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The purpose of this study was to investigate the effect of dynamic balance training on reading readiness of selected kindergarten subjects. The tenability of the following null hypotheses was investigated:

1. There is no relationship between initial dynamic balance ability and reading readiness of selected kindergarten children.

2. Dynamic balance ability is not increased through a training program of dynamic balance activities.

3. Dynamic balance training has no effect on reading readiness of selected kindergarten children.

Subjects were 28 kindergarten boys and girls enrolled in two classes in the First Presbyterian Church Kindergarten, Greensboro, North Carolina. Subjects were assigned at random to an experimental or control group, equating the number from each of the two classes and sex of the participants.

All children were pretested on four subtests of Form A of the <u>Metropolitan Readiness Tests</u> and the Balance Beam Test specifically designed for this study. The experimental group received 6 weeks of dynamic balance training meeting 3 times a week for 20 minutes each session. The control group received no such training, but participated in the regular kindergarten program. Following the

completion of the dynamic balance training, all subjects were post-tested on four subtests of Form B of the Metropolitan Readiness Tests and the Balance Beam Test.

The Pearson product-moment correlation technique was used to determine the initial relationship of dynamic balance ability and reading readiness. No statistically significant relationship was found between forward, backward, or total beam walking and reading readiness at the .05 level of confidence.

The analysis of covariance technique was used to determine the effect of dynamic balance training on dynamic balance ability. The F values obtained were statistically significant at the .01 level of confidence in favor of the experimental group. The subjects in the experimental group improved significantly more than the control subjects in forward, backward, and total beam walking.

The analysis of covariance technique was used to determine the effect of dynamic balance training on reading readiness. The resulting F was not significant at the .05 level of confidence indicating that the dynamic balance training had no effect on reading readiness.

Hypotheses one and three were accepted at the .05 level of confidence. Hypothesis two was rejected at the .01 level of confidence.

THE EFFECT OF DYNAMIC BALANCE TRAINING ON READING READINESS OF SELECTED KINDERGARTEN CHILDREN

by

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APPROVAL PAGE

This thesis has been approved by the following committee of the Faculty of the Graduate School at The University of North Carolina at Greensboro.

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Chapter 1

INTRODUCTION

The dichotomy between body and mind has long been discarded as neurologists and psychologists have recognized the concept of biological integration in man. Conflicting viewpoints surround this point of agreement as theorists and researchers have striven to discover, understand, and explain the relationship between muscular or motor activities and intellectual processes.

One of the first attempts to relate physical and developmental factors to total development was proposed by Olson (1949). His theory was an attempt to average developmental ages as height age, weight age, grip age, and mental age to obtain an organismic age. Olson's theory proposed that this composite age might serve as a more accurate predictor of school performance than would a sole intellectual measure. The contemporary significance and value of the organismic theory lies in its revolutionary focus on the potential influence of physical variables on academic performance.

Subsequent investigation has focused on man's biologically integrated development and current theorists have proposed a variety of theoretical models to explain the complex relationship between motor and intellectual components. Delacato (1963) proposed a theory of neurological organization. According to Delacato, man's developmental progression is likened to a phylogenic model. Man's neurological development progresses vertically up the spinal column through the medulla, pons, and mid-brain to the level of the cortex as with all mammals. Optimum development relies on total and uninterrupted neural organization. Man's unique functioning occurs as man achieves the ultimate of cortical dominance. Incomplete neural development, according to Delacato, results in potential intellectual dysfunction. Remediation of learning difficulties involves neural reorganization from the point of inadequate organization.

Three additional theoretical frameworks were proposed by Barsch (1967), Getman (1965), and Kephart (1960). Barsch (1967) proposed a Movigenic theory to explain the origin and development of movement patterns and the relationship of movement to learning efficiency. Ten constructs were the basis of his Movigenic theory which views the learner as one constantly engaged in the struggle toward efficiency in physical and cognitive movement. Barsch (1968) presented a curriculum based on the 10 constructs and additional components. It was designed to provide a child with learning experiences to enrich perceptual and cognitive growth through exploratory movements in space.

Getman (1965) proposed a visuomotor complex to organize speculations about the developmental sequences which lead to the acquisition of perceptual skills. Six systems were proposed as being closely integrated. Interdependence of the innate response, general motor, special motor, ocular motor, speech motor, and visualization systems, according to Getman, assures physiological readiness which, in turn, assures perceptual or cognitive readiness. Getman and Kane (1964) used this visuomotor or perceptuomotor complex as the basis for a readiness program designed to guide children toward maximum perceptual and cognitive growth.

Kephart (1960) advocated the inseparable relationship between perceptual and motor activities and explained the inseparability by viewing them as a closed and interrelated perceptual-motor process. This process includes an input, integration, and output. An individual receives cues through mechanisms as vision and sensory inputs and the input becomes a translation of environmental cues to nerve impulses. This data, according to Kephart, is interpreted in terms of past experiences and learning during the integration phase. The output phase of the process is a motor response, the only conscious part of the process. An individual completes the cycle of interpreting the appropriateness of the motor response by supplying feedback into the integration system.

The process of feedback makes the system a closed one. Kephart (1960) explained that if any part of the process, or servo-mechanism, is deficient, an individual may experience problems in the other processes. Barsch (1967), Getman (1965), and Kephart (1960) concurred in the concept that perceptual cannot be separated from motor, but must be viewed as perceptual-motor.

The current interest in perceptual-motor and motoric training as a method of both strengthening learning readiness and remediation of learning disabilities has initiated the concern in this study. The previously mentioned theories which stressed the interdependent relationship of motor development and intellectual functioning serve as a theoretical basis and rationale for perceptual-motor training programs. The value of these programs, therefore, depends on the validity of the yet unproven theories. The educational practices in perceptual-motor programs are beyond what research has verified as beneficial to the learner. A gap persists between available knowledge of the interdependence of motor and intellectual development and implementation in curricula.

Investigations have presented conflicting evidence regarding the effectiveness of perceptual-motor training programs in alleviating learning disabilities or increasing learning readiness. This variability of results may be due to the variety of training programs and cognitive measures employed. In addition, the perceptual-motor developmental programs are composed of activities to develop a medley of skills as form perception, body image, rhythm, space orientation, and balance. The effectiveness of training for these isolated skills has remained virtually untouched by research. The potential value of such research lies in the discovery of which fundamental perceptual-motor skills affect cognitive development, if any.

An analysis of current perceptual-motor programs identified balance as a common fundamental component associated with learning disabilities (Barsch, 1968; Frostig, 1969; Getman and Kane, 1964; and Kephart, 1960). Kephart (1960) emphasized the importance of balance as basic to additional readiness qualities. Research to support this concept presented vague evidence. Research purported that balance ability may be a reliable predictor of academic success. Moderate correlations have been presented relating balance ability to scholastic ability and achievement of school children.

Cratty and Martin (1969), on the other hand, suggested that evidence to support a positive relationship of balance and cognitive measures was hard to find. The authors doubted that, based on available research, improvement in balance ability would result in improvement in academic achievement.

Balance is comprised of two components. Cratty (1967) identified these as static and dynamic balance. In his motor program he isolated activities to develop each. Of most concern to physical educators is dynamic balance as movement is the stimulus for a dynamic balance response. Static balance is stationary balance without movement. Because balance, as evidenced by its continuous inclusion in perceptual-motor programs, is accepted as vital to perceptual-motor organization, the relationship between balance and cognitive abilities can be made more clear through further comparative and causal research.

STATEMENT OF PROBLEM AND HYPOTHESES

The purpose of this study was to investigate the effect of dynamic balance training on reading readiness of selected kindergarten children.

The tenability of the following null hypotheses was investigated:

1. There is no relationship between initial dynamic balance ability and reading readiness of selected kindergarten children.

2. Dynamic balance ability is not increased through a training program of dynamic balance activities.

3. Dynamic balance training has no effect on reading readiness of selected kindergarten children.

DEFINITIONS

For the purposes and continuity of this study, the following definitions of terms were accepted.

Dynamic Balance

Dynamic balance is maintenance of equilibrium during movement which requires perpetual adjustment to changing posture or body position (Travis, 1945).

Static Balance

Static balance is maintenance of equilibrium in one position without movement or sway (Espenschade and Eckert, 1967).

Dynamic Balance Ability

Dynamic balance ability is a measure of dynamic balance performance as quantified by a Balance Beam Test specifically designed for this study.

Reading Readiness

Reading readiness is a measure of readiness as quantified by the Word Meaning, Listening, Matching, and Alphabet subtests of the Metropolitan Readiness Tests (Hildreth *et al.*, 1966).

LIMITATIONS AND ASSUMPTIONS

The following limitations and assumptions governed this study:

1. Lesson plans were devised by the writer assuming content validity as activities were selected from the motor programs of experts. No attempt was made to validate lessons by other techniques.

2. The study was limited to two classrooms of kindergarten children in order to have more control over readiness experiences as well as classroom activities which may have involved dynamic balance practice.

3. Dynamic balance training activities of the experimental group were assumed not to have been shared or experienced by the control group.

Chapter 2

REVIEW OF LITERATURE

It was the purpose of this chapter to review literature appropriate to the study of dynamic balance and cognitive learning. The review of literature was divided into six aspects: (1) balance and its assessment, (2) relationship of dynamic balance and static balance, (3) specificity of dynamic balance ability, (4) relationship of dynamic balance to sex and age, (5) dynamic balance as a factor of perceptual-motor ability, and (6) relationships of perceptual-motor and cognitive abilities.

BALANCE AND ITS ASSESSMENT

The maintenance of body balance was described by Kephart (1960) as a fundamental to readiness for motor experiences. He pointed out that as a child interacts with his environment, he begins to systematize relationships in terms of laterality, internal awareness of left and right, and directionality, external awareness of left and right. Such awareness develops from a consistent cognizance of the center of gravity. Kephart stressed that a stable and consistent relationship to gravity is basic to motor development. Body balance is the key to maintaining this stable relationship to gravity under many and changing conditions. This harmonious relationship allows a child to systematize his interactions with the environment and project his movement patterns efficiently into space.

Two distinct types of balance were identified by Seashore (1947) and Travis (1945). Static balance was defined by Espenschade and Eckert (1967) as the maintenance of equilibrium in one position without movement or sway. Dynamic balance, on the other hand, was defined by Travis (1945) as the maintenance of equilibrium during movement which requires perpetual adjustment to changing body posture or position.

Movement, as indicated by Travis (1945), provides the stimulus for a dynamic balance response. Investigations have focused on sensori-motor inputs which provide information for postural adjustment. Several factors were isolated by Travis (1945) as involved, but he was not able to determine the dominant source of information. He stressed the importance of visual stimulation, auditory recognition, kinesthetic perception, semicircular canals of the ear, and skin and organic sensations. Involuntary regulation also was said to occur in the cerebellum. Travis pointed out that the output, or muscular response, requires the positioning of the body and perpetual changes to maintain the position.

Bass (1939) also analyzed balance and isolated nine different influencing factors. She labeled five of them as general eye-motor factor, kinesthetic response, general ambulatory sensitivity, function of two vertical semicircular canals, and tension-giving reinforcement.

The above components have been shown to influence dynamic balance skill. In order to evaluate this ability, numerous tests have been devised. Tests were of three types including: (1) mechanical apparatuses, (2) stunts, and (3) beam walking.

Mechanical Apparatuses

A commonly used device was the stabilometer. The stabilometer as used by Bachman (1961a) was a horizontal board fastened to a crosswise pivot rod. The individual being tested straddled the rod and balanced the platform. A device recorded deviation from the horizontal.

Variations of the stabilometer have been used in research. Reynold's Balance Test, as used by Slater-Hammel (1956), involved the use of a teeter-board and the subject had to adjust balance in order to match stimulus lights. Another similar device was the bongo board used by Purdy and Lockhart (1962).

To further examine dynamic balance, Mitchem and Popp (1969) have recently altered an apparatus originally designed in 1947. The Modified Gilmore Octagonal Apparatus consisted of an octagonal platform four feet in diameter. The subject was required to balance the platform over a center support. Microswitches detected and recorded the number of taps made at each corner on a border horizontal to the balanced platform.

A unique test used by Travis (1945) was the double-axle rotation chair. The device required that the subject continually reorient himself during rotation which was a task of dynamic balance.

Stunts

An original test was devised and used by Bachman (1961b) called the Bachman Ladder Climb Task. The apparatus was constructed of two parallel ladders with staggered rungs five inches apart. The ladder was freely standing and the task was to climb as high as possible without falling off. If the subject fell he was to begin to reclimb immediately. His score was based on the highest rung on which his foot was placed during the timed trial.

Another test for dynamic balance was the Bass Stepping Stone Test (McCloy and Young, 1954:106). Eleven circles eight and one-half inches in diameter were drawn on the floor in a staggered pattern. The subject leaped from one to the next alternating feet. Scoring was based on 50, plus the number of seconds to do the test, and minus 3 times the number of errors. Errors consisted of such things as touching the heel to the floor, hopping on the supporting foot, and touching the floor outside the circle.

The Sideward Leap Test (Scott and French, 1959:320-322) employed a floor pattern and involved leaping sideways to a mark, bending and pushing a cork off of another mark, and holding a balanced position for five seconds. One point was awarded for successful completion of the task, permitting 12 trials; 3 trials were given to the right, 3 to the left, and the sequence was then repeated. A scoring variation allowed for the summing of the number of seconds the subject successfully held the balanced position with a maximum of five seconds possible.

To measure dynamic balance of preschool children, McCaskill and Wellman (1938) devised a test using a walking path and a circle. The path was 10 feet long and 1 inch wide. The circle was four feet in diameter with a one inch wide path colored around the circumference. Three trials were given each child to walk each path. The number of times the child stepped off of the path was scored. If a child touched off the line without taking a step, no error was recorded.

