Comparison of motor skills between gifted and normal children

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COMPARISON OF MOTOR SKILLS BETWEEN GIFTED AND NORMAL CHILDREN

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Comparison of motor skills between gifted and normal children

by

Christine Mayer Burger

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
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INTRODUCTION

Human development encompasses the growth and maturation in social emotional skills, intellectual abilities and physical motor abilities. An individual's development in all areas is obviously interrelated and does not happen in isolation, but a study of each separate facet can promote quality educational practices and planning. Motor learning, like learning in all other skills areas is part of an individual's total development. As educators become increasingly aware that motor development is linked to general health, to social-emotional adjustment and to occupational adjustment more attention is being focused on the relationship of motor development to academic performance (Bruininks, 1978). An investigation of that relationship is the intent of this study.

Theoretical Framework

Few forms of human behavior do not involve some type of movement (Malpass, 1963). Motor development is a global term which refers to the sequence and rate at which the child acquires motor skills and thereby learns to use and control his body (Singer, 1972). The contributions of motor development to a child's life include: 1) good health, 2) emotional stability, 3) independence, 4) self-entertainment, 5) socialization, and 6) self-concept (Hurlock, 1972).

Each person's motor skill development is strongly influenced by three variables; biological and anatomical attributes, growth and maturation processes and environmental factors. According to Ausubel (1958)
the inherited biological and anatomical attributes possessed by the child at birth constitute the support system for motor development. He states that these attributes are unique to each child and are dependent on genetic transmission and prenatal development. Individual differences in the emergence of locomotor abilities are not determined by weight or body build but by genetic factors concerned with their development (Ausubel, 1958). Hurlock (1972) also adds that genetic endowment is clearly important because it establishes basic parameters within which motor development can take place, although she also allows that maturation plays an important role. The development of body control parallels the development of the motor area of the brain. Skilled movements cannot be mastered until the muscular mechanism of the child matures (Hurlock, 1972). While maturation establishes the sequence of motor skill development, the quality and rate of development can be enhanced or impeded by the environment (Herr, 1978). Once the body has physically matured to the extent necessary for the development of particular motor skills, environmental variables influence the rate and extent of their development. Important variables may include the child's opportunity for practice, the motive or incentive, the attitude towards motor tasks and the attitudes of others toward the child and their interactions with the child. Ausubel (1958) has stated that in addition to genetic factors other personality characteristics such as attitudes and feelings account for differences in the emergence of locomotor abilities. He stated that the development of these attitudes is complicated yet it appears that reinforcement or lack of it plays an important role. According to Gephart and Antonoplis (1969) reactions to the child's performance are
either reinforcing or punishing to the child and shape his attitudes
toward his own abilities and toward motor skills in general. Biases of
persons toward children who have been labeled mentally retarded, learning
disabled or gifted may affect the performance of these children and bring
on what is called the self-fulfilling prophecy effect. These researchers
indicate that this involves the transmission of expectancy of the chil-
dren in such a way that alters the normal functioning of the child. If
the expectations of a child's motor achievement are low because he is
mentally retarded then the child often only performs at a low level even
though he may be capable of more. Unreasonably high expectations can
also be defeating and may cause the child to avoid motor activity and
thus avoid the cause of his failure.

The exact relationship of motor development and cognitive
functioning has not yet been determined. Investigators (Ismail and
Gruber, 1967) utilizing correlational studies of intellect and movement
have indicated that there is a motor base to intellect and have concluded
that participation in physical training programs will improve not only
perceptual and motor skills but other abilities as well, most notably
academic performance. These investigators maintain that the range and
variability of motor skills and cognitive abilities found among children
are great. However, there is evidence that these two areas are somewhat
interrelated.

On one end of the mental ability spectrum, the motor skills and
abilities of handicapped children have been studied. Studies of retarded
children's motor development indicate that they are inferior in motor
proficiency when compared to their normal peers (Kirk, 1972). Following
a review of the literature pertaining to motor skills development among the mentally retarded, Malpass (1963) concluded that as a group, they demonstrated less motor competence in tasks requiring precise movements and reactions as well as those requiring complex skills and motor coordination. Singer (1972) indicated that the mentally retarded have difficulty learning manual skills and that generally their motor attributes are both qualitatively and quantitatively different from the same trait patterns in normal children. Children with learning disabilities also show problems with motor coordination as well as directionality, laterality and dominance (Fallen, 1978). Clements (1971) said that poor fine or gross visual-motor coordination, delayed motor milestones and general awkwardness or clumsiness are characteristics of children with learning disabilities. Wallace and McLoughlin (1975) included balance and rhythm as motor activity problems of children with learning disabilities. Malpass (1963) concluded that a definite relationship exists between the severity of mental dysfunction and the severity of motor skill deficiencies.

On the opposite side of the spectrum, research of the motor skills of gifted children is not as plentiful and seems to focus more on physical attributes instead of actual motor ability. Terman (1925) and Terman and Oden (1947) concluded that their gifted group was superior to individuals of normal intelligence in terms of physical health, size, appearance and energy. Gallagher (1976) said that gifted children tend to be equal to or slightly better than their average age mates in physical stature and health. French (1964) indicated that gifted children have superior physiques as demonstrated by above average height,
weight, coordination, endurance and general health. Both Roeper (1977) and Kincaid (1969) state that gifted children walk earlier than the average child. Studying other physical abilities, Hagen and Clark (1973) stated that gifted children receive an unusual quantity of information from the environment through a heightened sensory awareness. They characterized the gifted child as being unusually vulnerable to "Cartesian split," or lack of integration between body and mind. They stated that gifted children have a low tolerance for the lag between their standards and their actual athletic skills.

Since parents and teachers may have increased expectations for the motor abilities of gifted children due to increased intellectual ability, this may be a cause for concern. According to this writer, compounding this problem is the fact that the gifted child is probably stressed by these outside expectations and his own feelings of incompetence regarding his physical skills. Since there appears to be a consistent lack of research in the area of motor skills and abilities of gifted children, more information is needed to aid administrators, teachers and parents in planning and programming for the gifted.

Statement of the Problem

The purpose of the present study is to investigate the motor skills and abilities of gifted children. Motor skills of gifted children (defined by participation in an existing program for the talented and gifted) will be assessed and compared with the motor skills of normal children (defined by placement in a regular classroom in an elementary school and not needing any special services or provisions). The subjects
will be at the 2nd grade level and range from 84 to 96 months of age.

On each subject the researcher will have data that consist of scores on
the Bruininks-Oseretsky Test of Motor Proficiency (Short Form), height,
weight, grip strength, and laterality measures.

The specific null hypotheses to be tested are:

1. There is no significant difference between motor skill
   performance as measured by the Bruininks-Oseretsky Test of Motor
   Proficiency, grip strength, body size index, handwriting or
   laterality measures of the sampled group of gifted compared to
   normal children.

