pre-first grade. Students starting school in 1971 performed poorer on the Wells' sit and reach with a grand mean score of 5.01 and 4.74 and 6.18 in 1972 and 1973 respectively.

Profiles of the mean scores for Wells sit and reach and years subjects started school are illustrated in Figure 2. The profiles indicated that the regular first grade children starting school in 1971 and 1973 performed better than the pre-first children starting school in 1971 and 1973. However, the pre-first children starting school in 1972 performed better than the regular first grade children starting school in 1972. The inspection of profiles also indicated that the regular first grade children starting school in 1971 performed better than those children starting school in 1972 and 1973 whereas the pre-first children starting school in 1972 and 1973 performed better than those children starting school in 1971.

As listed in Table 4, the grand mean wrist flexion and extension score for males was 95.87 as compared to a higher score of 109.83 for females. The overall grand mean score for regular first grade children starting school in the years 1971, 1972, and 1973 was 109.82 as compared to a

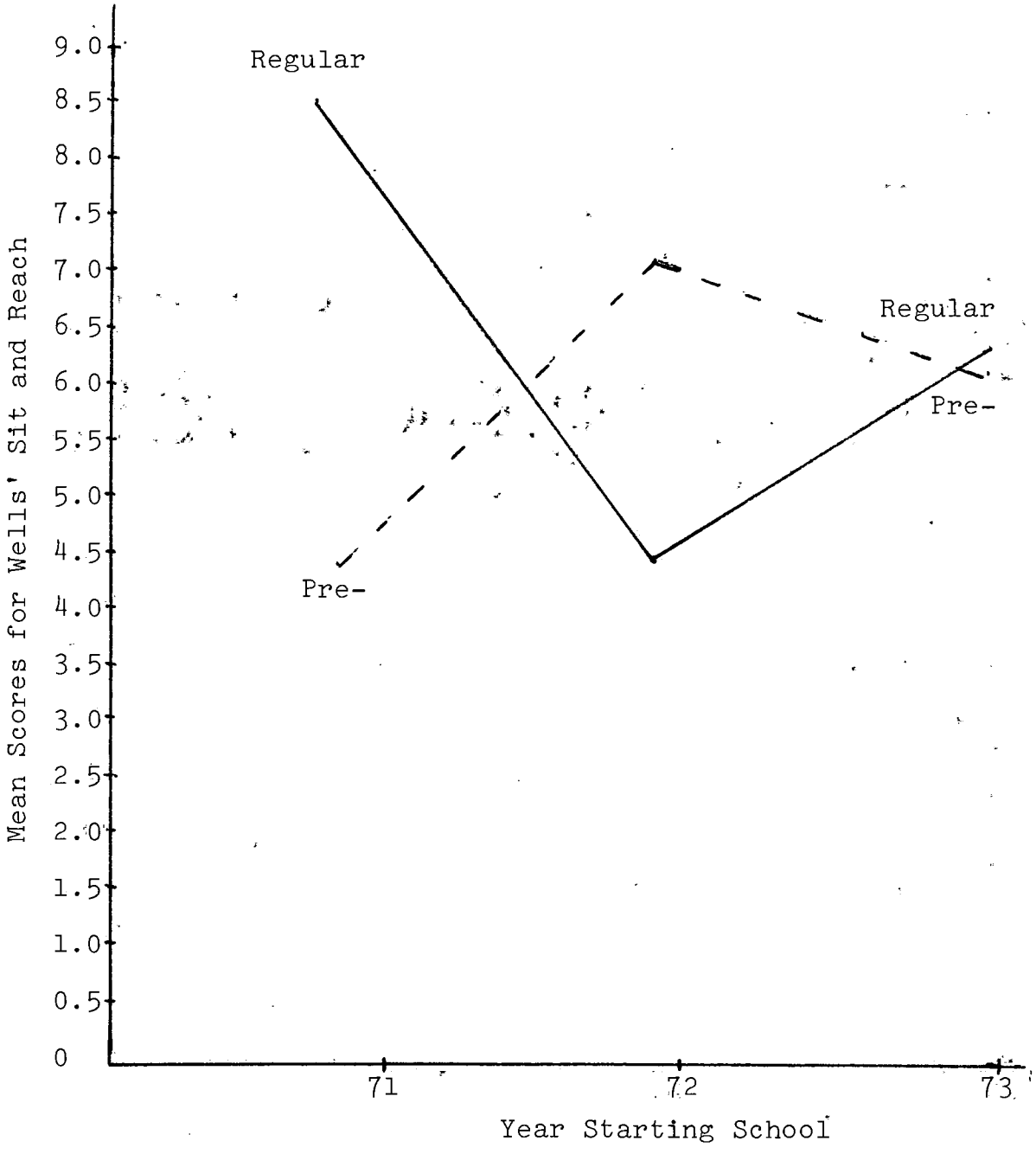

Figure 2

Profiles of Mean Scores for Well's Sit and Reach and Years Subjects Started School

lower score of 80.86 for those children placed in a pre-first grade. Students starting school in 1971 performed better on the wrist flexion and extension with a grand mean score of 119.14, 1972; 98.56 and 1973; 78.04 respectively.