Beam Walking Tests

Validity and reliability were identified by Barrow and McGee (1964) as criteria involved in test selection. Tasks requiring performance on some type of beam have shown varying reliability coefficients in dynamic balance testing. In 1947, Seashore (1947) stated that the validity of beam walking tests had not been well established. While subsequent research has not reported validity, beam walking tests were widely used in assessing dynamic balance.

One of the earliest investigations using a balance beam test was conducted by Alden et al. (1932). Four 10-foot beams one-half inch wide were placed end to end. In a heel-toe manner, subjects walked the length of the beams. The score was the total feet walked before falling off. A low reliability of .45 was reported by the investigators.

Seashore (1947) presented the Springfield Beam-Walking Test and cited related research done by his students. Testing required nine oak beams of varying widths from one quarter of an inch to four inches. Each beam was 10 feet long and 4-1/2 inches off the floor. The subject was instructed to walk in a heel-toe fashion with his hands on his hips. Street shoes were worn by all subjects. Scoring was based on completion of 10 steps on each beam permitting the subject to fall off of the beam twice. An average of trials was computed and reliability calculated. Using the first fall off method of scoring, 30 children 5 years old were tested with the Springfield Beam-Walking Test. A reliability coefficient of .66 was reported for a 3-trial test and .80 for a 6-trial test. Reliability was shown to increase with the number of trials and with the use of the second fall off method of scoring.

Horine (1968) adapted the preceding test using three beams of varying widths; two inches, one and one-half inch, and three-fourths of an inch. The subjects were 220 children 5 years old. They were given five trials to walk in a heel-toe manner beginning with the widest beam. The score was determined by the distance the subject walked on each beam before falling off twice. Using the test-retest method, reliability coefficients of .78 and .88 were reported.

An adaptation of the Springfield Beam-Walking Test was described by Heath (1942). In the Rail-Walking Test, there were three wooden rails; two were nine feet long and the third was six feet long. The widths of the rails were four, two, and one inch respectively. Barefooted subjects walked in a heel-toe manner. Scoring was facilitated by gradations of one-half foot marks placed on the beam and based on the distance walked before falling off. Three trials on each beam were summed and a composite score was calculated using a 1-2-4 ratio. Heath pointed out that if a great variation in foot length existed among subjects, a scoring technique using the number of steps criteria could be used. He indicated, however, that this would slightly penalize those with larger feet as the length of the walking surface was restricted.

Ismail et al. (1963) selected two tasks to measure dynamic balance, beam walking and sidewise beam walking. The tasks required that the subject take 10 correct steps on a beam 3 inches wide. The score was equal to 10 minus the number of errors. The researchers defined the criteria for errors. The sidewise beam walking was similar except the subject walked sidewise on the balls of his feet by moving the left foot and bringing the right foot to it. No reliability was reported.

Using first graders and third graders as subjects, Koegh (1965) administered a beam walking test consisting of three eight-foot long beams of varying widths; two inches, one and one-half inch, and one inch. Two trials were given each barefooted subject. A maximum of 30 points was awarded if the subject took 5 successful heel-toe steps and maintained his balance for 3 seconds. Reliability coefficients of .69 for the first graders and .84 for the third graders were reported.

Seils (1951) deleted a beam walking item from a gross motor performance battery. A reliability coefficient of .471 was reported for primary school children.

After a thorough review of beam walking tests, Cooke (1968) devised a unique balance test. In order to free the subject of unnatural restrictions and to simplify testing, Cooke made these modifications of previous tests. The subject was no longer required to keep his hands on his hips, but was free to use his arms as needed. Heel-toe walking was replaced as a less stringent criteria allowed the heel to be no more than four inches from the toe. The number of steps was used as the criterion for balance performance using the first fall off method of scoring. An average of four trials was recorded for forward and backward beam walking. A reliability coefficient of .786 was presented by Cooke using the test-retest method on subjects 8 to 12 years old.

Numerous other beam walking tests have been reported in the literature. Many were adaptations of the preceding tests. Unfortunately reliability coefficients for many of these additional tests were not reported by the investigators.

In summary, static and dynamic balance have been isolated as components of equilibrium (Travis, 1945). A review of dynamic balance tests revealed that the assessment of dynamic balance involved the use of three types of tests including mechanical apparatuses, stunts, and beam walking. Mechanical apparatuses and stunt tests used a variety of equipment. Beam walking tests used similar equipment varying the length and width of the walking surface, the scoring criteria, walking manner, and trials. Tests for static balance have been employed in conjunction with dynamic balance tests to assess the relationship of dynamic and static balance as components of equilibrium.

RELATIONSHIP OF DYNAMIC BALANCE AND STATIC BALANCE

Researchers have examined the relationship of dynamic and static balance as components of equilibrium. The ability to maintain a balanced posture without sway seemed to correlate very little with the ability to continually reorient the body in off-balance situations (Travis, 1945).

Travis (1945) selected to use the stabilometer and the double-axle rotation chair as measures of dynamic balance. An ataxiameter, which recorded body sway while standing, was selected to evaluate static balance ability. Travis found no significant correlation between either measure of dynamic balance with static balance skill. Fisher et al. (1946) found a similar near zero correlation between scores on the rail-walking test for dynamic balance and the ataxiameter.

Three tests of static balance ability and 3 of dynamic balance ability were administered by Drowatzky and Zuccato (1967) to girls 11 to 13. Intercorrelations indicated no relationship between scores on static tests to scores on dynamic tests. Because of the age of the subjects, it was suggested by Sanborn and Wyrick (1969) that the wide range of maturational levels may have influenced performance.

Earlier research by Bass (1939) also reinforced the premise that dynamic and static are separate and distinct balance abilities and bear no relationship to each other. Bass found a low correlation of .34 between measures of dynamic and static balance.

In summary, all research reviewed concurred that ability to balance in a static position was unrelated to the ability to balance during movement. No research was found which reported a high positive relationship between the two abilities. Mitchem and Popp (1969) suggested that very little had actually been researched to establish the relationship of dynamic balance to static balance. From the research examined, it appeared that the two balance skills involve different qualities.

Equilibrium has been examined and static and dynamic balance have been identified as component parts and as apparently different skills. A further examination of dynamic balance was essential to study the theory of general dynamic balance ability.

SPECIFICITY OF DYNAMIC BALANCE ABILITY

Singer (1968) maintained that an athlete may exhibit a superior degree of balance performance in one sport, but not in another. The balance required in gymnastics, he said, differs from the type of balance demanded by striking a baseball, shooting a jump shot, or wrestling. Herein was the concept of dynamic balance specificity. The following research studies have examined the specificity of dynamic balance which may minimize the theory of general dynamic balance ability.

Reeves, as cited by Lawther (1968), selected to administer seven tests of balance; not all were for dynamic balance. Out of 21 intercorrelations, only 3 showed a significant relationship. The findings indicated that the tests used were measuring unique and unrelated abilities, yet all supposedly were measuring balance.

Drowatzky and Zuccato (1967) computed intercorrelations between measures of dynamic balance as measured by the Sideward

Leap Test, the Bass Stepping Stone Test, and the Balance Beam Test. A correlation of .30 between the Sideward Leap Test and the Bass Stepping Stone Test was the only intercorrelation significant at the .05 level of confidence. Intercorrelations with three static balance tests showed no significant correlations. The study indicated that the tests appeared to measure different types of balance.

Three hundred and twenty subjects between the ages of 6 and 26 were given two tasks of dynamic balance in a study by Bachman (1961a). The tests used were a stabilometer and the Bachman Ladder Climb Test. Learning of the tasks was shown to be specific to the tasks as there was zero correlation noted between the 2 measures of learning of dynamic balance after 10 trials.

In another experiment, Travis (1945) used a stabilometer and a double-axle rotation chair. He found no correlation between these two measures of dynamic balance.

Espenschade and Eckert (1967) summarized information relative to the question of specificity of balance ability:

> The complexity of balance and the wide range of ability from one age level to another has resulted in very low intercorrelations of the various measures so that no single measure of balance can be considered to be useful for testing over a wide age range (Espenschade and Eckert, 1967:133-134).

As suggested by Espenschade and Eckert (1967) and supported by the reviewed studies, low or lack of intercorrelations of balance tests have supported the concept of specificity of dynamic balance ability.

The various studies reviewed suggested that an individual may perform well on one task, but not on another. This concurred with Singer's (1968) hypothesis that an athlete may exhibit varying levels of balance skill from one sport to another.

RELATIONSHIP OF DYNAMIC BALANCE TO SEX AND AGE

Problems of balance in terms of center of gravity were viewed as maturationally oriented by Knapp (1963). Size and shape of the human body change and affect the center of gravity and, therefore, balance. Knapp described a newly born child as structurally disadvantaged in relation to balance. He has a large head and poorly developed legs. The center of gravity, therefore, is high. As the child matures structurally, the center of gravity changes and, by the age of 13, Knapp said it appears to be near the crest of the ilium.

Bayley (1936) presented a developmental sequence of dynamic balance. She reported that at 22. 5 months, the child tries to stand on the board. At 32. 8 months, he may attempt to take a step. At approximately 56 months he may be able to walk the entire length. His speed in walking was also found by Bayley to be increased progressively after that.

Studies of effects of weight and height on dynamic balance were apparently inconclusive. Travis (1945) found weight to be of little importance. Ismail et al. (1969) found beam walking ability of primary age children to be affected negatively by both height and weight. Espenschade et al. (1953) concluded that dynamic balance was not related to either height or weight. The key to interpreting this data may lie in the specificity of the balance task.

Various studies have explored the role sex may play in dynamic balance ability. In the elementary grades sex seemed to affect performance to a slight degree. Investigations indicated that balance performance of girls was superior to boys before eight years of age after which boys excelled (Cratty, 1964; and Cron and Pronko, 1957). Seils (1951) found that boys demonstrated a steady increase in balance scores after eight years old. Seashore (1947) found that girls did not follow this pattern of increase. A question of the validity of comparing results was raised by Espenschade and Eckert (1967). They indicated that caution must be observed in relating studies to each other since the above researchers used different tests and techniques to assess dynamic balance.

Smith (1956) found that boys were superior to girls in dynamic balance as measured by the Springfield Beam-Walking Test in elementary school. Using the stabilometer, however, Travis (1945) found that girls performed slightly better than boys. Heath (1942) tested 700 children 6 to 14 years old using the Rail-Walking Test. Boys showed more improvement than girls, but both showed progress in performance.

Bachman (1966) studied the influence of sex on performance on the stabilometer and ladder climb tests. Subjects were between the ages of 26 and 50. He found a slight sex difference in performance on the ladder climb. The males tended to level off in ability after the females. Bachman explained that the women, perhaps, were fearful of climbing and aware of their awkwardness.

It was difficult to separate sex differences from age differences as reflected in dynamic balance ability. Great variability among levels of performance seemed to exist in research. Seashore (1947) observed that some 7-year-olds performed as well as the average 15-year-olds while the poorest 14-year-olds were at the level of the poorest 7-year-olds.

Performance on the Bachman Ladder Climb Test (Bachman, 1961a) showed that the particular dynamic balance involved did not improve significantly after 15 years of age for either sex. Females actually showed a slight decline after 15 which stabilized at 21 years of age. In another study, Bachman (1966) verified this and found no effect of age on ladder performance of men and women 26 to 50.

An "adolescence lag" in dynamic balance ability has appeared in research. Espenschade _et al._ (1953) found the rate of increase in balance to be delayed in boys 13 to 15. Goetzinger (1961) suggested that there is a decreasing gain in dynamic balance between the ages of 12 to 14, especially for girls. Bachman (1961a) concurred in that stabilometer performance appeared to be depressed during adolescence while performance on the ladder climb, however, seemed to be accelerated during adolescense.

Using the Springfield Beam-Walking Test, Espenschade _et al._ (1953) evaluated dynamic balance in boys 11-1/2 to 15-1/2. The rate of gain in dynamic balance was constant except slowed down between the ages of 13 to 15. Espenschade (1947) indicated little change in dynamic balance in girls 10 to 17.

A study completed by Espenschade _et al._ (1953) demonstrated that dynamic balance ability seemed to generally show a decline at puberty. This was consistent with the lag on improvement on Brace Test scores which the researchers noted also occurred at this time. Espenschade _et al._ concluded that changes in body proportions, physique, and strength occur rapidly during adolescence and may require special adjustments in terms of balance, especially in the male.

Dynamic balance appeared to reach plateaus, although various investigators found this occurring at different times. Koegh (1965) concluded through his research and that of others, that beam walking skill appeared to plateau between the ages of 7 and 10 with marked increases before and after. No sex differences were observed at this time. Cratty (1964), after reviewing selected research studies, suggested that a peak of dynamic balance ability may occur at age 11 followed by a plateau. This was consistent with Koegh's results and may further support the theory that dynamic balance ability plateaus early in life. Specificity of dynamic balance tasks may explain the discrepancy of results. The resulting confusion might be traced to the variety of testing techniques used to assess dynamic balance and the range of ages and maturational levels studied.

Maturation does not only occur structurally, but manifests itself in other phases of child development. One prominent phase was noted by Smith (1971) as perceptual-motor development.

DYNAMIC BALANCE AS A FACTOR OF PERCEPTUAL-MOTOR ABILITY

Perceptual-motor ability as defined by Kephart (1960), involves the matching of sensory information with an appropriate muscular response. Cratty (1964) stated that balance was accepted by many as a basic factor of perceptual-motor ability.