2. There is no significant difference between motor skill
   performance as measured by the Bruininks-Oseretsky Test of Motor
   Proficiency, grip strength, body size index, handwriting or
   laterality measures of the sampled group of boys compared to
   girls.

3. There are no significant relationships between any of the
   variables including motor skill performance as measured by the
   Bruininks-Oseretsky Test of Motor Proficiency, grip strength,
   body size index, handwriting, laterality measures, sex and
   gifted or normal grouping.
REVIEW OF LITERATURE

Motor, in the context of development, means muscular movement. Motor skills according to Herr (1978) are learned in a process called motor learning and the primary characteristic of motor learning is movement. Motor skills refer to levels of competence in carrying out certain motor behaviors or tasks (Whiting, 1975). Singer (1972) defines motor development as a global term which refers to the sequence and rate at which the child acquires motor skills and thereby learns to use and control his body.

Motor Development and Motor Skills

Zaichkowsky (1974) believes that the development of a child's motor behavior is a sequential process starting with simple reflexes and ending with coordinated motor skills. Generally, he sees motor behavior as moving from reflexes to postural movement to locomotor movements and finally to manipulative movements. These behaviors increase along with the development of motor control which develops along the principles of cephalocaudal development and proximodistal development. The rudimentary movement abilities that develop after reflexive responses in infancy include sitting, crawling and walking. During early childhood, general fundamental skills such as running, jumping, catching and throwing develop. According to Zaichkowsky these fundamental skills are common to all children and are necessary for ordinary survival but large individual differences in a child's ability to perform these fundamental skills will exist. He does stress that the order in which the rudimentary and
fundamental skills normally develop will be the same for all children, only the rate at which the skills develop will vary. During late childhood, more specific movement skills appear when the earlier skills become more refined, fluid and automatic. More emphasis is placed on form, accuracy and adaptability in this stage of development. Finally, in adolescence specialized abilities develop but mainly these are dependent on the amount of practice an individual has with specific skills.

Motor skills also develop along a continuum from gross to fine, depending on the muscles used. Gross motor skills incorporate large muscles of the neck, trunk, arms, legs, several muscle groups together or the whole body. Examples of gross motor activities are running, jumping, walking, skipping, balancing and throwing. Fine motor skills involve limited activities of the body extremities and are more precise movements of the small muscles in the lips, tongue, eyes, hands, fingers and feet. Examples of fine motor skills are grasping, handwriting, releasing, pinching and blinking. According to Hallahan and Kauffman (1976), attempts to place a movement into a specific category based on the muscles involved will prove unsatisfactory since many tasks, especially complex ones, involve large and small muscles and must be monitored by sensory information as well.

**Assessing Motor Skills**

Although motor skills tend to be specific in nature, there are certain basic abilities that underlie the execution of specific motor tasks. Factor analysis has been used with considerable success in identifying basic components of motor performance in humans and in
determining the proportion of variance in a variety of motor tasks that is attributable to these components. Studies such as those conducted by Cumbee (1954), Fleischman (1964), Rarick et al. (1976), Guilford (1958) and Cratty (1966) using factor analysis have shown that simple tasks are dominated by general factors. As the motor skills become more complex, they will contain specific factors as well as some general factors. Guilford (1958) postulated a matrix of psychomotor abilities based on an analysis of extant factor analysis studies and isolated such factors as speed, strength, impulsion, precision (static and dynamic), coordination and flexibility. Cratty (1966) postulated a three-factor theory of perceptual-motor behavior. According to Cratty level one is represented by general factors in human performance such as level of aspiration and task persistence. His second level consists of specific ability traits such as trunk strength, arm-leg speed, and flexibility. At the third level are factors specific to a given task such as practice conditions, and past experience. Cratty emphasizes that all three levels and their interaction affect skill performance. According to Cratty, general and specific factors operate in the learning of all tasks.

Fleischman (1964) made a comprehensive study of children over twelve and adults involving thousands of subjects performing up to 200 different motor tasks and concluded that there are twenty areas that constitute the motor skill domain. The psychomotor abilities include finger dexterity, manual dexterity, control precision, multilimb coordination, reaction time, arm-hand steadiness, wrist-finger speed, aiming, speed-of-arm movement, response orientation and rate control. The physical proficiencies that he identified included explosive strength, extend flexibility,
dynamic flexibility, gross body equilibrium balance, speed of limb movement, dynamic strength and static strength.

Cumbee (1954) tested two hundred college women and distinguished five factors of coordination which were balancing objects, body balance, two-handed agility, tempo and speed of arm and hand change of direction.

Rarick (1968) used a battery of 47 separate tests to investigate the structure of motor abilities in retarded and normal school children ages 9-14. His research showed clearly that there is a well-defined factor structure in children's motor abilities and that the factors do not change noticeably in the age range of 9 to 14 years and differ only slightly between the sexes. His five factors include explosive muscular force, static strength, general muscular coordination, body size and maturity. Rarick concluded that although the structure of motor abilities of retarded children may not be exactly the same as that for normal children, the differences are very slight.

Many studies have been done on various specific motor performances while others have attempted to develop an index based on performance in specific activities that would give an overall rating of general motor ability. In general, boys have been found to excel in those activities requiring strength and in gross movements, whereas girls tend to excel in the finer coordination activities (Yarmolenko, 1933).

With the steady increase in body size during childhood, it would be expected that there would also be an increase in motor performance. Espenshade (1960) reports that there is a steady increase in running speed during the period of early childhood. Cowan and Pratt (1934) tested 540 children ranging from three to twelve years in their ability
to hurdle jump and found continuous and gradual improvement over the entire age range with a slight indication of a sex difference in favor of girls below the age of seven and of boys above the age of seven. The researchers obtained no relationship between performance level at any age and height or weight. They did obtain a correlation of .77 between jumping performance and chronological age. According to Espenschade and Eckert (1980), performance in running and jumping has been found to improve with age and the degree of improvement being greater for boys than for girls. It is not surprising therefore, that jumping has been considered a predictor of body strength and also a diagnostic test of motor coordination (Carpenter, 1942).

According to Espenschade and Eckert (1980), throwing ability increases with age and boys are greatly superior to girls in the distance throw at all age levels, a sex difference that becomes greater as age increases. Wild (1938) stated that girls tend to have a less mature throwing pattern and that boys have a mechanical and strength advantage (from a larger forearm length and girth) in the propulsion of an object for distance. According to Yarmolenko (1933), boys have been found to be superior to girls in kicking a ball for distance and this superiority of the boys increased with advancing age as it did in the distance throw.

Studies of flexibility have usually been conducted in conjunction with other aspects of motor performance and few have been concerned with age differences in the school years. Hupprich and Sigerseth (1950) did a study where twelve measures of flexibility were taken on 300 girls from six to eighteen years of age. There was a general increase in flexibility until the girls approached twelve years of age where there was a
decline in flexibility. Their analysis of the results revealed low intercorrelations between the twelve measures of flexibility which indicated that a general flexibility factor did not exist and that each major joint appeared to have its own specific flexibility in this particular study.