As stated in Table 12, the obtained F ratio for year was 20.88. With 2 and 175 degrees of freedom, an F value of 3.07 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the year the subjects started school was considered to have had an effect on the wrist flexion test.

The obtained F ratio for class was 19.25. With 1 and 175 degrees of freedom, an F value of 3.90 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the class the subjects were placed in was considered to have had an effect on the wrist flexion test.

As listed in Table 4, the grand mean age for males was 105.58 months as compared to 105.97 months for females. The overall grand mean for regular first grade children starting school in the years 1971, 1972, and 1973 was 106.86 months as compared to a younger pre-first grade age of 102.84 months. Students starting school in 1971 were the oldest with a grand mean age of 116.36 months, and 103.62 months and 91.23 months in 1972 and 1973 respectively.

As stated in Table 13, the obtained F ratio for year

Table 12

Analysis of Variance of the Means of Wrist Flexion for Years, Classification, and Sex

Source of Variation	Sum of Squares	df	Mean Squares	F
Year (Y)	24043.41233	2	12021.70300	20.88608*
Class (C)	11083.97607	1	11083.97200	19.25690*
Sex (S)	849.11887	1	849.11865	1.47523
YC	1906.68443	2	953.31240	1.65630
YS	520.31049	2	260.15502	0.45198
CS	759.85985	1	759.85961	1.32015
YCS	654.13416	2	327.06689	0.56823
Error	100727.32117	175		
Total	140544.81637	186		

*Significant difference at the .05 level.

Table 13

Analysis of Variance of the Means of Age for Years, Classification and Sex

Source of Variation	Sum of Squares	df	Mean Squares	F
Year (Y)	10140.77618	2	5070.38670	231.24261*
Class (C)	68.24155	1	68.24155	3.11226
Sex (S)	33.26092	1	33.26091	1.51691
YC	36.61185	2	18.30592	0.83487
YS	12.55946	2	6.27973	0.28640
CS	2.82535	1	2.82535	0.12855
YCS	42.96244	2	21.40122	0.97968
Error	3837.17326	175	21.92670	
Total	14174.50701	186		

*Significant difference at the .05 level.

was 231.242. With 2 and 175 degrees of freedom, an F value of 3.07 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the age of the subjects was considered in proportion with the year the subjects started school.

As listed in Table 5, the grand mean height for males was 49.78 inches as compared to 49.29 inches for females. The overall grand mean height for regular first grade children starting school in the years 1971, 1972, and 1973 was 50.09 inches as compared to a shorter pre-first grade height of 48.25 inches. Students starting school in 1971 were the tallest with a grand mean height of 51.49 inches and 49.36 inches and 46.66 inches in 1972 and 1973 respectively.

As listed in Table 14, the obtained F ratio for year was 27.54 with 2 and 175 degrees of freedom, an F value of 3.07 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the height of the subjects was considered in proportion with the year the subjects started school.

As listed in Table 5, the grand mean weight for males was 59.95 pounds as compared to 58.60 pounds for females. The overall grand mean score for regular first grade children starting school in the years 1971, 1972, and

Table 14

Analysis of Variance of the Means of Height Score for Years, Classification, and Sex

Source of Variation	Sum of Squares	df	Mean Squares	F
Year (C)	314.54921	2	157.27454	27.54606*
Class (C)	19.47852	1	19.47852	3.41160
Sex (S)	13.42792	1	13.42792	2.35186
YC	0.40808	2	0.20404	0.03574
YS	0.44565	2	0.22282	0.03903
CS	2.57145	1	2.57144	0.45038
YCS	8.63750	2	4.31875	0.75642
Error	999.16072	175	5.70949	
Total	1358.67910			

*Significant difference at the .05 level.

1973 was 60.99 pounds as compared to a lighter pre-first grade weight of 55.19 pounds. Students starting school in 1971 were the heaviest with a grand mean weight of 66.34 pounds, and the grand mean values of 57.90 pounds and 50.01 pounds were taken in 1972 and 1973 respectively.