McCloy (1954) suggested that balance is dependent upon sensory and motor inputs as well as visual information. McCloy also proposed that success in dynamic balance is dependent upon the visual mechanism and the sensory-motor response. Cratty (1969), on the other hand, pointed out that visual judgments are dependent upon accurate movement capabilities and efficient balance abilities. Thus, it appeared that there is a dependent interrelationship between vision and balance.

Stallings (1968) investigated the relationship of visual-spacial orientation, visualization, and perceptual speed to performance on tests of motor skill. College women were presented a balance beam routine composed of six beam skills. Scores of the beam performance were correlated with the visual tests. Visual-spacial orientation seemed to affect balance beam performance during the learning phase. As proficiency on the beam developed, there seemed to be an increasing need for visual perceptual speed. Visualization, or the ability to form mental pictures, did not appear to affect beam performance.

Much of the early research supporting balance as a factor of perceptual-motor abilities was done with atypical children. Cratty (1967) found that balance training was important when working with Mongoloids with mild to moderate perceptual-motor problems. He also studied educable retardates and neurologically handicapped children. As an outcome of his research, Cratty included balance tasks as a part of his program designed to improve abilities of children with neurological and mental deficiencies. Cratty (1968) further suggested that balance tasks should be a part of any program of exposure for typical children with moderate perceptual-motor difficulties.

In a study of educable mentally retarded, Geddes (1968) studied two groups of children. Each group was pretested for dynamic balance using the Rail-Walking Test. The experimental group was taught mobility patterns through Doman's patterning techniques. The control group was provided with a physical education program consisting of such activities as tumbling, ball handling, and relays. After three months both groups were retested on the Rail-Walking Test. The control group that experienced the physical education program improved significantly more than the experimental group at the .05 level of confidence.

Dynamic balance appeared to be a fundamental for developing laterality and directionality as expressed by Kephart (1960). Kephart advocated that the inner awareness of left and right needs to be discovered and the child learns to project this awareness into space following perceptual-motor integration. Kephart explained that the child learns to regulate movement and is able to detect which side of his body has moved. Kephart concluded that the complexity of directionality increases as the child learns compensatory movements to regulate balance.

In summary, a dynamic balance motoric response appeared to depend on several input variables. McCloy (1954) isolated these as sensory, motor, and visual inputs. Children with perceptual-motor problems may benefit from balance activities as suggested by Cratty (1968). The controversy over the possible relationship of perceptual-motor skills to intellectual ability or achievement has initiated research to investigate possible correlations and causal effects.

RELATIONSHIPS OF PERCEPTUAL-MOTOR AND COGNITIVE ABILITIES

The interdependence of perceptual and motor aspects of a child's experiences was summarized by Kephart (1964):

> Consistent and efficient motor patterns permit the child to explore his environment and systematize his relationship to it. Perceptual data are similarly systematized by comparing them with his motoric system. Through such perceptual-motor matching, the perceptual world of the child and his behavioral world come to coincide. It is with this organized system of perceptual input and behavioral output that the child attacks and manipulates symbolic and conceptual material in a veridical fashion (Kephart, 1964:201).

Perceptual-motor development was identified by Smith (1971) as a phenomenon of human development. Kephart (1960) indicated that the systematized matching of the perceptual and behavioral world permits a child to meet the challenges of symbolic learning presented by the schools. He further believed that such development provides the matrix of readiness skills for more complex learning.

Kephart (1960) stressed that while most children arrive in the classroom with adequate perceptual-motor mechanisms, a significant percentage of children lack vital perceptual-motor abilities. He concluded that without such readiness qualities, a child cannot meet the demands of symbolic learning.

Getman and Kane (1964) professed the following premise regarding the relationship of developmental patterns to school instruction:

> The growth and development patterns through which all children move from infancy through childhood, set the stage, in large

measure, for all children's readiness to profit from formal instruction (Getman and Kane, 1964:III).

Readiness

Getman and Kane (1964) attempted to define the criteria for readiness and identify the qualities needed by a child:

> A child is ready to learn when his mental skills, his motor skills, his language and speech habits, the scope and nature of his prior experiences, and his emotional and social background come to bear upon new experiences which can be assimilated into new learning patterns (Getman and Kane, 1964:2).

In a discussion of readiness, Rutherford (1968) stated that readiness is dependent on more than the process of maturation. He emphasized, however, that perceptual-motor training programs subscribe to the theory that readiness for symbolic learning is dependent upon activities more basic to readiness than physical, mental, social, and psychological factors traditionally valued as paramount.

Furthermore, Rutherford (1968) pointed out that traditional readiness qualities as hearing and vision, motor coordination, ability to detect likenesses and differences, cooperation with others, and concept development are accepted as important, but Kephart (1960) described certain perceptual-motor attributes as more basic. They included laterality, directionality, body image, ocular control, and visual-kinesthetic matching. In order to develop these basic qualities, various programs have been designed to meet these developmental needs.

Developmental Programs

Typical of the various developmental programs, Kephart (1960) and Getman and Kane (1964) provided a range of activities designed to contribute to the improvement of certain skills. Kephart proposed a developmental program to develop the basic perceptual-motor attributes. A perceptual-motor survey for diagnosis of difficulties was presented as well as training activities for sensory-motor skills, ocular control, and form perception.

Professing a philosophy that learning follows readiness, Getman and Kane (1964) devised a perceptual-motor training program aimed at improving laterality, directionality, and spatial orientation through sensory-motor experiences. The goal of the program was to increase readiness skills to prepare for scholastic performance.

Other developmental programs have been defined by Frostig (1969), Barsch (1968), Cratty and Martin (1969), Cratty (1967), and Delacato (1963). The emphases of these programs revolved around the relationship between perceptual and motor abilities. The programs were comprised of a variety of training activities with similarities existing between programs.

Dynamic Balance and Cognitive Measures

An examination of the various programs revealed that all of the developmental programs included training methods for developing dynamic balance. Comparative studies and observations have been reported in the literature relating balance and cognitive measures.

Getman (1962) indicated that balance and bilaterality are closely related and he used many balance activities in his training program for poor readers. Getman suggested that the rationale for such an association may be that the concept of awareness of sideness is common to both reading and balance.

Cratty (Cratty and Martin, 1969) found a correlation of .45 between balance scores and the Gates Reading Survey. He concluded that the moderate correlation did not indicate a predictive or causal relationship, but suggested that the relationship may be due to the common influence of ocular control.

From a personal communication written by Dr. Samuel Kirk, Cooke (1968) pointed out an association Kirk observed between impaired balance and impaired cognitive abilities. Several studies have investigated this potential relationship.

Using 293 subjects 8 to 13 years old, Cooke(1968) correlated dynamic balance with cognitive abilities. Low positive significant correlations were reported between balance measures and all six cognitive measures employed. Numerous specific significant intercorrelations of measures were presented relating forward and backward beam walking to achievement and cognitive appraisals. This added support to information Cooke received from Dr. Newell C. Kephart in a personal correspondence. In this communication, Kephart reported that correlations were more often higher between backward beam walking and intelligence evaluations.

Thompson, as cited by Cooke (1968), reported low positive, yet significant, relationships between beam walking and various academic achievement measures. Beam walking correlated significantly with arithmetic achievement of fourth graders, language and study skills of sixth graders, and with science achievement of second, fourth, and sixth grade children. Ismail (1969) concurred that dynamic balance correlated with reading achievement of elementary school children. Static balance was also shown by Cleary (1968) to correlate significantly with reading ability of eight and nine year old subjects. Additionally, Ismail (1969) and Emmons (1968) presented and summarized evidence to indicate that balance ability may be a reliable predictor of academic success.

Comparative studies indicated that a relationship may exist between balance and cognitive attributes. Perceptual-motor training theorists further believed that motor training will affect readiness and achievement. An investigation of causal studies presented conflicting evidence regarding the validity of such theories.

Causal Effects of Perceptual-Motor Training Programs

Several causal studies demonstrated opposing evidence relating to the effect of perceptual-motor training on cognitive abilities.

Three studies appeared to lend significance to refute the value of perceptual-motor training to increase mental attributes. Four additional reports were reviewed, however, to support the use of perceptual-motor training.

Using two experimental and one control group, Emmons (1968) investigated the effect of the Getman-Kane and Kephart motor training programs on mental maturity and readiness scores of first grade Negro children. Tests employed were the California Test of Mental Maturity and the Metropolitan Readiness Tests. Emmons concluded that after 10 weeks of motor training neither program produced a significant effect on scores of the mental tests.

Anderson, in a similar study as cited by Emmons (1968), used the California Test of Mental Maturity and the Gates Reading Survey. The Delacato program of cross-patterned walking and creeping was found to produce no significant improvement in reading of 58 elementary school children of whom half received 10 weeks of daily training.

An experimental group, receiving motor training from the Kephart (1960) program, and a control group, experiencing a traditional physical education curriculum, were tested by O'Connor (1968). She also concluded that a program of gross motor training did not change academic ability of first grade children.

Four investigations reviewed have acknowledged the contributory effect of motor training on mental evaluations. An 11-week program of activities from the Kephart training program was conducted by Rutherford (1968) using kindergarten subjects. Test-retest scores on the Metropolitan Readiness Tests indicated that the perceptual-motor program was significantly effective in promoting readiness.

Rice (1962) reported research completed in Polk County, Florida. Involved in the research were nine experimental first grade classes that received rhythmic training, balance training, and other physical activities. The experimental classes made considerably more progress in paragraph meaning, arithmetic, and spelling than did the control classes.

Underachieving first grade children were studied by McCormick (1968). The children were matched for age, sex, I.Q., and reading level and randomly assigned to one of three groups. Group one received perceptual-motor training and group two received exercises from a traditional physical education curriculum. The control group received no planned activity during the seven week, biweekly, training program. Using the Lee Clark Reading Test, the perceptual-motor group made significant gains over the other two groups in posttest evaluation.

Similar results were obtained in a study done by Lipton (1970). Two experimental classes received 12 weeks of perceptual-motor training with an emphasis on directionality of movement. Activities in the training program were selected to develop qualities as locomotor skills, dynamic balance, coordination, spatial awareness, and rhythm. Two control classes received a traditional physical education program of rhythms, relays, stunts, self-testing activities, and games of low organization. Statistical analysis indicated that the experimental subjects made significantly greater gains in reading readiness as measured by the Metropolitan Readiness Tests than did the control subjects at the .01 level of confidence.

Controversy not only evolved from conflicting experimental results, but also from experimental techniques. In a recent article, Smith (1968) proposed the following questions regarding causal perceptual-motor research:

1. How much of the observed improvement in scholastic and behavioral performance by children who have participated in motor therapy programs is due to maturational factors?

2. Have special motor programs produced the Hawthorne effect?

3. Does individual attention to the children in motor therapy programs produce the improvements that are noted?

4. When multiple remedial treatments are employed, which treatment or combination of treatments results in the observed improvement?

5. What motor activities or series of activities are those that are effective? In what sequence should they be introduced? How many repetitions of certain tasks are beneficial?

6. Are the pretests (motor or perceptual-motor) that are used actually measuring what they purport to measure? Are they objective? Are they reliable?

7. With what is known about specificity and transfer effects, how do gross motor activities which seem to be extremely dissimilar to reading skills, promote improvement in reading (Smith, 1968:33).

Balance, readiness, and perceptual-motor development have been reviewed and found to be complex phenomena with little verification of potential interrelationships in a maturing child. In 1969, Cratty and Martin predicted that, "...movement experiences which improve perceptual-motor capacities of children will play an increasingly important role in education" (Cratty and Martin, 1969:4).

Chapter 3

PROCEDURE

The purpose of this study was to investigate the effect of dynamic balance training on reading readiness of selected kindergarten children. Seventeen subjects were selected randomly from each of two kindergarten classes in the First Presbyterian Church Kindergarten, Greensboro, North Carolina. Half of each class was selected randomly and together they formed the experimental group and the remaining subjects composed the control group. The number of boys and girls in each class and group was equated. In the final analysis, 13 subjects were from Class I and 15 from Class II. There were 14 subjects in the experimental group and 14 in the control. The total number of subjects was 28. Table 1 shows a detailed distribution of subjects. The randomization technique used throughout the study was a lottery. Selection was done by drawing from a box.

All children were pretested on four subtests of Form A of the Metropolitan Readiness Tests (Hildreth *et al.*, 1966) and on the Balance Beam Test specifically designed for this study. (See Appendix A.) The experimental group received six weeks of dynamic balance training. Lessons were conducted 3 times a week for 20

Table 1

Classroom Distribution of Experimental and Control Subjects

Class	Experimental		Control		Total
	Boys	Girls	Boys	Girls	
I	3	3	3	4	13
II	4	4	4	3	15
Total	14		14		28

minutes each day. The control group received no training, but participated in the regular kindergarten program. Following the completion of the dynamic balance training, all subjects were post-tested on four subtests of Form B of the Metropolitan Readiness Tests and on the Balance Beam Test. Appropriate statistical techniques were employed to assess the effect of dynamic balance training on reading readiness of these selected kindergarten children.

The following described in detail the procedures used in the conduction of this study. Steps were presented in the following sequence: (1) selection of subjects, (2) selection of tests, (3) administration of tests, (4) dynamic balance training program, and (5) statistical treatment of data.

SELECTION OF SUBJECTS

School Situation

The kindergarten program was conducted Monday through Friday from 9:00 a.m. to 12:00 noon in the Corl Building of the First Presbyterian Church. All teachers in the program possessed bachelor's degrees and current teaching certificates. A teaching assistant was assigned to each class to aid with classroom management.

After consultation with the director of the kindergarten program, two classroom teachers were advised of the scope of this study. Both agreed to cooperate and assist in the completion of the investigation.