Balance is a prerequisite for successful performance of many large muscle activities. Two distinct types of balance have been identified; namely, dynamic and static balance (Seashore, 1947; McCloy, 1946). According to McCloy (1946), the maintenance of a particular body position with a minimum of sway is referred to as static balance and dynamic balance is considered to be the maintenance of posture during the performance of a motor skill which tends to disturb the body's orientation. The distinct and separate nature of these two types of balance is revealed by a low correlation of .34 obtained by Bass (1939) between measures of static and dynamic balance. Walking board tests to measure dynamic balance were standardized by Seashore (1947) and he reported steady improvements in both sexes from five to eleven years old with a leveling off until age 18. According to Heath (1949), on the basis of railwalking tests given to over 700 children ranging from 6-14 years old, continuing improvement for both sexes is reported over the entire age range with a slight decrease in the rate of gain from 12-14 years old in females. A repeat of the Heath railwalking study was done by Goetzinger (1961) on children ages 8-16 years and he concluded that there is a continued improvement in performance in both sexes with increasing age but a slackening in the rate of growth in females from 12-14 years was found. Cron and Pronko (1957) used a 2x4 walking board
that was 12 feet long to measure dynamic balance of 322 boys and 179 girls from 3 to 13 years old. The scores for the task which consisted of three trials of a round trip on the board show females are slightly better than the males up until age eight but that performance for both sexes increases consistently with age until it levels off after age 12, particularly for females.

No sex differences are reported in studies of static balance. Sells (1951) timed subjects in grades 1-3 on a task of remaining on a balance stick, 1" by 1" by 12" when the subject's preferred foot was placed lengthwise on the long axis of the stick. Analysis of the data indicated a constant increase between six and eight years.

According to Espenschade and Eckert (1980), coordination is an essential element of motor performance and involves the ability to move easily and to control the sequence and timing of acts but is not easily measured objectively. A commonly used test of general motor ability and coordination is the Brace test (1937) with its graded series of 20 stunts. According to Espenschade (1947), the test is fairly objective and reliable and has been shown to measure abilities which are slightly, if at all, related to strength or height or weight. Espenschade (1947) concluded that both sexes perform equally well and consistently improve in total performance on the Brace test until age 11 after which there is an increasingly greater sex difference, with the girls leveling off while boys continued to improve at a relatively consistent rate until age 18. The researcher reported that the percentage of both sexes passing items measuring control and agility is equal between 10 and 13 years of age.
Body and mind are never independent (Ismail and Gruber, 1967). There are many theories (Frostig, 1970; Delacato, 1959; Olson, 1959; Kephart, 1964; Getman, 1962; and Barsch, 1967) that support the position that perceptual, motor, and cognitive processes are interrelated in some ways. Many of the aforementioned theorists maintain that movement is essential for the development of perceptual skills and that both of these abilities are essential for cognitive development. The belief that physical skills can contribute to intellectual functioning is probably based on the very early writings of eminent philosophers and educators such as Plato, Locke, Comenius, Rousseau and Pestalozzi as well as Montessori, Dewey and Piaget. All of these individuals believed that motor activity was either the basis of the intellect or that motor activity contributed to the development of the intellect. When psychologists first began to measure cognitive abilities, the tests contained items that had strong motor components. Cattell (1890) included items such as rate of movement, dynamometer pressure, reaction time to sound and various tasks involving tactual sensitivity in his first test of intelligence.

There are several theories that attempt to show connections between perceptual, motor and cognitive processes. Olson (1959) proposed a concept of an organismic age. The organismic age consists of seven ages including physical characteristics such as height, weight, grip strength and mental, dental, reading and carpal factors. He believes in the concept of the "whole child" and that achievement in school is a function of the child's total growth and therefore there is a strong relationship
between physical measures and academic achievement. Klausmeier (1958) did a series of experiments which cast doubt on the organismic age concept. He generally found little relationship between physical development and achievement at school. However, Singer (1968) said that the problem was one of trying to relate purely physical characteristics like height, weight and strength to intellectual success. This investigator thought that motor coordination items were more highly related to academic achievement. Ismail et al. (1963) succeeded in utilizing coordination tasks and balance tasks as predictors of intellectual achievement.

He stated that the nature of these tasks requires greater perceptual and cognitive involvement than is needed for simple tasks like exhibiting hand-grip strength. He stated that high neural centers influence intellectual attainment as well as complex motor-skill success.

Some educators have strong convictions regarding the relationship between cognitive, perceptual and motor abilities and have proposed perceptual-motor theories that attempt to show causal connections between these three processes. They say that movement is essential for the development of perceptual skills and that both of these skills are essential for cognitive development. A controversial theory is that proposed by Delacato (1959). He believes that many perceptual motor and cognitive disabilities stem from inadequate neurological organization. The central concept of his theory assumes that as the human grows, there is successive development of the brain and spinal cord. He believes that many motor and cognitive disabilities can be remediated through "patterning." The theorist stresses the need to restructure the organization of the developing nervous system so that the child can reach
full development. Although positive case studies have been reported, no experimental studies support the theory.

Kephart (1964) advanced a theory that involves educating the peripheral functions rather than the central nervous functions. Kephart believes that inadequate development of certain motor skills may inhibit the child's development in later, more sophisticated skills. Kephart states that today's complex society no longer offers a child the opportunity to explore his environment and thus the child may develop improper perceptual motor match. Kephart believes that if children do not learn to match sensory data to motor data then difficulties in reading, writing and movement activities may result. Kephart's theory has received widespread support among special educators, psychologists and physical educators even though some research results on the effectiveness of this program are contradictory (Rarick, 1968).

Barsch (1967) has supported Kephart's hypothesis by stating that perceptual processes (visual, auditory, tactual, kinesthetic, gustatory and olfactory) are antecedents to intellectual development. He believes the quality of perceptions is derived from the maturation of skills of movement efficiency. Barsch developed a Movigenic theory. This theory related to learning efficient movement patterns. He states that movement efficiency is a prime requisite to the total architecture of the human organism and that the organism matures as it moves. He stresses that the increased use of symbols begins to replace motoric ways of learning although symbolic fluency is initially dependent on the efficiency of movement patterns.

Frostig (1970) developed training programs that specifically
emphasized visual perception as it relates to motor ability. It is her belief that it is important to develop several basic visual skills, specifically; visual and motor coordination, figure-ground perception, perceptual constancy, perception of positions in space, and perception of spatial relationships. The motor aspects that Frostig emphasizes are agility, eye-hand coordination, flexibility, strength, balance and endurance. Getman (1962), an optometrist, advanced the theory that a child's growth, intellectual development and behavior are related to movement experiences and visual development. Getman contends that the majority of learning experiences depend on visual perceptions. His perceptual-motor program is organized around six stages: 1) general motor patterns (creeping, walking, hopping), 2) special movement patterns (eye-hand coordination), 3) eye movement patterns (matched movement for both eyes), 4) visual language patterns (effective communication patterns), 5) visualization patterns (visual memory skills), 6) visual perception organization.