As listed in Table 15, the obtained F ratio for year was 12.36. With 2 and 175 degrees of freedom, an F value of 3.07 is required for significance at the .05 level. Since the obtained ratio exceeded that required for significance, the null hypothesis was rejected and the weight of the subjects was considered in proportion with the year the subjects started school.

As listed in Tables 16 and 17, the mean scores obtained from data collected in this investigation and those noted by James N. DiNucci and John Roger Shore indicated the following differences:

a) The boys participating in this study had a higher mean score than those observed by DiNucci and Shore on the balance, modified push-ups, and the arm flexion on the back test items.

b) The girls participating in this study had a higher mean score than those observed by DiNucci and Shore on the balance, modified push-ups, and arm flexion on the back test items.

c) The observations made by DiNucci and Shore proved a higher mean score for the boys on the grip

Table 15

Analysis of Variance of the Means of Weight for Years, Classification, and Sex

Sourc of Variation	Sum of Squares	df	Mean Squares	F
Year (Y)	3378.94201	2	1689.47090	12.36471*
Class (C)	135.81715	1	135.81714	0.99400
Sex (S)	34.91404	1	34.91403	0.25552
YC	328.66565	2	164.33276	1.20270
YS	37.51779	2	18.75890	0.13729
CS	78.51232	1	78.51231	0.57461
YCS	23.36713	2	11.68356	0.08551
Error	23911.39035	175	136.63649	
Total	27929.12644	186		

*$F_{2\ 175\ .05} = 3.07$.

Table 16

Mean Scores of Boys in DiNucci and Shore's Study Compared with This Study

Test-item	Mean	Stand. Dev.
Balance	11.88	7.8
	23.44*	
Grip	24.5	8.5
	14.94*	
Push-ups	13.97	6.96
	16.39*	
Arm Flexion	91	13
	197.37*	
Run	87.2	15.9
	80.15*	
Sit and Reach	11.2	2.2
	6.72*	
Wrist Flexion	121.67	16.88
	95.87*	

*Scores taken from this investigation.

Table 17

Mean Scores of Girls in DiNucci and Shore's Study Compared with This Study

Test-item	Mean	Stand. Dev.
Balance	14.95	7.42
	29.22*	
Grip	21.4	7.2
	13.44*	
Push-ups	9.55	5.96
	16.02*	
Arm Flexion	94.27	15.81
	201.46*	
Run	90.3	11.5
	89.59*	
Sit and Reach	12.08	2.03
	5.60*	
Wrist Flexion	141.05	18.28
	109.83*	

*Scores taken from this investigation.

strength, 300-yard run, Wells' sit and reach, wrist flexion, and extension test items.

d) The observations make by DiNucci and Shore proved a higher mean score for the girls on the grip strength, 300-yard run, Wells' sit and reach, and wrist flexion and extension test items.

e) Similar performances were noted in sex differences on motor performance. DiNucci and Shore's study indicated that the males performed better on the grip strength, modified push ups and the 300-yard run test items. The females performed better on the balance, arm flexion on the back, Wells' sit and reach and wrist flexion and extension test items. This study indicated that the males performed better on the grip strength, modified push-ups, 300-yard run, and Wells' sit and reach test items. The females performed better on the balance, arm flexion on the back and the wrist flexion and extension test items.

Summary

This investigation assessed the motor fitness level of the students and differentiated the motor fitness level of boys and girls placed in a pre-first class with boys and girls placed in a regular first grade. A 3x2x2 factorial arrangement with no repeated measures was the design utilized to enable the comparison of the main and interaction effects of these variables. Each subject was tested on seven test items and the age, height and weight of each

subject was recorded and all scores were the data subjected to analysis.

The analysis and interpretation of the data was presented in three categories of males and females in regular and pre-first grade levels in the years starting school; 1971, 1972, 1973.

In addition, a comparison of mean scores obtained from data collected in this investigation and those noted by James N. DiNucci and John Roger Shore was made.

Chapter 5

DISCUSSION OF RESULTS

This investigation assessed the motor fitness level of boys and girls in the lower elementary grades and differentiated the motor fitness level of boys and girls placed in a pre-first class with boys and girls placed in a regular first grade. All subjects were tested on balance, grip strength, push-ups, arm flexion on the back, 300-yard run, sit-ups, and wrist flexion and extension.

The balance test item indicated a better performance for the regular first grade children than the pre-first grade students. The females performed better than the males and a decline in performance was noted from year to year.