The program, facilities, and equipment of the two experimental classrooms were similar. No formal workbooks, textbooks, or curriculum guides were used in either classroom. The daily routine of the classes was identical except where scheduling difficulties prohibited both classes from using the same facilities at the same time. The first hour of school was free play at which time the children participated in unstructured play within the self-contained classroom. During the second hour the children functioned as a group by sitting on a rug and quietly listening to the teacher read and discuss stories, singing songs, or playing group games. The final part of the morning involved three activities; a rest time, a snack time, and more play time. Outdoor facilities were available for this play period as well as a large indoor rainy day playroom.

These two facilities were available to both classes. Common playground equipment as swings, climbing apparatuses, and crawling tunnels were located in the outdoor play area. In the indoor facility three-wheeled bicycles, wagons, and a small climbing apparatus were the main play items. No equipment resembling a balance beam was located in either of the above facilities or in the classrooms.

Equipment in each of the experimental classrooms was identical and the classes shared supplementary equipment. Furniture in the classrooms included compartments for the children's coats, several low tables and chairs, a piano, storage shelves, and a desk for the teacher. Play equipment included easels and paints, a play kitchen, a games area, dress-up clothes, small toys, and a large selection of wooden building blocks. Although impossible to control absolutely, it was assumed that the similarity of program, facilities, and equipment provided more control over readiness experiences of the two experimental classrooms as well as classroom activities involving dynamic balance practice.

Subjects

Subjects for this study were kindergarten children ranging in age from 5 to 6 years old. All subjects were enrolled in the First Presbyterian Church Kindergarten, Greensboro, North Carolina. All children would be attending first grade the next fall. The socio-economic background of the subjects was similar with most children coming from families where the parents were professional people, business executives, or self-employed. Subjects were both male and female and all were caucasian.

Not all children in both experimental classes were eligible for participation in the study. Upon the teachers' recommendations, several children were eliminated due to excessive absentee records and one child was eliminated as he was seven years old and repeating kindergarten.

Seventeen of the remaining children in each class were selected randomly to participate in the study. Eight boys and nine girls from

Class I and nine boys and eight girls from Class II were assigned randomly to the study. Six subjects were dropped from the study due to absence during various phases of testing. The total number of subjects was 28. Table 1 (page 38) showed a detailed distribution of subjects. Half of each class was selected randomly and together they formed the experimental group and the remaining subjects composed the control group. The number of boys and girls in each class and group was equated.

SELECTION OF TESTS

Balance Beam Test

Rationale. A review of literature identified three types of tests used to assess dynamic balance ability. The types were mechanical apparatuses, stunts, and beam walking. A beam walking test was selected to evaluate dynamic balance ability in this study. Eight reasons justified the selection of a balance beam test over other available tests of dynamic balance:

1. A review of dynamic balance tests indicated that beam tests were fairly reliable measures of dynamic balance.

2. Balance beam tests were used in testing over a wide age range including the age of the subjects in this study.

3. Balance beam tests were easy to administer and required no complicated equipment.

4. Directions for balance beam tests were simple and easily understandable by kindergarten children.

5. Beam walking forward and backward has been shown to relate to scholastic performance and a beam test could employ both backward and forward locomotion.

6. Balance beams were used in various perceptual-motor training programs and used as one subtest of the Perceptual-Motor Survey (Kephart, 1960).

7. Varying the width of the walking surface would increase the discriminatory range of the test to better analyze dynamic balance ability.

8. Little or no fear was likely to be exhibited by children in an appropriate balance beam task.

Construction of the balance beam. The balance beam constructed for this study was a modification of the Cooke (1968) balance beam. (See Figure 1.) The beam was constructed from a piece of solid redwood 10 feet long with a cross-section of 4 inches by 4 inches. One side functioned as a four inch wide walking surface. Boards three inches, two inches and one inch wide were attached lengthwise on the three remaining sides. The three additional walking surfaces were raised seven-eighths of an inch above the solid beam. A square piece of lumber 12 inches by 12 inches by 2 inches was placed on either end of the beam to stabilize the beam and provide for four balanced and

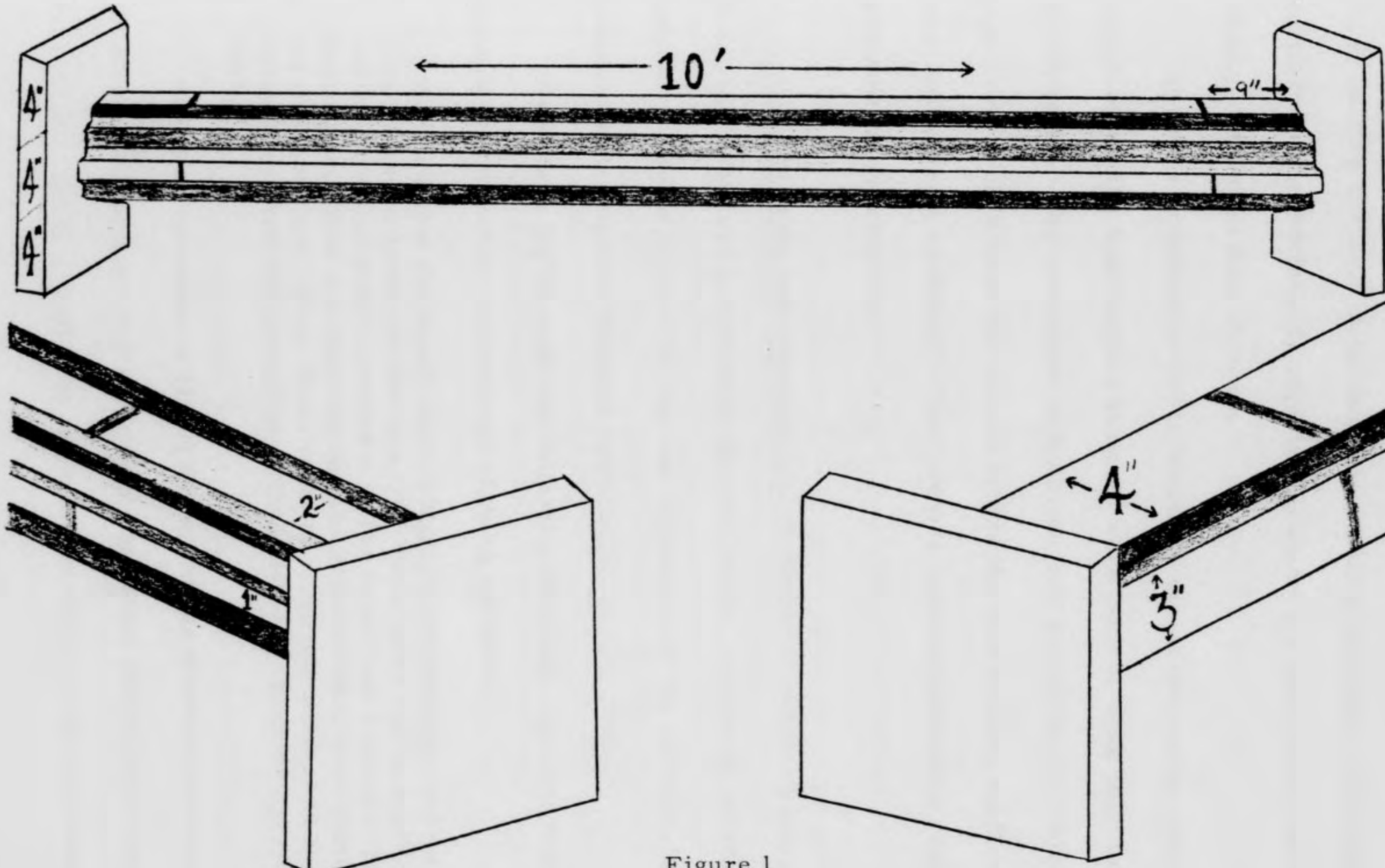


Figure 1

Balance Beam

level walking surfaces to be usable by rotating the beam. The walking surface was approximately eight inches above the floor, thus, minimizing a potential fear element.

In order to minimize the influence on visual perception and discrimination, the four walking surfaces were painted white with a non-glossy paint. The remainder of the beam was painted black. A red tape line one inch wide was placed across the four walking surfaces nine inches from each end. This line was used to facilitate starting and scoring procedures.

Balance beam test development. A review of balance beam tests failed to isolate one test suitable for this study. In view of previously used tests and in light of the age and experience of the subjects, a balance beam test was designed specifically for this study.

Halverson (1971) made the following comment regarding the assessment of motor performance of young children:

> We know that the small child is highly individualistic and variable in response to tasks set for him. We know there can be marked variation in children's responses to the same task from one trial to another, from one observation period to another, even from one mood to another. This, then, must be taken into account in the assessment and interpretation of the results of children's performance.

Based on Halverson's (1971) statement, an attempt was made to eliminate standardized restrictions on movement and to foster natural responses. Cooke (1968) first saw merit in this concept of balance beam testing. With this in mind, he permitted the subject to use his arms freely rather than make it mandatory to keep his arms on his hips. In addition, Cooke modified heel-toe walking and permitted the heel to be no more than four inches in front of the toe.

In order to free the subject of what appeared as unnatural restrictions, the following modifications were used in the development of the Balance Beam Test.

1. The subject was tested in bare feet in order to eliminate the variability of kinds of shoes as well as to free the subject of any movement restrictions which may be imposed by certain types of shoes.

2. The subject was permitted to use his arms freely and in a manner suitable to his needs.

3. The subject was not restricted in the specific type of walking step to be used or in the distance between heel and toe.

4. The subject was permitted to mount the beam at the start of the test in any manner he desired.

Prior to the establishment of final testing procedures, a pilot examination of children walking on a balance beam and responding to a variety of instructions was made incorporating the above modifications. Of significance was the observation that three general types of walking steps were exhibited by the children when permitted to walk a beam in a natural manner. The types were labeled full step, partial step, and shuffle step. They were defined as follows:

1. A full step was the continual change of the leading foot with the heel of the lead foot stepping beyond the toes of the trailing foot during forward walking and with the toes of the leading foot stepping beyond the heel of the trailing foot during backward walking.

2. A partial step was the continual change of the leading foot with the heel of the lead foot not stepping beyond the toes of the trailing foot during forward walking and the toes of the leading foot not stepping beyond the heel of the trailing foot during backward walking.

3. A shuffle step was the continual use of one foot as the leading foot with the toes of one foot always leading during forward walking and one heel always leading during backward walking.

A fourth step was later defined as a stabilizer step. A stabilizer step was a slight movement of the feet without a definite transfer of weight and was used to regain or maintain balance. As in a study by McCaskill and Wellman (1938), a stabilizer step was not counted as a step for scoring purposes.

A variety of instructions created a variety of responses in the pilot examination. Simple directions were found to be most effective in obtaining a natural response and were easily understood by the children.

In order to obtain as much information about a subject's dynamic balance ability, several components of performance were recognized as important and pilot testing was conducted after training three judges as to testing and scoring techniques. Judges were asked to identify and count the number and type of step used by a subject before falling off the beam. The investigator served as the test administrator and gave test instructions to the subjects and noted the distance the subject walked before falling off and the side to which the subject fell off. Marks indicating feet and half feet were on the floor below the beam to facilitate the accurate accounting of distance traveled on the beam. Pilot subjects performed both forward and backward beam walking.

Several difficulties were identified in pilot testing. Appropriate modifications were made prior to testing of the experimental and control subjects. One important decision was the elimination of the one inch beam. The beam did not discriminate between abilities as few children were able to mount the beam or take a successful step. The one inch beam also appeared to hurt the feet of some children.

Following pilot testing, it was also determined that two trials forward and backward on each of the remaining three beams would compose the test. Rationale for two trials was based on the importance of retaining the interest of the examinee as well as avoiding potential fatigue during testing.

The remaining three beams; the four-inch, three-inch, and two-inch beams, were used in the test. The effect of the order on performance was not known so an order was determined randomly. It was also noted during pilot testing that some children had difficulty mounting the beam. Therefore, a block was placed on both sides of both ends of the beam to help the children mount the beam in a more effective manner.

Conferences with the judges ironed out many potential scoring difficulties. Objectivity was subjectively evaluated upon examination of practice scoring sheets from pilot testing. For pilot subjects, the judges' scores seldom deviated more than one or two from each other. Prior to the decision to begin experimental testing, it was subjectively determined by the judges and the investigator that the judges were competent in testing techniques and procedures.

Scoring of the Balance Beam Test. An analysis of Balance Beam Test data was done to determine the most appropriate scoring procedure. Discarded in the initial evaluation was the information regarding the side to which the subject fell. This was not considered important to the study since balance, not laterality, was the primary focus.

Further evaluation centered on the reliability of two methods of scoring. Reliability coefficients were computed using the number of steps as the criteria. Because the majority of steps used by the subjects were full steps, only the number of full steps and the total number of all kinds of steps were utilized. Correlating the number of full and total steps of trial one with the number used in trial two produced low reliability coefficients. An empirical analysis of this data revealed that a higher number of total steps did not necessarily indicate skilled performance nor did a low number. In view of this observation and the low reliability coefficients, the number of full and total steps was discarded as the performance criterion.

Using the distance traversed as the performance criterion, more acceptable reliability coefficients were calculated. The total distance walked forward and backward on each of the three beams on trial one was correlated with the total score on trial two. In addition, reliability was computed separately for the sum of the distance forward and the sum of the distance backward. In view of the acceptable reliability coefficients and supported by previous scoring procedures used by researchers as Heath (1942) and Horine (1968), the distance traversed was accepted as the performance criterion.

Reading Readiness Tests

Rationale. Recommendations of a reading specialist and an early childhood specialist associated with the University of North Carolina, Greensboro, supported the selection of the *Metropolitan Readiness Tests* (Hildreth *et al.*, 1966). They agreed that the tests were suited to the socio-economic and cultural backgrounds of the subjects in this study.