Researchers doing correlational studies of intellect and movement have indicated that there is a motor base to intellect and have concluded that participation in physical training programs will improve perceptual and motor skills as well as other abilities, especially academic performance (Ismail and Gruber, 1967). However, Cratty (1972) stated that the evidence did not support the hypothesis that motor ability change is accomplished by changes in other traits. He did state that if movement activities were started early enough and contained in a highly individualized program that appropriate movement activities offer possibilities in the remediation of developmental lag.
Motor Skills of Children with Special Needs

The range and variability of motor skill deficiencies found among young handicapped children are great. Within each subgroup, extremes in range and variability are evident. Studies of retarded children's motor development indicate that they are inferior in motor proficiency when compared to their normal peers (Kirk, 1972). Malpass (1963) concluded that as a group, the mentally retarded demonstrated less motor competence in tasks requiring precise movements and reactions as well as those requiring complex skills and motor coordination. Blake (1976) agreed with these conclusions. Singer (1972) indicated that the mentally retarded have difficulty learning manual skills and that generally their motor attributes are both quantitatively and qualitatively different from the same trait patterns in normal children.

The research in this area leads to some important conclusions about motor skills development and proficiency of the mentally retarded. First, there is a definite relationship between the age and performance. Just as in normal children, as retarded children grow older, they become more proficient in motor skills (Herr, 1978). Second, the sequence of motor skill development is the same as for other children, but discrepancies in the rates of growth (usually slower than for normal children) have been noted as early as infancy (Share and French, 1974). These discrepancies and differences tend to increase with age (Malpass, 1963). Finally, a definite relationship exists between the severity of motor skill deficiencies and the severity of mental retardation (Malpass, 1963).

According to Rarick (1968), studies with retarded children have
resulted in positive but low correlations between motor tests and measurements of intelligence in school age children and in general, as IQ is lower, the performance on motor tests also decreases. Francis and Rarick (1959) found that among 84 correlations between motor tests and intelligence for both sexes, 81 were positive for boys and 56 were positive for girls. The data from a more recent national survey (Rarick et al., 1970) of 4200 mentally retarded boys and girls gave similar results. Out of 154 correlations between motor performance and IQ, 152 were positive but many of those fell in the .20 and .30 range. Other investigators have reported somewhat higher correlations. Heath (1953) found correlations of .66 between rail-walking performance and mental age of retarded children. Malpass (1960) reported correlations of .44 between the Lincoln-Oseretsky Motor Test and The WISC for educable retarded boys and girls. Distefano et al. (1958) using institutionalized males and females found correlations of .04 to .58 between the Lincoln-Oseretsky Test and the Vineland railwalking tests with intellectual measures.

Ismail, Kephart and Cowell (1963) studied the relationship between motor aptitude, I.Q. and academic achievement of 60 boys and 60 girls between 10 and 12 years of age. They concluded that there is no sex difference in pattern of the factor structure pertaining to motor aptitude, I.Q. or academic achievement. However, they concluded that Otis I.Q. scores can be predicted more accurately than Stanford Academic Achievement scores utilizing motor aptitude test items. In conclusion, they stressed the need for classifying children into identifiable subgroups in terms of level of achievement as well as sex as it tends to
increase the power of prediction and efficiency of estimating the intellectual component, since Otis I.Q. scores and the Stanford Academic Achievement scores can be predicted more accurately by motor aptitude test items in high and low achievers than in medium achievers.

Francis and Rarick (1959) conducted a study to: determine age and sex trends in gross motor abilities in mentally retarded children; compare those traits with normal children; and, finally, to determine the extent that the degree of mental retardation is related to motor achievement levels. The subjects were 284 retarded children in public schools between seven and fourteen years old. The IQs ranged from 50 to 90. The findings were that the trend for strength followed the same pattern as normal children although at a lower level at every age, that the means of retarded children were two to four years behind the norms for normal children, that the difference increased with age, and finally, that intelligence was positively correlated with most of the motor performance tests.

Thurstone (1959) did a study with 559 children from 7 to 15 years old. The IQs of these retarded children ranged from 50-79. She compared scores of retarded children and normal children on such items as grip strength, standing broad jump, 40-yard run, and tennis ball throw. The scores of the normal children were consistently and significantly better on almost every test at all age levels \( (p \leq .01) \).

Howe (1959) compared normal and retarded children equated on age, sex and background on measures of grip strength, balance, throwing and jumping. The normal children were superior to the mentally deficient on all tests \( (p \leq .05) \). This information coincides with Ismail and Gruber
(1967) where they concluded that motor coordination and balance tests were highly related to the intellectual achievement in normal children.

It might be concluded then that motor proficiency is directly related to intellectual ability when groups of intellectually subnormal and normal children are compared. But, according to Asmussen and Haeboll-Nielsen (1956) children who are within the normal intelligence limits are not distinguished on motor skill measures. They studied 204 boys that were split into three groups, two within normal IQ limits and one below normal. The children were tested on jumping, strength of leg and finger dexterity. The tests did not distinguish performances within the normal range but did distinguish the low IQ group from the other two. These investigators concluded that there is no difference in performance if the IQ is above 95. Below this level, they concluded that motor performance is lower than in normal children.

There are several instruments that are useful in assessing motor performance among young children. One such device is the Bruininks-Oseretsky Test of Motor Proficiency which is based on an adaptation of the Oseretsky Tests of Motor Proficiency and on a survey of research studies. The Bruininks-Oseretsky Test measures six of Guilford's (1958) seven psychomotor abilities, four of Cratty's (1966) six perceptual-motor traits, seven of eleven psychomotor abilities and five of the nine physical fitness factors indicated by Fleishman (1964), ten of the areas identified by Harrow (1972) and six of eight motor proficiency factors identified by Rarick and Dobbins (1972). The test measures running speed, balance, bilateral coordination, strength, upper limb speed and dexterity through such items as running, jumping, balancing on a balance
beam, throwing and catching a tennis ball, sorting cards and writing tasks.

Since the results from a number of studies (Bruininks, 1974; Cratty, 1970; Wedell, 1973) indicate that mentally retarded and learning disabled subjects score lower than nonhandicapped subjects on various motor tasks (with the greatest discrepancy between severely retarded and normal subjects) the researcher (Bruininks, 1978) did testing to see if this hypothesis was also true when the Bruininks-Oseretsky Test was used. To test this hypothesis that mentally retarded subjects and learning disabled subjects would score lower on the Bruininks-Oseretsky Test than normal subjects of the same sex and age and community, three studies were conducted.

In the first study (Bruininks, 1978), 72 five to fourteen year old mildly retarded children with IQs ranging from 61-75 that were enrolled in special classes or schools were contrasted with 72 normal subjects. The t-tests for differences between the mean scores on all the subtests, the three composite scores and the Short Form were all statistically significant at or beyond the .05 level.