The grip strength test item indicated a better performance for the regular first grade children than the pre-first grade students. The males proved slightly stronger than the females and a small decline in strength resulted from year to year.

The modified push-up test item indicated a better performance for the regular first grade children than the pre-first grade students. The males and females performed equally well and a slight decline in performance resulted from older to younger students.

The arm flexion on the back test indicated a better performance for the regular first grade children than the pre-first grade students. The females performed better than the males and a slight decline in performance resulted from older to younger students.

The 300-yard run test indicated a better performance in the pre-first grade children than the regular first grade students. The males were slightly faster than the females and the younger students ran faster than the older students.

The Wells' sit and reach test item indicated a slight difference between the regular first grade students and the pre-first grade students in that the regular first graders performed better than the pre-first graders. The males performed better than the females and a very small difference was noted in the performance levels of the children ranging in age from seven to ten years.

The wrist flexion and extension test item indicated the regular first graders performed better than the pre-first graders. The females proved more flexible than the males and the older children were slightly more flexible than the younger students.

Previous Investigations and Their Implications

Research has shown as the grade level advances, improvement is found in motor performance. Glassow (36) indicated that motor performance scores improve during early childhood. Seils (57), Rarick (52), and Latchaw (44)

similarly summarized in their respective studies that significant increments resulted from grade to grade on motor performance tests. This investigation concluded that the older children performed better on the balance, grip strength, modified push-ups, wrist flexion and extehsion test items. A slight difference was noted between the older children and younger students on the arm flexion and extension test item and the Wells' sit and reach test item. The younger students ran faster than the older children.

Research concerning sex differences on motor performance is evident. Keogh (42) found that boys superseded girls in mean performance on throwing for distance and had a similar advantage in accuracy. Espenschade (33) indicated that girls are favored i performance of hopping, stepping and galloping while boys perform better in jumping and throwing. Espenschade (33) also pointed out that boys achieve a higher percentage of grip strenght improvement that girls. DiNucci and Shore's (66) study indicated that the males performed better on the grip strength, modified push-ups, and the 300-yard run test items. The females performed better on the balance, arm flexion on the back, Wells' sit and reach, and wrist flexion and extension test items. This study indicated that the males performed better on the grip strength, Modified push-ups, 300-yard run, and Well's sit and reach te test items. The females performed better on the balance, arm flexion on the back, and the wrist flexion and extension test items.

The mean scores computed from the data collected in this study indicated that the males performed better on the 300-yard run test item. A slight difference favoring the males resulted in the grip strength, modified push-ups, Wells' sit and reach test items. However, the females performed better on the balance and wrist flexion and extension test items. Females performed slightly better on the arm-flexion on the back test item.

Summary

The subjects in this study were tested on balance, grip strength, push-ups, arm flexion on the back, 300-yard run, sit-ups, and wrist flexion and extension.

Each test item indicated the performance level of every subject in the study. Differences were noted in the year the subjects started school, their classification of regular or pre-first grade level, and their particular sex.

Consideration was also given to previous investigations and their implications with regard to results obtained from this study.

Chapter 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Problem. The purpose of this study was to assess the motor fitness level of boys and girls in the lower elementary grades and to differentiate the motor fitness level of boys and girls placed in a pre-first class with boys and girls placed in a regular first grade.

Experimental procedures. One hundred boys and 75 girls ranging in age from seven to 10 years of age in the pre-first, post-first, first, second and third grades at Perry Browne Elementary School in Norwich, New York participated in this study. Each subject was tested in terms of their motor fitness level through balance, grip strength, run, flexibility in the back and wrist, and modified push-up items.

Each subject was tested individually by one tester. Only one test was administered to each subject during a single test period.

Analysis of the data. The investigation took the term of a 3x2x2 factoral arrangement, with no repeated measures. The mean scores of each of the 175 subjects for each of the seven test items were computerized and are listed in

Appendix B. The mean scores on all subjects tested and the age, height, and weight of each subject were the data subjected to analysis. A grand mean score was computed for each sex, grade classification, and the year in which the subject began school; either 1971, 1972, or 1973.

Analysis of variance tables were completed in order to illustrate the source of variation and if any effect resulted on each of the seven test items and on the age, height and weight measurements. The tests of significance were made at the .05 level. In cases where the obtained ratio exceeded the required ratio for significance, the null hypothesis was rejected and therefore, it was concluded that the source of variation had an effect on the test items or on the age, height, or weight of the subject.

Further analyzation of the data was completed in graph form. The profiles of mean scores were graphed for the purpose of illustrating the significant interaction resulting from the year, class, and sex cell means. Inspection of the profiles indicated the performances of the pre-first and regular first grade, and sex of the subjects starting school in the years 1971, 1972, and 1973.