Hildreth *et al.* (1966) presented three types of validity including content, construct, and predictive validity on which they based the worth of the *Metropolitan Readiness Tests.* Content validity was claimed by the authors after enumerating the extent to which each of the six subtests examined certain criteria. The criteria were components of first grade readiness derived from a review of literature and professional judgments. Construct validity was accepted on the evidence that the readiness tests provided scores consistent with other measures of readiness and mental abilities. Finally, predictive validity was claimed as readiness scores have correlated with later achievement tests and reported to have predictive value.

Reliability coefficients were also reported by Hildreth et al. (1966). Using the test-retest method, high reliability coefficients of .90 to .95 for kindergarten children were cited for the total of the original six subtests. Lower coefficients were reported on individual subtests. Totaling subtests appeared to have high reliability. The authors pointed out, however, that the instability of young children is a variable affecting reliability estimates.

Upon the recommendation of the early childhood specialist, two separate forms were administered to avoid contamination of posttest data by reminiscence from the pretest. Two parallel forms of the readiness tests were available. Form A and Form B were administered during pretesting and posttesting respectively.

The manual accompanying the Metropolitan Readiness Tests (Hildreth et al., 1966) indicated that the tests may be administered effectively by a teacher without previous experience in readiness testing. Based on this the investigator assumed responsibility for readiness test administration. The reading specialist cooperated in training the examiner to administer the tests. In addition, the examiner prepared further by practicing testing procedures. Practice testing was done using five children from a kindergarten class that was not participating in the study.

Selected subtests. Six subtests composed the Metropolitan Readiness Tests. Upon the recommendation of the reading specialist associated with the University of North Carolina, Greensboro, the first four subtests were selected as reading readiness subtests. The selected subtests were the Word Meaning, Listening, Matching, and Alphabet tests. Each was described by Hildreth *et al.* (1966). The Word Meaning test, a 16-item picture vocabulary test, required the subject to select 1 of 3 pictures which was identified by the word the examiner said. The Listening test, a 16-item test of comprehension of sentences, required the subject to select 1 of 3 pictures which was an illustration of an event or situation described by the examiner. The Matching test, a 14-item visual perception and recognition test, required that the subject match 1 picture with 1 of 3 choices. The Alphabet test, a 16-item test of ability to recognize lower-case letters, required the subject to choose, among 4 choices, the letter said by the examiner.

Scoring of the reading readiness tests. Four subtests of the Metropolitan Readiness Tests were graded according to the directions and answers accompanying the tests. One point was given for each correct answer. A score was determined by adding the four subscores to identify a total reading readiness score.

ADMINISTRATION OF TESTS

Prior to the administration of the initial tests, the investigator visited the two experimental classrooms for several days. This was deemed important for two reasons. First of all, the investigator was able to become familiar with the school procedures and with the children. Secondly, the children were able to meet and feel at ease with the investigator. It was assumed that this mutual familiarity would increase the validity of testing.

The testing schedule was formulated and was identical for both the administration of the pretest and the posttest. Readiness testing was done on Monday and Tuesday of the testing week and balance testing was done on Wednesday and Thursday. Friday was available for any carry-over testing.

Administration of the Reading Readiness Tests

The four subtests of the Metropolitan Readiness Tests were administered to all subjects. The Word Meaning and Listening subtests were given to all subjects on the first day of testing and the Matching and Alphabet subtests were given on the next day. The schedule was based on suggestions accompanying the Metropolitan Readiness Tests (Hildreth et al., 1966). The manual recommended that only two subtests be given in one session and no more than one session in a half-day. Test directions also suggested that the number of children in each session be less than 15.

The subjects in each classroom were assigned randomly to form two testing groups. Equated in each test group was the number of children from the experimental and control groups. Testing was done in class groups. The order for testing of each class was determined randomly. Class I was tested first and Class II second. Each class required 2 testing sessions to keep the size of the groups less than 15.

Testing was done in a large, well-lighted room. Prior to initiation of testing, three tables were arranged in a horseshoe pattern to permit all subjects to see the examiner and the examiner to see all subjects. (See Figure 2.) Each examinee was provided with a crayon and an eight-inch by four-inch paper marker. Test directions suggested that a marker would aid children in keeping their place during testing.

Children were permitted to color the picture on the front page of the test booklet as the examiner passed out all testing materials. Children were not permitted to talk after this time.

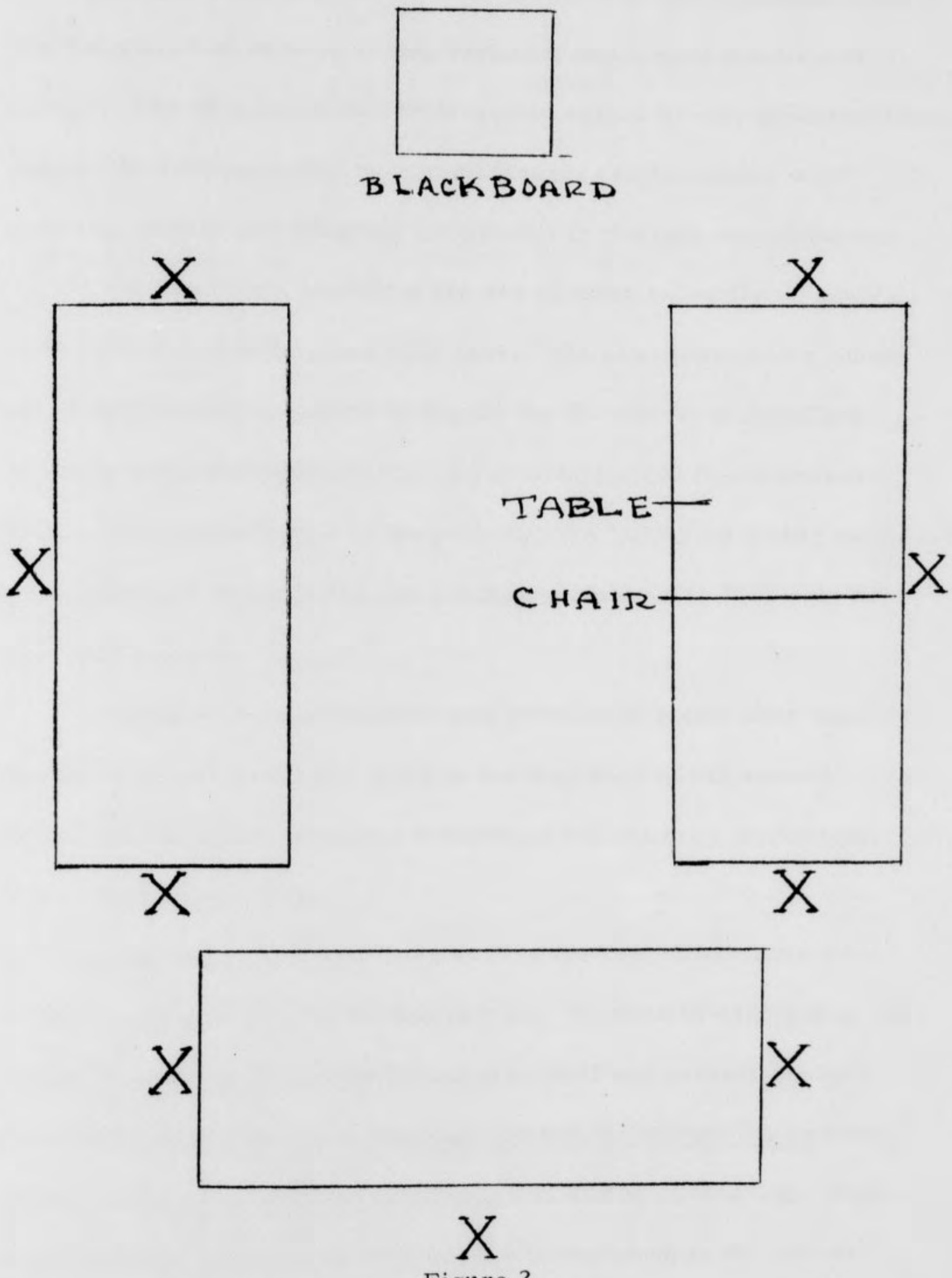


Figure 2

Floor Plan Used for Reading Readiness Testing

Examples and test directions were read by the examiner verbatum from the test manual as any deviation would have invalidated scores. The director of the kindergarten school briefly observed from outside the test room and concurred that the administrator was speaking clearly and adhering specifically to the test specifications.

Test directions permitted the use of extra examples to assure that the children understood their task. The examiner used a blackboard and several examples to clarify the directions on the Word Meaning and Matching subtests. An assistant aided the examiner during the administration of the pretest. She helped by giving children new crayons if theirs broke and reminding children to look only at their own papers.

A break of several minutes was given each group after completion of the first test and prior to the beginning of the second. During this time the examiner encouraged the children to stretch, move, and jump in place.

In summary, subjects from each of the two classrooms were divided randomly into two testing groups. Equated in each group was the number of subjects from the experimental and control groups. Four subtests of Form A of the Metropolitan Readiness Tests were administered over two days to all subjects during pretesting. Test directions and procedures were explicitly explained in the accompanying test manual and specifically followed by the examiner. Two subtests were administered each day permitting a brief rest between tests. All four test groups were tested in the morning of each test day. Posttesting followed the same procedures using Form B of the readiness tests.

Administration of the Balance Beam Test

Dynamic balance testing of the experimental and control subjects was done in a large, well-lighted classroom which possessed a minimum of visual distractions. This was the same room in which the readiness tests were administered. The balance beam was placed in the center of the room with feet and half feet gradations marked on the floor below the beam.

Three judges were seated in chairs approximately six feet from and parallel to the beam. One judge was seated opposite the center of the beam on one side and the remaining two judges were seated one and one-half feet either side of the center on the opposite side. (See Figure 3.)

Prior to testing, each judge was provided with a clipboard, pencil, and a Balance Test Data Sheet for each child with the name of the subject indicated on each. (See Appendix B.) The order of testing was determined randomly. Each subject was tested individually. Class I was tested first and then Class II. The test administrator went to the classroom and got each subject individually. As the subject

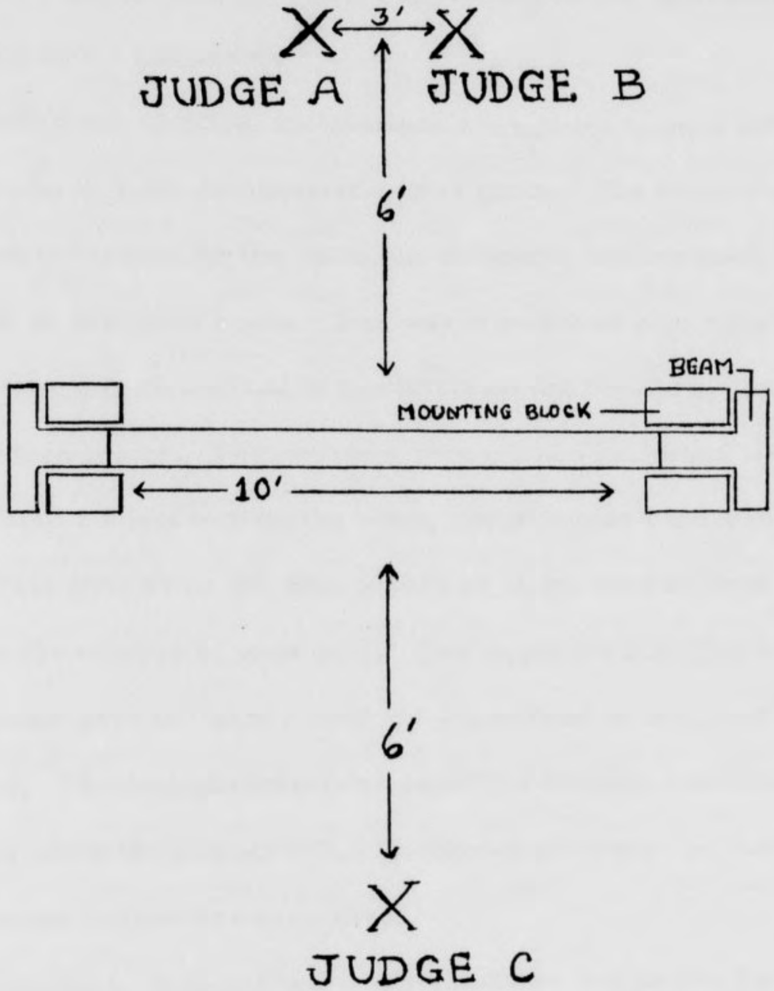


Figure 3

Floor Plan Used for Dynamic Balance Testing entered the room he was introduced to the judges and instructed to remove his shoes and socks.

Specific and identical instructions were given to each subject. (See Appendix A.) No demonstration was given. The subject was asked to walk forward on the beam, to dismount, and remount to walk backwards on the same beam. This was considered a complete trial. The total test was comprised of two trials on the two-inch, four-inch, and three-inch beams. Performance forward and backward was scored.

As each subject walked the beam, three judges recorded on the Balance Test Data Sheet the kind of step or steps used by each subject as well as the number of each used. (See Appendix B.) The test administrator gave initial instructions and walked on the floor behind the subject. The test administrator noted the distance traversed and the side to which the subject fell. During actual testing no communication between judges was permitted.

In summary, subjects were individually tested on the Balance Beam Test. Three judges recorded the number and type of step used while the test administrator gave instructions, noted distance traversed, and side to which the subject fell. The subjects performed two trials of forward and backward beam walking on the two-inch, four-inch, and three-inch beams in that order.