In a second study (Bruininks, 1978), 19 moderately-to-severely retarded children ages 6 to 13 with IQs ranging from 29 to 50 were compared with normal children. The t-tests for differences between the means scores on all the subtests, the three composite scores and the Short Form were all statistically significant at or beyond the .05 level.

Lastly, Bruininks (1978) compared normal children with 55 learning disabled subjects enrolled in special schools or special education classes. These children were between 5 and 12 years of age and were
approximately two years below grade level in reading and mathematics. The t-tests for differences between the mean scores for seven of the eight subtests, the three composites and the Short Form were statistically significant at or beyond the .01 level. On Subtest 6 which tests response speed, there was no significant difference between the mean scores for these subjects. All of these results confirm the hypothesis that the Bruininks-Oseretsky Test differentiates between normal and handicapped subjects in a manner consistent with other comparative studies on motor performance and is useful as a test to measure motor performance for retarded, learning disabled and normal subjects. It can be concluded that normal subjects perform significantly better than handicapped subjects (when matched for age) on all parts of the Bruininks-Oseretsky Test (Bruininks, 1978).

**Motor Skills of Gifted Children**

Research on physical motor skills of gifted children is certainly not plentiful. In fact, a rather narrow concept of giftedness is prevalent considering intellectual superiority as the only characteristic. However, the definition contained in the educational amendments of 1978, P.L. 95-561, Section 902 indicates a greater range of abilities

"For the purposes of this part, the term gifted and talented children means children and whenever applicable, youth who are identified at the preschool, elementary or secondary level as possessing demonstrated or potential abilities that give evidence of high performance capability in areas such as intellectual, creative, specific academic or leadership ability or in the performing and visual arts and who by reason thereof require services or activities not ordinarily provided by the school."
Acceptance of various facets of giftedness has caused a wide range of methods for identifying the gifted. According to Zettel (1979), after doing a nationwide survey to compile information on various state definitions of giftedness and identification techniques, he found that psychomotor abilities were included in the definition in only 23 states and he identified only two states that were actually providing programs at the time of the survey. In Idaho, manual dexterity tests and motor tests were recommended but most states looked for gross or fine motor abilities in mechanical, artistic or medical areas rather than athletics (Zettel, 1979).

Gifted children have long been stereotyped as socially inept, physically inferior, weak, unattractive, emotionally unstable and maladjusted. Yet descriptive studies (Terman, 1925, French, 1964; Gallagher, 1976) of gifted children contradict these stereotypes and tend to describe gifted children as being better adjusted, more attractive, taller, heavier, stronger, and healthier than average.

Terman (1925) was one of the earliest researchers dealing with the gifted. From his extensive studies on 1,528 gifted individuals, he stated that in physique and general health, the high-IQ children surpassed the best standards for American children. At birth, they averaged 3/4 pound heavier than average and height and strength were also superior. He said that the gifted children learned to walk a month earlier and talk 3 1/2 months earlier than average children. He stressed that medical examinations revealed that the incidence of sensory defects, dental caries, poor posture and malnutrition was far below that of medical surveys of school populations in the United States. Finally, this
researcher claimed that this physical superiority was maintained throughout life and at the age of 44, the gifted individuals mortality rate was 4/5 that of the general population.

French (1964) from examining literature on gifted children concluded that the gifted exhibited superior physique as demonstrated by above-average, weight, height, coordination, endurance and general health. Gallagher (1976) included in his list of characteristics of gifted children that gifted children tend to be equal to or slightly better than average age mates in physical stature and health. Buhler and Guir1 (1960) stated that gifted children often exhibit expressive fine arts talent, early physical competence and well-developed mechanical skills. Roeper (1977) mentioned in her list of characteristics of the gifted child that they will walk and talk earlier than the average child. Finally, Kincaid (1969) studied highly gifted children and concluded that four of ten children walked before their first birthday (11.7 months for females and 11.8 months for boys) and included early walking as a characteristic that would be useful for identifying gifted children.

Seagoe (1974) concluded that gifted children receive an unusual quantity of information from the environment as a result of heightened sensory awareness. She also mentions that there may be a discrepancy between physical and intellectual development and that the gifted child has a low tolerance for the lag between their expectations and standards and their actual athletic skills. She felt that this may result in the neglect of physical well-being and the avoidance of physical activity which could be detrimental to full mental and physical health and inhibit the individual's development to the full potential. She suggested that
schools may also be unintentionally encouraging the student to avoid physical activity. She concluded that if physical development of the gifted child is to be encouraged, programs need to provide experiences which develop integration between body and mind in these children with nonnormative development patterns.

Confessore and Confessore (1981) compared the attitudes of physical activity of high school students identified as talented in the visual and performing arts and those not identified as talented. They found that girls who are talented in art, music, dance, theatre or writing had essentially the same attitudes toward physical activity as the normal girls, so they were less likely to be seen as maladjusted in their choice of leisure activities. The boys however, had significantly different attitudes toward physical activity so the talented boys were often viewed as maladjusted and even effeminate in their choice of leisure activities. The researchers concluded that with the high rates of suicide and emotional disturbance among talented boys, the finding that these boys express low preference for physical activities is a critical issue for further study.

Believing that gifted children are not physically superior, Laycock and Caylor (1964) studied the physiques of gifted children and compared them to their less gifted siblings. They assessed five body measurements including height, weight, biacromial diameter, bi-iliac diameter and leg circumference. They concluded that gifted children were not bigger than normal children from the same homes. They stated that superior home care and high economic and social conditions in the gifted child's environment were the cause of physical superiority and not simply the degree of
intellectual superiority.

Along the same lines, Swassing (1980) stated that physically, gifted youngsters do not differ substantially from other children their age. He stated that any gifted child may be taller or shorter than his age-mates, and may weigh more, the same as or less than his peers. He concluded that "on a class picnic, the gifted child would not be easily identifiable."

According to Singer (1968) although it seems reasonable to expect that intellectually gifted will do exceptionally well on motor skill performance since the retarded are below normal, this is not the case. He says, that general findings indicate that a greater intellect and outstanding academic achievement are not related to physical performance.

As for actual research studies done comparing gifted and normal children's motor abilities, there is a consistent lack. In order to expand and further explore this area, the present investigator will assess the motor skills of these two groups of children in a comprehensive manner, using a variety of techniques along with a recent, nationally-normed motor proficiency assessment device. Thus, the current question for study is, "Are gifted children physically superior or motorically advanced when compared with normal children of the same age?"
The purpose of this research is to focus on the physical motor skills of gifted children and compare them with normal children. Specifically, a short form of an existing test of motor skills will be used along with measuring the height, weight, grip strength, eye dominance, hand dominance and foot dominance. Handwriting samples are another dependent variable under consideration. Sex, and gifted or normal groupings serve as independent variables.