Conclusions

On the basis of the data and within the limitations and determinations of this investigation the following conclusions may be made:

1. A sex difference on motor performance is evident on the grip and 300-yard run test items.

2. The regular first grade students performed better on six of the seven test items than the pre-first grade children. The exception was the 300 yard run test item in which the pre-first children performed better than the regular first grade students.

3. A difference in motor fitness level was noted between the older and younger subjects. That is, the older children performed better than the younger students on six of the seven test items. The exception was the 300-yard run test item in which the younger subjects ran faster than the older subjects.

4. Sex differences in motor performance were noted in mean scores of boys and girls in DiNucci and Shore's study as compared with this study. DiNucci and Shore's study indicated that the males performed better on the grip strength, modified push-ups, and the 300-yard run test items. The females performed better on the balance, arm flexion on the back and Wells' sit and reach test items. The females also performed better on the wrist flexion and extension test items.

Recommendations

Several studies related to this investigation are recommended for future research:

1. A study could be undertaken in which the test-items were administered more than once so that a reliability coefficient may be determined.

2. An investigation could include a larger number of subjects.

3. A study could involve subjects taken from two different elementary schools and a comparison in motor fitness level and performance could be made.

4. An investigation could involve the use of the Shape-O-Ball test only and thus, consider the relationship, if any, of a child's perceptual-motor ability and motor performance.

APPENDICES

Appendix A. Test Items

1. Balance on stick lengthwise:

   Student balances on stick, using preferred foot.

   At the starting signal, student holds this position as long as possible, up to 60 seconds.

   Three trials are allowed.

   Score the sum of the 3 times, (record to nearest tenth of a second.

2. Grip strength:

   In a standing position, student squeezes manuometer, hand forms sweep arc downward, with elbow slightly bent. Hands are not allowed to touch body or any object.

   Two trials are allowed, with the better score recorded.

3. Modified push-ups:

   Each student must stand, with two feet flat on floor, arms stretched out in front, and hands flat against wall, on tape line.(13 inches from floor).

   Each student lowers body towards wall so that upper chest touches wall, then raises to a straight arm position.

   Each student performs as many times as possible, each push-up counting one point.

   Half-credit is given if student does not go completely down or does not push completely up, maximum of four

half credits allowed.

4. Arm flexion on back:

Student stands at attention with thumb and forefinger placed on lateral crest of ilium (show) wrist is straight, feet apart enough to give solid stance.

Instrument is fastened to underside of wrist, dial is locked.

Subject places hand as far up the back as possible in a hammer lock position, pointer is locked.

During the movement, body is not allowed to bend forward or sideways, nor is position of feet allowed to change.

Score the number of degrees through which movement took place.

5. 300-yard run:

On the starting signal, (whistle) student runs length or course (100 yards) three times in the style of a shuttle run.

One turn is allowed and score the time to the nearest tenth of a second required to complete the 300 yard distance.

6. Wells' sit and reach:

Student sits on floor, knees straight, feet flat against vertical portion of measuring scale.

Student bounces three times reaching forward along measuring scale. On the fourth bounce, student reaches

as far forward as possible and holds the position for two seconds.

Score the distance to nearest half inch reached on the fourth bounce.

A score of 11 indicated a reach to the point directly above the toes.

7. Wrist flexion and extension:

Student sits in a standard armchair, back straight, forearm resting on chair arms, fist doubled and extend beyond chair arms; palm of hand to be measured turned up with instrument fastened to thumb inside of fist.

Student moves fist upward and backward in an arc as far as possible, dial is locked.

Subject moves fist forward, downward, backward in an arc as far as possible, pointer is locked.

Forearm is not allowed to be raised from chair during the movement.

Score the number of degrees through which movement took place.