DYNAMIC BALANCE TRAINING PROGRAM

Organization and Procedures

The dynamic balance training program lasted for six weeks. Experimental subjects met each Monday, Wednesday, and Friday for approximately 20 minutes during the free play hour of the kindergarten classes. The experimental subjects from Class I had training activities from 9:15 a.m. to 9:35 a.m. Those in Class II came from 9:40 a.m. to 10:00 a.m. Two training sessions had to be cancelled due to a school conflict and school closure because of poor weather. The investigator served as the instructor for all sessions.

Experimental subjects walked from their classroom to another large room where training activities occurred. At each session the children removed their shoes and socks prior to participation.

The training program consisted of a variety of dynamic balance activities. During each training session, children attempted all tasks and were encouraged to follow them to completion. Some tasks were difficult for some children and the instructor occasionally aided a subject so he could complete the task. An attempt was made to keep the children actively participating insofar as was feasible during each session.

Both training groups received identical lessons insofar as possible. Needs of the children necessitated minor variations.

Several lessons were tape recorded and three physical education instructors listened to the tapes and concurred that the material, sequence, and methodology appeared to be identical.

It was observed that the children seemed to enjoy the training sessions and activities. The enthusiasm of the children remained extremely high throughout the duration of the study.

Selection of Activities

Dynamic balance activities were selected from the motor training programs of Barsch (1968), Cratty (1967), Frostig (1969), Getman and Kane (1964), Kephart (1960), and Mourouzis et al. (1970). It was assumed, therefore, that the activities selected for use in this study were valid as activities designed to develop dynamic balance ability. A complete list of activities is located in Appendix C.

Two guidelines governed the sequence of activities. Where possible, the sequence followed the progression of activities recommended in the various sources. Integration of the sources and abilities of the children required that the progression be established most often by empirical judgment of the instructor.

The most commonly employed activities were hopping and jumping as well as tasks on balance boards and the balance beam. Balance boards and the balance beam were frequently used as they were most commonly used in the motor training programs. Two concepts were suggested by Kephart (1960) in a discussion of balance beam training. These two suggestions were followed in training sessions. First of all, a child who walked a beam with no difficulty did not exhibit balance; he had to lose his balance and be required to correct or regain his balance. Tasks in the training program were planned to challenge and be difficult for the children to perform. Secondly, a child who ran the length of the beam did not exhibit balance as he may have been able to complete the distance without demonstrating balance skill. During training the children were encouraged to perform slowly. Kephart also stated that the balance boards presented a more difficult skill than balance beams as they required left-to-right and fore-to-aft balance awareness. For this reason the balance boards were introduced on the ninth lesson.

In summary, identical dynamic balance training lessons were organized and administered to two groups of experimental subjects. Activities were selected from the motor training programs of experts. Frequently used activities involved hopping and jumping and use of balance boards and the balance beam.

STATISTICAL TREATMENT OF DATA

Balance Beam Test Data

Objectivity and reliability coefficients were computed for the Balance Beam Test. Objectivity was calculated using pretest data and applying the Pearson product-moment correlation technique. This was computed to ascertain the interjudge agreement in scoring the full, partial, shuffle, and total number of steps of subjects.

Reliability was computed in two ways using two criteria, steps and distance. Trial one of the pretest was correlated with trial two of the pretest to calculate the reliability of the subjects' performance. Using the number of full steps and total number of all types of steps as the performance criteria, correlation coefficients for the number of steps were computed. Using the distance traversed as the performance criterion, reliability coefficients were calculated for forward walking, backward walking, and total walking which was the sum of forward and backward walking. Each score represented the total distance traversed before falling on each of the three beams. The Spearman-Brown prophecy formula was applied to the distance reliability coefficients to correct for a two-trial test.

Null Hypotheses Analyses

The tenability of three null hypotheses was evaluated applying the following statistical procedures. The analysis of covariance technique was employed to determine the effect of dynamic balance training on dynamic balance ability and the effect of dynamic balance training on reading readiness of selected kindergarten children. With this technique it was possible to adjust the posttest scores to allow for differences in the pretest data. The selection of the covariant technique was supported by Campbell and Stanley (1963) who suggested that analysis of covariance was the preferable technique for a pretest-posttest design with one experimental variable.

An F value was obtained in all cases by dividing the adjusted mean square between groups by the adjusted mean square within groups. Each F value was based on 1 and 25 degrees of freedom. The required level of statistical significance was derived from an F table (Garrett, 1966:465). For 1 and 25 degrees of freedom an F of 4.26 was significant at the .05 level of confidence and an F of 7.82 was significant at the .01 level of confidence.

A significant F represented a significant difference between groups. The direction of the difference was assessed by evaluating the mean gains of each group.

To reject the null hypothesis that dynamic balance ability is not increased through a training program of dynamic balance activities, the .01 level of confidence was selected. The .05 level of confidence was selected as the level of confidence for rejecting the null hypotheses that dynamic balance training has no effect on reading readiness of selected kindergarten children and that there is no relationship between initial dynamic balance ability and reading readiness of selected kindergarten children.

The .01 level of confidence was selected for the first hypothesis because the training was highly specific for dynamic balance. Additionally, the validity of conclusions rested on the evidence that the dynamic training was successful in increasing dynamic balance ability. The .05 level of confidence was selected for the other hypotheses because the size of the sample was small.

Chapter 4

PRESENTATION AND ANALYSIS OF DATA

This study investigated the effect of dynamic balance training on reading readiness of selected kindergarten children. Of additional concern was the initial relationship of dynamic balance ability and reading readiness and the effect of dynamic balance training on dynamic balance ability of the same subjects.

Subjects were children enrolled in two classes in the First Presbyterian Church Kindergarten, Greensboro, North Carolina. In the final analysis, 13 subjects were from Class I and 15 from Class II. There were 14 subjects in the experimental group and 14 in the control group. The total number of subjects in the final analysis was 28. Table 1 (page 38) showed a more detailed distribution of subjects.

Four subtests of the Metropolitan Readiness Tests and the Balance Beam Test designed specifically for this study were administered. Both tests were administered prior to and following a series of dynamic balance training sessions.

Subjects were assigned at random to an experimental group or control group, equating the number from each of the two classes and sex of the participants. All children were pretested on four subtests of Form A of the Metropolitan Readiness Tests and the Balance Beam

Test designed specifically for this study. The experimental group received 6 weeks of dynamic balance training meeting 3 times a week for 20 minutes each session. The control group received no such training, but participated in the regular kindergarten program. Following completion of the dynamic balance training, all subjects were post-tested on four subtests of Form B of the Metropolitan Readiness Tests and the Balance Beam Test. Appropriate statistical techniques were employed to assess the tenability of the null hypotheses established at the onset of this investigation.

BALANCE BEAM TEST ANALYSIS

An analysis of the Balance Beam Test data was made to determine the interjudge objectivity and to establish the most reliable estimate of dynamic balance performance as measured by the beam walking test. Pretest data was used for these computations.

Objectivity

Three judges were used to record balance test data. Judges were identified as judge A, B, and C. Interjudge objectivity correlations were computed between judge A and B, A and C, and B and C. The Pearson product-moment correlation was used to determine the judges' ability to agree on the type and number of each step taken for forward and backward walking on each of the three beams. Objectivity was calculated for all three types of steps; full, partial, and shuffle steps, as well as for the total of the above three. Objectivity correlations are presented in Table 2.

It must be noted that the range of correlation coefficients was between .12 and perfect agreement of 1.00. This presented an inaccurate picture of the agreement. Of the three types of steps, the partial and shuffle steps were least often used by the subjects. A score of zero was recorded by the judges for steps not used. This zero score was reflected in and affected the correlations. For example, an r of .16 was computed between judges A and B on the 2-inch forward beam task for partial steps. The correlation was low whereas, in actuality, the judges disagreed on only 4 of the 28 subjects. The percentage of agreement was high, but because of the zeros recorded for most subjects, the correlation of .16 represented a distortion of results.

To eliminate this possible distortion and because the majority of steps used by the subjects were full steps, the objectivity correlations for full steps and the total score were seen as most significant. The range of these correlations was .89 to 1.00. Half of the correlations were .98 and above. The objectivity of the majority of the correlations, therefore, was rated as excellent according to the standards defined by Barrow and McGee (1964:42).

In the analysis it was impossible to calculate objectivity of the distance measure as only the test administrator noted the distance

Table 2

Interjudge Objectivity Correlations
for Number and Type of Step

Beam	Judges		
	A and B	A and C	B and C
2 Inch Forward			
Full	.89	.90	.99
Partial	.16	.12	.76
Shuffle	1.00	1.00	1.00
Total	.98	.98	.99
2 Inch Backward			
Full	.93	.94	.91
Partial	.93	.95	.84
Shuffle	.99	.98	.99
Total	1.00	.98	.99
4 Inch Forward			
Full	.95	.99	.94
Partial	.50	.81	.28
Shuffle	.69	.46	.69
Total	.94	.98	.94
4 Inch Backward			
Full	.97	.96	.96
Partial	.95	.98	.93
Shuffle	.95	.99	.46
Total	1.00	.99	.98
3 Inch Forward			
Full	.96	.96	.97
Partial	.47	.47	1.00
Shuffle	1.00	1.00	1.00
Total	.97	.98	.99
3 Inch Backward			
Full	.96	.97	.96
Partial	.97	.97	.96
Shuffle	1.00	1.00	.98
Total	1.00	1.00	1.00

traversed. The assessment was considered simple; however, the lack of objectivity correlations was accepted as a limitation of the study.

Reliability

Reliability of the Balance Beam Test was determined using two criteria, steps and distance. Using the number of full steps and total number of all types of steps as the performance criteria, fairly low reliabilities were found when correlating trial one with trial two of the pretest. Data are presented in Table 3. Only four correlations were acceptable according to the standards established by Barrow and McGee (1964:42) after applying the Spearman-Brown prophecy formula to correct for a two-trial test.

Using distance traversed as the performance criteria, a more acceptable determination of reliability was found. For each subject a forward, backward, and total score was calculated. The forward score represented the total distance the subject walked forward before falling off on each of the three beams on one trial. The backward score represented the sum of backward distances on the three beams. The total score was the forward score plus the backward score for one trial.

Reliability coefficients are presented in Table 4 to report the correlations between trial one and trial two of the pretest using a forward only score, a backward only score and a total score comprised

Table 3

Reliability Coefficients for Number of Steps

Beam	Steps	Trial 1 vs. Trial 2 Reliability Coefficients
2 Inch Forward	Full	.43
	Total*	.48
2 Inch Backward	Full	.38
	Total*	-.06
4 Inch Forward	Full	.26
	Total*	.52
4 Inch Backward	Full	.90**
	Total*	.57
3 Inch Forward	Full	.89**
	Total*	.87**
3 Inch Backward	Full	.66**
	Total*	.53

*Total refers to the sum of full, partial, and shuffle steps.

**Coefficient was acceptable when stepped-up with the Spearman-Brown prophecy formula according to standards established by Barrow and McGee (1964:42).

Table 4

Reliability of Coefficients for Distance

Scoring Method	Pearson Product-Moment Coefficient	Stepped-Up
Forward Distance	.80	.89*
Backward Distance	.45	.63
Total Distance	.75	.86*

*Coefficient was acceptable according to standards established by Barrow and McGee (1964:42).

of both forward and backward scores. After applying the Spearman-Brown prophecy formula to adjust for a two-trial test, two of the three coefficients were acceptable according to the standards defined by Barrow and McGee (1964:42). Coefficients of .89 for forward distance and .86 for backward distance were computed and found to be acceptable. A coefficient of .63 was calculated for backward distance which was questionable according to the standards defined by Barrow and McGee (1964:42).

Discussion

An analysis of the Balance Beam Test data revealed that the test designed for this study was a fairly objective and reliable instrument. The excellent objectivity correlations indicated that the judges were successful in agreeing with the number and type of step taken by the children.

Interpreting the reliability coefficients revealed that using the distance criteria produced the most reliable response. The distance traversed was accepted, therefore, to be the most reliable and effective criterion measure of dynamic balance ability of selected kindergarten children on the Balance Beam Test. Distance was also used by Alden et al. (1932), Heath (1942), and Horine (1968) as the criteria for balance performance. Seashore (1947) found that increasing the number of trials increased reliability. It is suggested by the investigator that in future testing permitting one practice trial may increase reliability. Additionally, Halverson (1971) stated that a child's performance may vary from trial to trial. This instability of performance may have lowered the reliability and accounted for lack of higher correlations. Reliability, however, for total distance on the Balance Beam Test was higher than Seashore (1947) reported for either a three or six-trial test with five-year-old subjects.

At this point in the study the number of steps and kind were eliminated as criterion measures. Through subjective evaluation there appeared to be no relationship between the number of steps or the kind to the distance walked as some children took small steps and some used large steps. Cooke (1968) scored on the basis of number of steps. He was able to do this because he restricted the subject to a modified heel-toe step which permitted a higher relationship between number of steps and distance traversed.

Empirical analysis of the data revealed, also, that a higher number of steps did not necessarily indicate skilled performance nor did a low number. A child who was very unsteady may have used many steps as he walked deliberately the length of the beam. Also, a child who took eight steps may have walked the entire length of the beam or may have fallen off after three feet.

In final analysis, therefore, the subject's score on the Balance Beam Test was the sum of the distance walked on each beam before falling off. This included forward and backward walking and two trials of each on the three beams. Subscores were determined by summing the six forward performances for a forward score and the six backward performances for a backward score. Forward and backward subscores were added to identify a composite or total dynamic balance score.