Subjects

The 50 subjects were enrolled in the Ankeny School District and the Des Moines Public Schools during the 1983-1984 academic year. The research was carried out during the months of January to March, 1984. Children involved in the current study ranged in age from 84 to 96 months. Twenty-five of the children were in already existing programs for gifted and talented students and had been placed there by falling in the top 5% of the tested children in their school district on Stanford-Binet IQ scores. Of these, five boys and four girls were from the Ankeny district and eight boys and eight girls were from the Des Moines school district. The other 25 children were from the Des Moines school district and were in regular classroom settings at a 2nd grade level in elementary schools. Of the gifted children, three were black females, three were black males, nine were white females and 10 were white males. The normal children sampled consisted of seven black females, five black males, seven white males and six white females.
Human Subjects Approval was received from Iowa State University Human Subjects Review Committee on Jan. 21, 1984. A copy may found in Appendix D. Before starting the study, letters were sent to parents of all children in the two 2nd grade classrooms that had been chosen by the school principal to participate, which explained the general purpose of the investigation. The parents were requested to return a signed permission slip before the data collection was initiated. Permission slips resulted from 90% of the letters that were sent out. A copy of this letter may be found in Appendix A.

Procedure

Personal contact was made with the Vice President for Instruction of Des Moines Public Schools. Objectives and procedures for the proposed research were distributed and discussed and permission was secured to undertake the project. The researcher was given names of two elementary schools that would participate and was instructed to make arrangements for data collection through the two building principals. In the Ankeny school district, permission was obtained and arrangements for data collection were made through the coordinator of the AGATE (Ankeny Gifted and Talented Education) program. The principal of Jefferson Elementary School in Des Moines, Iowa chose two 2nd grade classrooms in his school that would be used to draw from the "normal" sample in this research project.

Twenty-five subjects (age seven) were randomly selected from the children whose parents had returned permission slips in the two 2nd grade classrooms participating in the study. The gifted children were randomly
selected from lists of gifted children that were seven years old from the three different participating schools. Keeping the age level the same for both groups allowed for accurate comparisons to be made.

Each child was removed from his classroom individually for the 15-20 minute testing period. The subjects were taken to the gymnasium in each of the schools by the researcher. The gym was set up with the various items from the Bruininks-Oseretsky Test (1978) at different stations in the gym and the materials for the handwriting and laterality measures were at two school desks along the wall of the gymnasium. After the child entered the gymnasium, the researcher recorded on the test form the initials of the child as well as symbols signifying the sex, race and gifted or normal grouping of the child.

Assessments

An assistant, who was trained in physical education and was "blind" to the purposes of the study, was employed by the researcher to assist with recording various measurements and data. The following assessments were done on each subject by the researcher and the assistant: 1) The Short Form of the Bruininks-Oseretsky Test of Motor Proficiency (1978) was administered exactly according to directions for each item in the Examiner's Manual for the test (A copy of the Individual Record Form which is the score sheet from the instrument can be found in Appendix B); 2) Grip strength was measured using a hand dynamometer; 3) Weight was measured by an electronic digital display scale and was recorded to the nearest pound; 4) To insure accuracy, height was measured twice using a standard L-square and recorded to the nearest centimeter; 5) Handwriting
samples were received from each subject by having them copy a sentence onto regulation primary grade handwriting paper with a "chunky" #2 lead pencil, the type used in elementary classrooms for beginning handwriting; and 6) Three different aspects of laterality were assessed. For assessing laterality, eye dominance was determined by having the child look into a kaleidoscope, and the observer noted which eye was used. Hand dominance was rated by noting which hand the child used for the writing and drawing tasks. Foot dominance was assessed by having the child kick a "Nerfball" with the preferred foot while the observer noted which foot was used most in three trials.

After a child completed all of the tasks, he/she was returned to the classroom by the researcher and another child was brought to the gymnasium. All data were collected on five successive Fridays in January and February of 1984 from 9:00 a.m. to 3:00 p.m. After the data collection was completed, a thank-you letter was sent to all parents who had returned signed permission slips. A copy of this letter may be found in Appendix C.

The Bruininks-Oseretsky Test of Motor Proficiency. The Bruininks-Oseretsky Test is an individually administered test that measures the motor functioning of children from four to 14 years of age. The complete Battery—eight subtests comprised of 46 separate items—provides a comprehensive index of motor proficiency as well as separate measures of both gross and fine motor skills. The Short Form consisting of 14 items from the Complete Battery provides an abbreviated measure of general motor proficiency.

Dr. Robert H. Bruininks began the development of the Bruininks—
Oseretsky Test in 1972. He based his test in part on the U.S. adaptation of the Oseretsky Tests of Motor Proficiency (Doll, 1946). Although there is some similarity between these two tests, the revised test contains changes in content, structure and technical qualities.

The Bruininks-Oseretsky Test was developed to provide teachers, clinicians and researchers with useful information to assist in assessing the motor skills of individuals, in developing and evaluating motor training programs and in assessing motor dysfunctions and developmental handicaps in children (Bruininks, 1978). The test equipment is designed to be appealing to children and to facilitate administration and scoring as well as providing uniform testing conditions. The Short Form requires 15-20 minutes to administer. Examiners do not need special training but must be thoroughly familiar with the directions for administering the test and should practice giving it in simulated situations before actual administration. This researcher administered the test to a number of different first graders before actually administering the test for data collection purposes.

According to Bruininks (1978) test reliability refers to both the precision of the test as a measuring instrument and the consistency with which the test measures a particular ability. He stresses the need to recognize that all test scores contain some degree of error. He states that only test-retest reliability was obtained for the Bruininks-Oseretsky Test since many of the test items depend on speed of responding, making the coefficient-Alpha and split-half procedures inappropriate (Bruininks, 1978). The test-retest reliability coefficient as reported by Bruininks for subjects in Grade 2 are as follows: gross
motor composite = .77; fine motor composite = .88 and the Short Form total score = .87. The reliability coefficient split by sex in Grade 2 are as follows: gross motor composite for boys = .90; fine motor composite for boys = .88; Short Form total for boys = .91; gross motor composite for girls = .65; fine motor composite for girls = .84; Short Form total for girls = .81. The test-retest reliability coefficients were achieved through a special study done with a sample of 63 second graders and 63 sixth graders who took the Bruininks-Oseretsky Test twice within a 7-12 day period. Subjects participating in the study were from two suburban schools and one parochial school near Minneapolis, Minnesota.

Each of the eight subtests in the Bruininks-Oseretsky Test is designed to assess a separate aspect of motor development. Four of the subtests measure gross motor skills (1-4), three measure fine motor skills (6-8) and one measures both gross and fine motor skills (5). According to Bruininks (1978) the differentiated measurement of gross and fine motor skills makes it possible to obtain meaningful comparisons of performance in the two areas. The following scores are available from the Short Form of the Bruininks-Oseretsky Test of Motor Proficiency:

- Subtest 1 - Running Speed and Agility (one item). This subtest measures running speed during a shuttle run.