Appendix B. Mean Scores

Mean Scores for Subjects--1971

		Pre-Reg		Regular	
		M - 12	F - 2	M - 33	F - 26
Balance	$\bar{X}$	22.33	14.15	35.76	39.09
	S.D.	15.33	8.70	30.40	33.47
Grip	$\bar{X}$	16.33	10.00	17.67	15.77
	S.D.	2.31	2.83	4.57	2.97
Push-ups	$\bar{X}$	13.92	8.00	21.88	18.50
	S.D.	10.15	2.83	13.32	11.22
Arm Flexion	$\bar{X}$	229.75	187.50	205.79	190.00
	S.D.	78.12	67.18	118.22	92.47
300-yard Run	$\bar{X}$	77.04	96.50	91.76	117.23
	S.D.	8.73	28.99	24.27	28.32
Sit and Reach	$\bar{X}$	4.25	5.50	8.97	8.00
	S.D.	2.42	3.54	4.95	4.56
Wrist Flexion	$\bar{X}$	110.83	117.00	114.18	129.46
	S.D.	25.27	18.38	29.48	21.48
Age	$\bar{X}$	117.75	119.00	116.39	115.50
	S.D.	1.76	1.41	6.55	4.78
Height	$\bar{X}$	50.92	50.10	52.13	51.07
	S.D.	2.13	0.14	2.61	2.22
Weight	$\bar{X}$	60.96	60.00	68.52	66.56
	S.D.	9.68	11.31	16.09	15.04

Mean Scores for Subjects--1972

		Pre-		Regular	
		M - 12	F - 4	M - 23	M - 32
Balance	$\bar{X}$	17.65	18.13	25.57	19.69
	S.D.	11.24	16.97	21.34	12.42
Grip	$\bar{X}$	15.00	13.50	14.48	13.63
	S.D.	2.22	2.52	4.25	3.11
Push-ups	$\bar{X}$	13.42	13.25	20.09	18.59
	S.D.	6.11	11.76	12.04	8.86
Arm Flexion	$\bar{X}$	150.08	200.75	251.48	236.81
	S.D.	31.90	67.76	61.19	79.68
300-yard Run	$\bar{X}$	77.82	81.50	76.45	77.50
	S.D.	11.06	9.43	8.52	8.43
Sit and Reach	$\bar{X}$	7.50	4.75	4.83	3.66
	S.D.	2.39	2.99	3.66	2.70
Wrist Flexion	$\bar{X}$	76.83	72.25	95.13	113.19
	S.D.	12.26	22.32	26.03	23.32
Age	$\bar{X}$	104.92	106.28	102.39	103.69
	S.D.	3.20	1.50	3.76	5.46
Height	$\bar{X}$	49.15	48.32	49.72	49.33
	S.D.	1.83	0.85	2.43	2.71
Weight	$\bar{X}$	58.33	61.63	59.10	56.43
	S.D.	8.86	3.15	10.51	10.09

Mean Scores for Subjects--1973

		Pre-		Regular	
		M - 15	F - 7	M - 13	F - 8
Balance	$\bar{X}$	15.93	17.14	11.18	22.79
	S.D.	9.46	12.74	5.47	22.14
Grip	$\bar{X}$	10.47	9.14	12.69	9.75
	S.D.	5.21	4.78	2.18	2.55
Push-ups	$\bar{X}$	9.87	9.86	8.46	6.50
	S.D.	2.64	4.06	5.99	5.95
Arm Flexion	$\bar{X}$	146.20	124.71	153.15	168.38
	S.D.	20.57	40.89	40.35	30.40
300-yard Run	$\bar{X}$	66.89	63.74	78.37	73.13
	S.D.	12.14	11.06	10.51	8.54
Sit Up and Reach	$\bar{X}$	6.20	6.14	6.54	5.63
	S.D.	2.46	3.24	2.73	2.62
Wrist Flexion	$\bar{X}$	65.20	64.57	91.69	91.75
	S.D.	15.58	22.64	23.83	28.80
Age	$\bar{X}$	91.53	91.43	89.38	93.50
	S.D.	3.38	2.94	2.82	5.26
Height	$\bar{X}$	46.00	46.40	47.88	46.12
	S.D.	2.46	1.90	2.30	2.47
Weight	$\bar{X}$	48.90	48.36	53.02	48.69
	S.D.	8.77	6.77	7.25	7.07

BIBLIOGRAPHY

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Books

1. Barrow, H. M. A Practical Approach to Measurement in Physical Education. Philadelphia: Lea and Febiger, 1964.

2. Baumgartner, T. A., and A. S. Jackson. Measurement for Evaluation in Physical Education. Boston: Houghton Mifflin Company, 1975.

3. Brace, D. K. Measuring Motor Ability. Austin: University of Texas, 1930.

4. Clarke, H. H. Application of Measurement to Health and Physical Education. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1967.