The concept of permitting and recording the three variations of steps was deemed valuable for three reasons. Permitting the use of any step without restriction encouraged a more natural movement response. Secondly, as suggested by Halverson (1971), the variation of a child's response must be accounted for in motor performance testing. Low reliabilities for the number and type of step on the Balance Beam Test indicated that a subject may use a variety of steps and may be inconsistent in their use while performing this balance task. Different steps may be used to meet the varying demands of the task and necessary to demonstrate balance. Finally, this study demonstrated that the number and type of step may be objectively recorded.

INITIAL RELATIONSHIP OF DYNAMIC BALANCE ABILITY AND READING READINESS

Presentation of Data

An analysis of the initial relationship between dynamic balance ability and reading readiness was computed using the Pearson product-moment correlation. It was hypothesized that there is no relationship between initial dynamic balance ability and reading readiness of selected kindergarten children. A forward score, backward score, and a total score were correlated separately with a total readiness score derived from four subtests of Form A of the Metropolitan Readiness Tests to determine the tenability of the hypothesis.

For 28 subjects, the following three correlation coefficients were calculated comparing dynamic balance scores with the reading readiness criteria: (1) .36 for forward walking and reading readiness, (2) .19 for backward walking and reading readiness, and (3) .29 for total walking and reading readiness. Data are presented in Table 5. The significance of the three correlations was evaluated using Table 25 from Garrett (1966:201). None of the above correlation coefficients was found to be significant at the .05 level of confidence.

Discussion

The results of these calculations indicated that there was no significant relationship between forward, backward, or total beam walking and reading readiness of selected kindergarten children. The apparent lack of a significant relationship presented evidence conflicting with research reported by Cooke (1968); Cratty (Cratty and Martin, 1969); and Thompson, as cited by Cooke (1968). These three investigators reported significant relationships between dynamic

Table 5

Pearson Product-Moment Correlations Between Initial Balance and Reading Readiness Scores

Tests	Forward Balance Score	Backward Balance Score	Total Balance Score
Reading Readiness Scores	.36	.19	.29

*An r of .374 was required for significance at .05 level of confidence.

balance and cognitive measures. Variability of results may have been due to the variety of tests used. The hypothesis that there is no relationship between initial dynamic balance ability and reading readiness of selected kindergarten children was accepted at the .05 level of confidence.

EFFECT OF DYNAMIC BALANCE TRAINING ON DYNAMIC BALANCE ABILITY

Presentation of Data

The effect of dynamic balance training on dynamic balance ability was computed using the analysis of covariance technique. It was hypothesized that dynamic balance ability is not increased through a training program of dynamic balance activities. An analysis of the pretest and posttest data was made using a total score and two subscores of forward walking and backward walking.

For forward beam walking, the difference between the experimental and control groups was calculated as an F of 12.02, which was significant at the .01 level of confidence. Specific data are presented in Table 6. The significant difference was too great to be attributed to chance. An examination of the mean gains of the experimental and control groups in Table 7 indicates that the significant difference favored the experimental group. It may be concluded that dynamic balance ability as represented by forward walking was significantly

Table 6

Analysis of Covariance of the Difference Between Forward Balance Scores of Groups

Source of Variation	SS(adjusted)	df	MS	F
Between groups	444.75	1	444.75	12.02*
Within groups	925.31	25	37.01	
Total	1370.06	26		

*F was significant at .01 level of confidence. F of 7.82 required for significance at the .01 level of confidence.

Table 7

Mean Gains for Balance Beam
Test Performance

	Experimental			Control		
Test	Mean X*	Mean Y**	Mean Gain	Mean X*	Mean Y**	Mean Gain
Forward	45.36	47.50	2.14	40.78	36.21	-4.57
Backward	32.89	38.75	5.86	25.04	22.96	-2.07
Total	77.96	86.54	8.57	65.82	59.61	-6.21

*X indicated pretest.

*Y indicated posttest.

increased and may be logically attributed to the training program of dynamic balance activities.

For backward beam walking, the difference between the experimental and control groups was calculated as an F of 11.35, which was significant at the .01 level of confidence. Specific data are presented in Table 8. This difference was also too great to be accounted for by chance. An examination of mean gains of the experimental and control groups in Table 7 indicated that the significant difference again favored the experimental group. It may be concluded that dynamic balance as represented by backward walking was significantly increased and may be logically attributed to the training program of dynamic balance activities.

For total beam walking, forward plus backward, the difference between the experimental and control groups was calculated as an F of 32.74, which was significant at the .01 level of confidence. Specific data are presented in Table 9. This difference was also too great to be accounted for by chance. An examination of the mean gains of the experimental and control subjects in Table 7, indicated that the significant difference again favored the experimental group. It may be concluded that dynamic balance ability as represented by total walking was significantly increased and may be logically attributed to the training program of dynamic balance activities.

Table 8

Analysis of Covariance of the Difference Between Backward Balance Scores of Groups

Source of Variation	SS(adjusted)	df	MS	F
Between groups	527.92	1	527.92	11.35*
Within groups	1162.98	25	46.52	
Total	1690.90	26		

*F was significant at .01 level of confidence. F of 7.82 required for significance at .01 the level of confidence.

Table 9

Analysis of Covariance of the Difference Between Total Balance Scores of Groups

Source of Variation	SS(adjusted)	df	MS	F
Between groups	6132.10	1	6132.10	32.74*
Within groups	4682.19	25	187.29	
Total	10814.29	26		

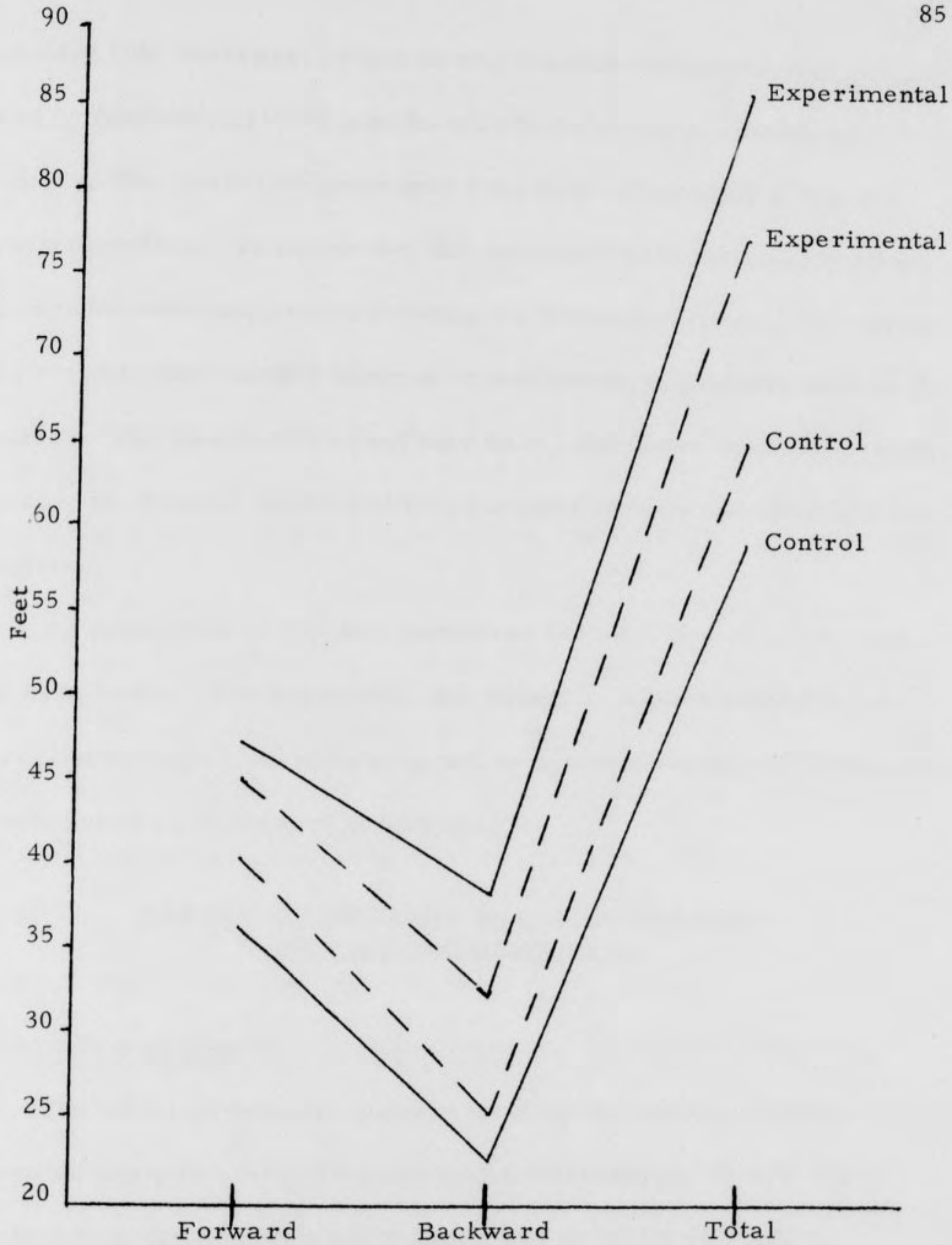
*F was significant at .01 level of confidence. F of 7.82 required for significance at .01 the level of confidence.

Discussion

An evaluation of the data revealed that the experimental subjects who received dynamic balance training improved significantly in dynamic balance ability. Improvement was significant at the .01 level of confidence as measured by forward walking and backward walking subscores and by a total walking score which was a sum of forward and backward walking.

Figure 4 permits a graphic analysis of the dynamic balance scores of the experimental and control groups. It was noted that the means of the experimental group were higher than the means of the control group on the three pretest scores. An evaluation of the posttest dynamic balance scores indicated that in each of the three cases, the control subjects as a group performed less skillfully on the posttest than on the pretest. A comparison of the means of the experimental group using all three scores revealed, however, that the experimental subjects as a group performed more skillfully in forward, backward, and total walking on the posttest.

Keogh (1965) concluded that dynamic balance ability appeared to plateau in children between the ages of 7 and 10 with a marked increase occurring prior to 7 years of age. For this reason, it was expected that subjects in this study would perform equally well or more skillfully on the posttest than on the pretest. The control subjects, however, scored lower on the posttest. Two suggestions may have



— — — Pretest Means

——— Posttest Means

Figure 4

Means of Balance Beam Test Scores
for Pretest and Posttest

explained this decrease. First of all, the variability of motor response noted by Halverson (1971) may have influenced test performance. Secondly, the control subjects may have been affected by a reverse Hawthorne effect. Because they did not receive the special attention the experimental subjects did during the training program, the control subjects may have lacked interest or motivation to perform well on the posttest. The Hawthorne effect may have contributed to the significant increase in dynamic balance ability demonstrated by the experimental subjects.

An evaluation of the data permitted the rejection of the second null hypothesis. The hypothesis that dynamic balance ability is not increased through a training program of dynamic balance activities was rejected at the .01 level of confidence.

EFFECT OF DYNAMIC BALANCE TRAINING ON READING READINESS

Presentation of Data

The effect of dynamic balance training on reading readiness was computed using the analysis of covariance technique. It was hypothesized that dynamic balance training has no effect on reading readiness of selected kindergarten children. An analysis of the pretest and posttest data from four subtests of the Metropolitan Readiness Tests was made to determine the tenability of the hypothesis.

An F of 3.31 was computed using pretest and posttest data of the experimental and control groups. It was determined that the difference between the groups was not significant at the .01 level of confidence. Specific data are presented in Table 10. Any difference between the groups, therefore, was probably due to chance factors rather than the dynamic balance training program as the treatment variable.

Discussion

An evaluation of the statistical data revealed that the experimental subjects who received dynamic balance training did not improve significantly in reading readiness over the control group that received no training. It was statistically shown that the experimental subjects did in reality improve in dynamic balance ability. The improvement, however, appeared to have no effect on improvement in reading readiness. Results in this study concurred with Emmons (1968) who found no significant change in scores on the Metropolitan Readiness Tests following a motor training program. The third hypothesis was accepted: Dynamic balance training has no effect on reading readiness of selected kindergarten children.

SUMMARY

Subjects for this study were 28 kindergarten children enrolled in the First Presbyterian Church Kindergarten, Greensboro, North

Table 10

Analysis of Covariance of the Difference Between Reading Readiness Scores of Groups*

Source of Variation	SS(adjusted)	df	MS	F
Between groups	73.40	1	73.397	3.311
Within groups	554.06	25	22.162	
Total	627.46	26		

*F of 4.24 required for significance at the .05 level of confidence.

Carolina. Children were assigned randomly to an experimental or control group. All subjects were pretested on four subtests of Form A of the Metropolitan Readiness Tests and the Balance Beam Test. Experimental subjects received six weeks of dynamic balance training. Following completion of the training all subjects were posttested on four subtests of Form B of the Metropolitan Readiness Tests and the Balance Beam Test. Statistical techniques were employed to determine the tenability of the three null hypotheses established at the onset of this investigation.

An analysis of the Balance Beam Test data permitted the formulation of three balance scores. No objectivity was reported for the test using the distance criteria because only the test administrator noted the distance traversed. Reliability coefficients of .89 for forward walking, .63 for backward walking, and .86 for total walking were calculated using the split halves method of computing reliability. Hypothesis one was accepted after determining Pearson product-moment correlation coefficients between initial balance scores and readiness scores. Coefficients were .36 for forward walking, .19 for backward walking, and .29 for total walking. The following hypothesis was accepted at the .05 level of confidence: There is no relationship between initial dynamic balance ability and reading readiness of selected kindergarten children.

Hypothesis two was rejected using the analysis of covariance technique. An F of 12.02 was obtained for forward balancing, an F of 11.35 for backward balancing, and an F of 32.74 for total balancing improvement between groups. The following hypothesis was rejected at the .01 level of confidence: Dynamic balance ability is not increased through a training program of dynamic balance activities.