- Subtest 2 - Balance (two items). One item assesses static balance by requiring the subject to maintain balance while standing on one leg. One item assesses dynamic balance by requiring the subject to maintain balance while executing walking movements on the balance beam.
• Subtest 3 - Bilateral Coordination (two items). These items assess sequential and simultaneous coordination of upper limbs with the lower limbs.

• Subtest 4 - Strength (one item). This subtest assesses arm and shoulder strength, abdominal strength and leg strength by the broad jump.

• Subtest 5 - Upper-limb coordination (two items). These items assess the coordination of visual tracking with movements of the arms and hands as well as precise movements of arms, hands and fingers.

• Subtest 6 - Response Speed (one item). This subject measures the ability to respond quickly to a moving visual stimulus by having the child stop a falling stick.

• Subtest 7 - Visual Motor Control (three items). These items measure the ability to coordinate precise hand and visual movements.

• Subtest 8 - Upper Limb Speed and Dexterity (two items). This subtest measures hand and finger dexterity as well as hand and arm speed.

• Gross Motor Composite - This score summarizes performance on Subtests 1-4, and is an index of the ability to use the large muscles effectively.

• Fine Motor Composite - This score summarizes the performance on Subtests 6-8 and it is an index of the ability to use the small muscles of the lower arm and hand effectively.

• Battery Total - This score summarizes performance on all eight subtests and is an index of general motor proficiency.

Handwriting Samples. Subjects each provided a sample of their handwriting after being asked to copy a sentence from a piece of paper. While the child was writing, the researcher noted which hand the child
was using for this task in order to assess hand preference. According to Burns (1974), there are only a few diagnostic scales for handwriting which can be used to detect specific faults in handwriting. The researcher decided on the Zaner-Bloser chart on Handwriting Faults and How to Correct Them (Freeman, 1958) in order to compare specifically and objectively the handwriting abilities of gifted children with normal children. The researcher was trained by an elementary school teacher who specialized in handwriting instruction, regarding the correct usage of the Zaner-Bloser chart and scoring techniques.

Subjects were asked to write the sentence "The quick brown fox jumped over the lazy dog" which is suggested on the Zaner-Bloser chart. The researcher judged the sample according to twelve predetermined points for analysis according to the Zaner-Bloser chart, regarding spacing of letters, shape of the letters, height of the letters, slant of the letters and spacing between the words. A numerical score from one point to 12 points was assigned to each subject's sample. To insure accuracy, an elementary school teacher, trained in handwriting instruction was asked to rate the handwriting samples on the same 12-point scale. The teacher was not the instructor for any subject in the sample and was totally "blind" to the group status (gifted or normal) of the children as well as to the purpose of the study. To determine the level of the two judge's agreement, correlations were computed. The correlation coefficient between the two independent judges showed an inter-rater reliability of .88.

Grip Strength. The muscular strength of children has traditionally been assessed by measurements of static strength that employ either
spring dynamometers or cable tensiometers. In the present study, a spring dynamometer was used. The use of the dynamometers was demonstrated for the child by the researcher. The dynamometer was then placed on the table in front of the child so the subject could use their preferred hand for the assessment. No subject varied in the use of his/her preferred hand during the three trials. Three measurements of grip strength were obtained on each child and then an average of the three was computed. Grip strength has been shown to be a highly reproducible measurement and one that reflects an important functional dimension of growing children which undergoes dramatic changes with advancing age (Rarick, 1973). Studies of the development of static strength in elementary school children have employed grip strength as recorded by a hand dynamometer because of its ease of administration. It is then inferred that such a measure is indicative of general body strength because grip strength has been found to be highly correlated with other static strength measures (Jones, 1949).

Laterality Measures. The development of preferred handedness has been of concern to numerous investigators as a possible factor in the development of speech and hearing problems. Delacato (1966) stated that 60-80% of superior readers are completely one-sided. He states that lack of complete and constant laterality results in reading and language problems. However, Capobianco (1967) found no difference in the reading ability between established and non-established laterality groups. He administered five tests of handedness and four tests of eyedness to subjects with special learning disabilities and correlated these test scores with reading ability measures and his results indicated that
lateral dominance did not facilitate reading achievement; in fact, in certain cases incomplete dominance resulted in better reading performance. Studies by Belmont and Birch (1965) and by Smith (1950) indicate that the incidence of cross-dominance is as prevalent in populations of normal children as in groups of children with learning difficulties. An investigation by Stephens, Cunningham and Stigler (1968) found no relationship between cross-dominance and reading readiness in kindergarten children. In the current study, eyedness was determined by noting which eye the child used to look through a kaleidoscope. Handedness was determined in this study by noting which hand the subject used for writing, drawing and throwing tasks. Footedness was assessed by having the subject kick a "Nerfball" from a mid-line starting point three times and noting which foot the subject kicked with most frequently.

**Statistical Treatment**

After completion of the testing, the researcher organized the data for statistical treatments. Each subject was given a score on each of the 14 items on the Short Form of the Bruininks-Oseretsky Test. Eight subtest scores were also computed from the individual items. A gross motor composite score was arrived at by totaling the scores from Subtests 1-4. A fine motor composite score was arrived at by totaling the scores from subtests 6-8. An overall battery score also was obtained. The subject's weight was recorded to the nearest pound, height was recorded to the nearest centimeter and age data was recorded to the nearest month. Body size index was calculated by using the formula height/weight. Grip strength was computed by averaging the scores from three trials on each
subject. Handwriting ratings from both judges were recorded. Finally, laterality of eye, hand, and foot was recorded with the foot laterality rating being assessed after observing the subject on three trials.

The data were analyzed using three specific procedures.

1. Means and standard deviations were computed for all variables.

2. Pearson product-moment correlation matrices were formed to determine if giftedness or sex was related to the various scores.

3. Analysis of variance (ANOVA) was performed for all variables to determine any interactions that were present.

Significance levels were set at or beyond the .05 level of probability.
RESULTS

Of major concern in the present study is whether motor skill proficiency varies depending on a child's classification in either the gifted or normal segment of children in his/her school. The following null hypotheses were proposed for the study:

1. There is no significant difference between motor skill performance as measured by the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP), grip strength, height, weight, handwriting or laterality measures of the sampled group of gifted compared to normal subjects.

2. There is no significant difference between motor skill performance as measured by the BOTMP, grip strength, height, weight, handwriting or laterality measures of the sampled group of boys compared to girls.

3. There are no significant relationships between any variables including group and sex.

Children's classification as either gifted or normal and their sex are considered as the independent variables. Fourteen individual motor test items, eight subtest scores, two composite scores and one total score from the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) along with height, weight, body size index, handwriting ratings, grip strength and laterality measures comprise the 35 dependent variables.

To determine whether significant differences exist between the sampled gifted and normal groups or boys and girls, means and standard deviations were calculated on these two groups for all variables. Analysis of variance (ANOVA) was also carried out on all variables. Inspection of variances under consideration indicated several significant differences in variance. Homogeneity of variance was tested for each variable using the F ratio \(F = \frac{S_1^2}{S_2^2}\).