5. Corbin, C. B. A Textbook of Motor Development. Dubuque, Iowa: William C. Brown Company Publishers, 1973.

6. Cratty, Bryant. Perceptual-Motor Efficiency in Children. Philadelphia: Lea and Febiger, 1969.

7. Curtiss, M. L. Physical Education for Elementary Schools. Milwaukee: Bruce Publishing Company, 1957.

8. Englehart, M. D. Measures of Educational Research. Chicago: Rand McNally and Company, 1972.

9. Espenschade, A. S., and H. M. Eckert. Motor Development. Columbus, Ohio: Charles E. Merrill Books, Inc., 1967.

10. Fait, H. F. Physical Education for the Elementary School Child. Philadelphia: W. B. Saunders Company, 1971.

11. Gesell, A. Child Development. New York: Harper and Row, Publishers, 1943.

12. Herrick, V. Elementary School. Englewood Cliffs, New Jersey: Prentice-Hall, 1956.

13. Hinman, S. Physical Education in the Elementary Grades. New York: Prentice-Hall, Inc., 1939.

14. Humphrey, J. H. Child Learning. Dubuque, Iowa: William C. Brown Company, 1965.

15. Hurlock, E. B. Child Development. New York: McGraw-Hill Book Company, 1964.

16. Jones, H. E. Motor Performance and Growth. Los Angeles: University of California Press, 1949.

17. Kagan, J. Understanding Children. New York: Harcourt Brace Jovanovich, Inc., 1971.

18. Nerbovig, M. H., and H. J. Klaus. Teaching in the Elementary School. New York: Harper and Row Publisher, 1969.

19. Olson, W. C. Child Development. Boston: C. C. Heath and Company, 1959.

20. Prescott, D. A. The Child in the Educative Process. New York: McGraw-Hill Book Co., Inc., 1957.

21. Rosenblith, J. F., and W. Allinsmith. Causes of Behavior. Boston: Allyn and Bach, Inc., 1962.

22. Singer, R. N. Motor Learning and Human Performance. London: Macmillan Company, 1968.

23. Stoh, L. H. Child Development. New York: Holt, Rinehart, Winston, Inc., 1967.

24. Strang, R. Child Study. New York: Macmillan Company, 1959.

25. Weber, E. Early Childhood Education Perspectives on Change. Columbus, Ohio: Charles A. Jones Publishing Co., 1970.

Periodicals

26. Bachmann, J. C. "Motor Learning and Performance as Related to Age and Sex in Two Measures of Balance Coordination," Research Quarterly, 32:123-137, 1961.

27. Bayley, N., and A. Espenschade. "Motor Development from Birth to Maturity," Review of Educational Research, 2:5, 1941.

28. Bookwalter, K. W. "The Relationship of Body Size and Shape to Physical Performance," Research Quarterly, 23:271-279, 1952.

29. Cozens, F. W. "Age, Height, and Weight as Factors in the Classification of Elementary School Children," Journal of Health, Physical Education and Recreation, 10:21, 58, 1932.

30. Cumbee, F. Z., Margaret Meyer, and Gerald Peterson. "Factorial Analysis of Motor Coordination Variables for Third and Fourth Grade Girls," Research Quarterly, 28:100-108, 1957.

31. _____. "A Factorial Analysis of Motor Coordination," Research Quarterly, 25:412-428, 1954.

32. Cureton, T. K. "Improving the Physical Fitness of Youth," Monograph of Society for Research in Child Development, 29:4, 1964.

33. Espenschade, A. "Restudy of Relationships between Physical Performance of School Children and Age, Height, and Weight," Research Quaterly, 34:144-153, 1963.

34. Gill, N. T., and L. L. Hudson. "Perceptual and Socio-Economic Variables, Instruction in Body-Orientation, and Predicted Academic Success in Young Children," Perceptual and Motor Skills, 26:1175-1183, 1968.

35. Glasgow, T. L. "Construction of a Gross Muscular Strength Test Battery for Boys in the Lower Elementary Grades," Journal of Health, Physical Education and Recreation, 10:60, 1972.

36. Glassow, R. B. "Motor Performance of Girls, Age 6-14 years," Research Quarterly, 3:426-433, 1960.

37. _____. "Improvement of Motor Development and Physical Fitness in Elementary School Children," Research Quarterly, 3:350-365, 1953.

38. Govatos, L. A. "Motor Skill Learning," Review of Education Research, 37:583-98, December, 1967.

39. Henry, F. M., and G. A. Nelson, "Age Differences and Inter-Relationships between Skill and Learning in Gross Motor Performance of 10 and 15 Year Old Boys," Research Quarterly, 27:162-175, 1956.

40. Hupprich, F. L., and P. O. Sigerseth. "Specificity of Flexibility in Girls," Research Quarterly, 21: 25-33, 1950.

41. Jackson, H. "Factor Analysis of Selected Muscular Strength and Motor Performance Tests," Research Quarterly, 42:164-172, 1971.