Hypothesis three was accepted using the analysis of covariance technique. An F of 3.31 was obtained for evaluation of reading readiness improvement between groups. The following hypothesis was accepted at the .05 level of confidence: Dynamic balance training has no effect on reading readiness of selected kindergarten children.

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

This study investigated the effect of dynamic balance training on reading readiness of selected kindergarten children. Of additional concern was the initial relationship of dynamic balance ability and reading readiness and the effect of dynamic balance training on dynamic balance ability of the same subjects. Subjects were 28 children enrolled in 2 classes at the First Presbyterian Church Kindergarten, Greensboro, North Carolina.

Tests employed were four subtests of the _Metropolitan Readiness Tests_ and the Balance Beam Test designed specifically for this study. Both were administered prior to and following a series of dynamic balance training sessions.

Subjects were assigned randomly to an experimental or control group, equating the number from each of the two classes and sex of the participants. All children were pretested on four subtests of Form A of the _Metropolitan Readiness Tests_ and the Balance Beam Test. The experimental group received 6 weeks of dynamic balance training meeting 3 times a week for 20 minutes each session. The control group received no such training, but participated in the regular kindergarten program. Following completion of the dynamic balance training, all subjects were posttested on four subtests of Form B of the Metropolitan Readiness Tests and the Balance Beam Test.

The Pearson product-moment correlation technique was used to determine the initial relationship of dynamic balance ability and reading readiness. No statistically significant relationship was found between forward, backward, or total beam walking and reading readiness at the .05 level of confidence.

The analysis of covariance technique was used to determine the effect of dynamic balance training on dynamic balance ability. The F values obtained were found to be significant at the .01 level of confidence in favor of the experimental group. The experimental subjects improved significantly more than did the control subjects in forward, backward, and total beam walking.

The analysis of covariance technique was also used to determine the effect of dynamic balance training on reading readiness. The resulting F was not significant at the .05 level of confidence indicating that dynamic balance training had no effect on reading readiness.

CONCLUSIONS

Within the limitations of this study, the following conclusions were made:

1. There was no relationship between forward, backward, or total dynamic balance performance as measured by the Balance Beam Test and the four reading subtests of the Metropolitan Readiness Tests for both the experimental and control groups.

2. Dynamic balance ability was significantly improved as measured by forward, backward, and total walking on the Balance Beam Test for the experimental group.

3. Reading readiness as measured by the four reading subtests of the Metropolitan Readiness Tests was not significantly improved for either the experimental or control group.

RECOMMENDATIONS

The following recommendations were made for further research:

1. Study the effect of a longer dynamic balance training program on reading readiness or other cognitive measures.

2. Repeat a similar study with subjects in first grade and evaluate the effect of dynamic balance training on school achievement measures including reading achievement if valid reading tests are published for first grade children.

3. Execute a similar study to assess any sex differences which may be inherent in the potential effect on cognitive measures.

4. Duplicate a similar study and assess the effect of dynamic balance training on reading of subjects who exhibit inferior dynamic balance performance.

5. Repeat a similar study but provide an opportunity for the investigator to work with the control subjects in an unrelated activity to minimize the potential Hawthorne effect.

6. Isolate additional perceptual-motor skills and study the effect of training on cognitive measures.

7. Continue to eliminate the standardized movement restrictions in balance beam testing and incorporate the concept of natural and unrestricted movement to accommodate individual responses to movement tasks.

8. Investigate potential uses of the number and type of step in balance beam testing as the recording in this study demonstrated high objectivity.

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APPENDIXES

Appendix A

BALANCE BEAM TEST DIRECTIONS

Directions to the Administrator

Adhere to the following directions:

1. Upon entering the testing room, introduce the subjects to the judges and instruct him to take off his shoes and socks.

2. Repeat the directions verbatum to each child as he is individually tested.

3. Verbal clarifications of test directions is permitted if the subject apparently does not understand the task.

4. At the start of the test and each trial, be sure the subject's feet are not in front of the red line. They may touch, but not be beyond.

5. At the end of a trial, be sure the subject steps off of the beam before giving instructions for the next phase.

6. Indicate that a trial is terminated by saying "thank you" if the subject's foot steps on any black surface of the beam. A step onto the black includes any touching which involves even a slight transfer of weight onto the black.

7. If a child turns his shoulders and feet perpendicular to the length of the beam, the trial should be stopped immediately when he turns. He should be instructed to keep walking with his feet going forward. A retrial is permitted and if he repeats the turning, the trial is counted and terminated when his feet and shoulders have completely turned. Stop the trial by saying "thank you."

8. Report the distance of the trial to the nearest half foot by verbally telling the judges and indicate also the side, right or left, to which the subject fell off. Distance is determined by the last step occurring before an error. Distance should be noted from the toe on forward walking and from the heel on backward walking. A subject who walks the entire length receives a maximum score of eight and one-half feet.

9. Turn the beam at the appropriate time. Judges will assist in this task.

10. Walk quietly behind the subject as he performs noting and watching carefully for touching on the black, turning sideways of the feet, and distance walked.

11. Repeat the following directions to each subject for each trial on each beam:

> Today we are going to see how well you can walk on this walking board. Put your foot behind the red line and walk slowly to the other end.
>
> Put your foot in front of the red line and walk backwards.

Directions to the Judges

Adhere to the following directions:

1. Using the Balance Test Data Sheet, record the type of step or steps used by each subject and the number of each used. Types are defined as:

Full Step: A full step is the continual change of the leading foot with the heel of the lead foot stepping beyond the toes of the trailing foot during forward walking and with the toes of the leading foot stepping beyond the heel of the trailing foot during backward walking.

Partial Step: A partial step is the continual change of the leading foot with the heel of the lead foot not stepping beyond the toes of the trailing foot during forward walking and the toes of the leading foot not stepping beyond the heel of the trailing foot during backward walking.

Shuffle Step: A shuffle step is the continual use of one foot as the leading foot with the toes of one foot always leading during forward walking and one heel always leading during backward walking.

Stabilizer Step: A stabilizer step is the slight movement of the feet without a definite transfer of weight and is used to regain or maintain balance.

2. Two complete trials will be given each subject on each beam. A complete trial includes both forward and backward walking. Record the number of steps next to the type as indicated on the Balance Test Data Sheet. Do not figure totals.

3. Begin counting with the first step the subject takes completely beyond the red line. If the heel in forward walking or the toe in backward walking is touching the line, the step is not counted.

4. A trial is terminated and stop recording when one of the following occurs:

A. The subject walks completely beyond the red tape line at the terminal end. If the heel on forward walking or the toe in backward walking is touching the line, the step is counted.

B. The last step occurs before a subject falls off.

C. The last step occurs before the test administrator says "thank you."

5. Do not count or record a stabilizer step.

6. Record in the top square next to the type of step in each box, on the data sheet, the distance the subject walks as verbalized by the test administrator. Record in the bottom square, the side to which the subject fell.

7. A code system may be devised using dots and dashes to facilitate counting the type of step. The code should be used on scratch paper and transferred as a numerical value to the Balance Test Data Sheet.

8. Assist the test administrator in turning the beam.

9. No communication is permitted between the judges during testing.

Appendix B

BALANCE TEST DATA SHEET

SUBJECT ____________________ JUDGE ____________________

BEAM	TRIAL 1		TRIAL 2	
2 INCH FORWARD	F ____ P ____ S ____ TOTAL ____		F ____ P ____ S ____ TOTAL ____	
2 INCH BACKWARD	F ____ P ____ S ____ TOTAL ____		F ____ P ____ S ____ TOTAL ____	
4 INCH FORWARD	F ____ P ____ S ____ TOTAL ____		F ____ P ____ S ____ TOTAL ____	
4 INCH BACKWARD	F ____ P ____ S ____ TOTAL ____		F ____ P ____ S ____ TOTAL ____	
3 INCH FORWARD	F ____ P ____ S ____ TOTAL ____		F ____ P ____ S ____ TOTAL ____	
3 INCH BACKWARD	F ____ P ____ S ____ TOTAL ____		F ____ P ____ S ____ TOTAL ____	

Appendix C

DYNAMIC BALANCE TRAINING ACTIVITIES

The following activities were presented in the dynamic balance training program. The sequence following each major activity, however, does represent the order to introduction into the program. The list as it appears does not indicate the order of introduction of the major activities in the program.

General Activities

I. Hopping and jumping the length of the room
   A. Hop forward
   B. Hop backward
   C. Hop alternating feet in a pattern
   D. Jump backward
   E. Hop over rope held nine inches high

II. Walking the length of the room
   A. Walk forward on tip-toes
   B. Walk sideways
   C. Walk forward, toes pointed in
   D. Walk forward, toes pointed out
   E. Walk forward using giant steps
   F. Walk forward using baby steps
   G. Walk forward rapidly
   H. Walk forward on heels
   I. Walk rapidly forward, stop and go on command
   J. Crab walk forward
   K. Crab walk backward

III. Jumping and hopping in squares 12 inches by 12 inches taped onto the floor
   A. Jump in square
   B. Hop in square
   C. Jump in square with eyes closed
   D. Hop in square with eyes closed
   E. Jump over square forward
   F. Jump over square backward

IV. Square to square hopping (Nine squares 12 inches by 12 inches were placed in a zig zag pattern 1 foot apart on the floor.)
   A. Hop from square to square with a slight pause in each
   B. Jump from square to square with a slight pause in each

V. Ladder walking
   A. Walk forward between rungs
   B. Walk forward on rungs

VI. Rope walking or tape line walking
   A. Walk forward on curved rope or tape line
   B. Walk backward on curved rope or tape line

VII. Rope jumping over ropes held at three inches, six inches, and nine inches
   A. Jump forward
   B. Jump backward
   C. Hop forward

VIII. Paper walking (Two sheets of paper were given to each child. The child stepped on the paper with one foot on each piece. Balancing on the leading foot, the trailing foot was held in the air while the paper was moved forward so he could step on it and move in a forward direction. This was repeated the length of the room.)

IX. Obstacle course (The child moved rapidly and alternately over and under five bars placed three and one-half feet apart.)

<u>Balance Beam Activities</u>

I. Four-inch beam
   A. Forward
   B. Forward, arms straight out to sides
   C. Backward, arms straight out to sides
   D. Sideways
   E. Stationary hopping
   F. Hop length of beam
   G. Forward to center, pick up object, continue to end
   H. Backward to center, kneel, continue to end
   I. Forward, eyes closed
   J. Forward, catch thrown ball
   K. Forward, over rope held knee high
   L. Forward, under rope held chest high

II. Three-inch beam
   A. Forward, arms overhead
   B. Forward, arms folded on chest
   C. Backward, arms straight out to sides
   D. Forward, bean bag on head
   E. Backward, bean bag on head
   F. Forward, over rope held knee high
   G. Forward, under rope held chest high
   H. Forward to center, kneel, continue to end
   I. Sideways, over rope held knee high
   J. Forward, eyes closed
   K. Backward to center, kneel, continue to end
   L. Forward to end, turn, forward to start
   M. Backward using shuffle steps
   N. Forward, bent knees
   O. Forward on tip toes
   P. Hop length of beam
   Q. Forward to center, kneel with bean bag on head, continue to end
   R. Forward, bean bag on hands
   S. Forward to end, turn, backward to start
   T. Forward, over rope held knee high and under rope held chest high
   U. Forward, pick up three objects on beam

III. Two-inch beam
   A. Forward
   B. Forward, arms overhead
   C. Forward to center, pick up object, continue to end
   D. Backward using shuffle steps
   E. Forward, bean bag on head
   F. Backward, bean bag on head
   G. Forward, over rope held knee high
   H. Forward to center, kneel, continue to end
   I. Forward to center, turn, continue backward to end
   J. Forward, over rope held knee high and under rope held chest high
   K. Sideways to center, turn, continue sideways to end
   L. Backward to center, turn, continue to end
   M. Backward, over rope held knee high and under rope held chest high
   N. Forward to center, turn, continue forward to end

IV. One-inch beam
  A. Forward
  B. Backward

<u>Balance Board Activities</u>

I. Large Base
  A. Attempt to balance platform without touching
  B. Balance, arms sideward out
  C. Balance, arms overhead
  D. Touch toes keeping balanced platform
  E. Balance, catch thrown bean bag
  F. Turn around on balanced board
  G. Pick up three bean bags placed at each side and in front; stand up after picking up each
  H. Pick up three spoons placed at each side and in front; stand up after picking up each
  I. Touch board to right, left, front, back and return the board to a balanced position after each

II. Small Base
  A. Attempt to balance platform without touching
  B. Balance, arms sideward out
  C. Balance, arms overhead
  D. Rock platform without touching
  E. Touch toes keeping balanced platform
  F. Balance platform bending low

Appendix D

SAMPLE DYNAMIC BALANCE LESSON

DYNAMIC BALANCE TRAINING

Date: April 6, 1971 Lesson Number: 12

Equipment Needed: 6 Bean Bags
4 Balance Boards
Balance Beam

Activities:

I. Hopping and jumping the length of the room
  A. Hop forward, right foot
  B. Hop forward, left foot
  C. Jump backward
  D. Hop backward, right foot
  E. Hop backward, left foot

II. Balance Boards
  A. Large base
    1. Touch toes
    2. Pick up bean bags placed at each side and front; stand up between picking up each
  B. Small base
    1. Balance with arms raised overhead
    2. Bend and touch toes

III. Beam Walking (Three-inch beam)
  A. Walk backwards with bean bag on each hand
  B. Return by walking on tape line

IV. Beam Walking (Two-inch beam)
  A. Walk forward, kneel, continue to end
  B. Walk forward over knee high rope and under chest high rope