42. Keogh, J. "Motor Performance of Elementary School Children," Research Quarterly, 36:250, 1965.

43. Larson, L. A. "A Factor Analysis of Motor Ability Variables and Tests with Tests for College Men," Research Quarterly, 12:499-517, 1941.

44. Latchaw, M. "Measuring Selected Motor Skills in Fourth, Fifth and Sixth Grades," Research Quarterly, 25:439-449, 1954.

45. Lemcke, L. "Generality and Specificity in Learning and Performing Selected Gross Motor Tasks," Research Quarterly, 41:250, 1970.

46. Lipton, E. D. "A Perceptual-Motor Development Program's Affect on Visual Perception and Reading Readiness of First-grade Children," Research Quarterly, 41:402-5, 1970.

47. Lockhart, A., and J. A. Mott. "An Experiment in Homogeneous Group and its Effect on Achievement in Sports Fundamentals," Research Quarterly, 22:58-62, 1951.

48. Masche, K. A. "Effects of Two Different Programs of Instruction on Motor Performance of Second Grade Students," Research Quarterly, 41:406-11,

49. McCulloch, L. "Promoting Learning Readiness Skills Through Perception-Motor Training in Physical Education," AAHPER--Foundation Practices in Perceptual-Motor Learning, 1:87-92, 1971.

50. McGraw, L. W. "A Factor Analysis of Motor Learning," Research Quarterly, 20:316-335, 1949.

51. Phillips, M. "Study of a Series of Physical Education Tests by Factor Analysis," Research Quarterly, 20:60-71, 1949.

52. Rarick, G. L. "A Study of Twenty Third-grade Children Exhibiting Extreme Levels of Achievement on Tests of Motor Proficiency," Research Quarterly, 20:142-152, 1949.

53. _____, and N. Oysler. "Physical Maturity, Muscular Strength, and Motor Performance of Young School Age Boys," Research Quarterly, 35:523-531, 1964.

54. Sapir, S. "See Differences in Perceptual-Motor Development," Perceptual and Motor Skills, 22:987-991, 1966.

55. Seashore, H. G. "The Development of a Beam-Walking Test and its Use in Measuring Development of Balance in Children," Research Quarterly, 18:246-259, 1947.

56. Seiderman, A. S. "A Look at Perceptual-Motor Training," Academic Therapy, 7:315-321, 1972.

57. Seils, L. G. "The Relationship between Measures of Physical Growth and Gross Motor Performance of Primary-Grade School Children," Research Quarterly, 19:244-260, 1948.

58. Singer, R. N. "Interrelationship of Physical, Perceptual-Motor and Academic Achievement Variables in Elementary School Children," Perceptual and Motor Skills, 27:1323-1332, 1968.

59. _____, and J. W. Brunk. "Relation of Perceptual-Motor Ability and Intellectual Ability in Elementary School Children," Perceptual and Motor Skills, 24:967-970, 1967.

60. Skubic, V., and M. Anderson. "The Interrelationship of Perceptual-Motor Achievement, Academic Achievement and Intelligence of Fourth Grade Children," Journal of Learning Disabilities, 3:413-20, 1970.

61. Trussell, E. "Prediction of Success in a Motor Skill on the Basis of Early Learning Achievement," Research Quarterly, 36:342-347, 1965.

62. Welch, M. "Prediction of Motor Skill Attainment from Early Learning," Perceptual and Motor Skills, 17:263-266, 1963.

63. Wild, M. R. "The Behavior Pattern of Throwing and Some Observations Concerning Its Course of Development in Children," Research Quarterly, 9:20-24, 1938.

64. Wrenn, J. P. "Videotape Feedback as It Influences Elementary School Children in Their Ability to Perform a Motor Task," Research Quarterly, 41:100-108, 1970.

Unpublished Material

65. DeGroat, P. D. "The Effect of Perceptual-Motor Skills on Reading." Master's thesis, Central Missouri State College, Warrensburg, 1971. (Microfiche.)

66. DiNucci, J. M., and J. R. Shore. "The Construction of a Motor Fitness Test Battery for Boys in the Lower Elementary." AAHPER National Convention, 1973. (Mimeographed.)

67. Dougherty, N. J. "A Comparison of the Effects of Command, Task, and Individual Program Styles of Teaching in the Development of Physical Fitness and Motor Skills." Doctoral dissertation, Temple University, 1970. (Microfiche.)

68. Edgar, C. L. "Perceptual-Motor Training as an Aid to Development of Reading Abilities." Paper presented at the Claremont Reading Conference, 1967.