**Differences between Gifted and Normal Groups**

Means, standard deviations and F-values by group on BOTMP items are presented in Table 1. Significant differences between groups, favoring the gifted children, were found for item 1 (shuttle run: $F = 7.78$, $p \leq .01$), item 3 (walking balance beam: $F = 6.00$, $p \leq .01$), item 5 (jumping and clapping hands: $F = 4.55$, $p \leq .05$), item 9 (response speed: $F = 10.93$, $p \leq .01$), and item 13 (sorting shape cards with preferred hand: $F = 4.96$, $p \leq .05$).

Table 2 presents means, standard deviations and F-value by group on BOTMP subtotal and total. All subtest scores are higher for the gifted children and several are significantly higher. The latter include Subtest 1, Running Speed and Agility ($F = 7.78$, $p \leq .01$); Subtest 2, Balance ($F = 3.86$, $p \leq .05$); Subtest 3, Bilateral Coordination ($F = 7.07$, $p \leq .01$) and Subtest 6, Response Speed ($F = 10.93$, $p \leq .01$). In addition, gifted children scored significantly higher on the Gross Motor Composite ($F = 11.22$, $p \leq .01$), the Fine Motor composite ($F = 9.23$, $p \leq .01$), and the BOTMP Total Score ($F = 10.00$, $p \leq .01$).

Group differences on grip strength, laterality, handwriting and anthropometrics are presented in Table 3. Although more children in the gifted group chose to use their left hand than did the children in the normal group ($F = 6.55$, $p \leq .01$), the gifted children received significantly better handwriting ratings from judge one ($F = 5.80$, $p \leq .05$) and judge two ($F = 12.47$, $p \leq .01$). Differences between the groups on grip strength, height, weight, body size index, eye laterality and foot laterality were not significant.

On the bases of these data, the first null hypothesis regarding
Table 1
Means, Standard Deviations and F-values by Group on BOTMP Items

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<th>Item</th>
<th>Gifted Mean</th>
<th>Gifted Stan. Dev.</th>
<th>Normal Mean</th>
<th>Normal Stan. Dev.</th>
<th>F value</th>
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<td>7.44</td>
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<td>7.78**</td>
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<td>1.20</td>
<td>2.16</td>
<td>1.06</td>
<td>6.00**</td>
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<td>5.64</td>
<td>1.72</td>
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</tr>
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<td>3.64</td>
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<td>0.35</td>
</tr>
<tr>
<td>11</td>
<td>1.68</td>
<td>0.47</td>
<td>1.44</td>
<td>0.50</td>
<td>2.91</td>
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<tr>
<td>12</td>
<td>1.44</td>
<td>0.58</td>
<td>1.32</td>
<td>0.69</td>
<td>0.38</td>
</tr>
<tr>
<td>13</td>
<td>4.80</td>
<td>1.08</td>
<td>4.12</td>
<td>1.12</td>
<td>4.96*</td>
</tr>
<tr>
<td>14</td>
<td>4.76</td>
<td>1.53</td>
<td>4.76</td>
<td>1.26</td>
<td>0.01</td>
</tr>
</tbody>
</table>

aHigher numerical score indicates better performance.

*p<.05.

**p<.01.
Table 2
Means, Standard Deviations and F-values by Group on BOTMP Subtotals and Totals

<table>
<thead>
<tr>
<th></th>
<th>Gifted</th>
<th>Normal</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean(^a)</td>
<td>Stan. Dev.</td>
<td>Mean(^a)</td>
</tr>
<tr>
<td>RSA (Running Speed &amp; Agility)</td>
<td>8.84</td>
<td>1.90</td>
<td>7.44</td>
</tr>
<tr>
<td>B (Balance)</td>
<td>8.08</td>
<td>2.46</td>
<td>6.68</td>
</tr>
<tr>
<td>BC (Bilateral Coordination)</td>
<td>3.68</td>
<td>0.74</td>
<td>3.12</td>
</tr>
<tr>
<td>S (Strength)</td>
<td>11.28</td>
<td>1.59</td>
<td>10.44</td>
</tr>
<tr>
<td>ULC (Upper Limb Coordination)</td>
<td>4.32</td>
<td>1.37</td>
<td>4.88</td>
</tr>
<tr>
<td>RS (Response Speed)</td>
<td>7.28</td>
<td>1.69</td>
<td>5.64</td>
</tr>
<tr>
<td>VMC (Visual Motor Control)</td>
<td>6.84</td>
<td>1.28</td>
<td>6.40</td>
</tr>
<tr>
<td>ULSD (Upper Limb Speed &amp; Dexterity)</td>
<td>9.56</td>
<td>2.18</td>
<td>8.88</td>
</tr>
<tr>
<td>FMC (Fine Motor Composite)</td>
<td>23.68</td>
<td>3.36</td>
<td>20.92</td>
</tr>
<tr>
<td>GMC (Gross Motor Composite)</td>
<td>31.88</td>
<td>4.51</td>
<td>27.68</td>
</tr>
<tr>
<td>Total</td>
<td>59.88</td>
<td>7.48</td>
<td>53.48</td>
</tr>
</tbody>
</table>

\(^a\)Higher numerical score indicates better performance.

*\(p<.05\).

**\(p<.01\).
<table>
<thead>
<tr>
<th>Variable</th>
<th>Gifted Mean</th>
<th>Stan. Dev.</th>
<th>Normal Mean</th>
<th>Stan. Dev.</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grip Strength</td>
<td>14.08</td>
<td>4.10</td>
<td>13.56</td>
<td>3.96</td>
<td>0.13</td>
</tr>
<tr>
<td>Height</td>
<td>12.90</td>
<td>7.64</td>
<td>129.04</td>
<td>5.11</td>
<td>0.02</td>
</tr>
<tr>
<td>Weight</td>
<td>56.92</td>
<td>8.48</td>
<td>59.12</td>
<td>11.14</td>
<td>0.69</td>
</tr>
<tr>
<td>Body Size Index (Height/Weight)</td>
<td>2.30</td>
<td>0.24</td>
<td>2.23</td>
<td>0.32</td>
<td>0.57</td>
</tr>
<tr>
<td>Handwriting (Judge 1)</td>
<td>9.84</td>
<td>1.31</td>
<td>8.80</td>
<td>1.95</td>
<td>5.80*</td>
</tr>
<tr>
<td>Handwriting (Judge 2)</td>
<td>10.24</td>
<td>1.12</td>
<td>8.76</td>
<td>1.94</td>
<td>12.47**</td>
</tr>
<tr>
<td>Laterality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye</td>
<td>1.60</td>
<td>0.50</td>
<td>1.60</td>
<td>0.50</td>
<td>0.00</td>
</tr>
<tr>
<td>Foot</td>
<td>2.00</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Hand</td>
<td>1.76</td>
<td>0.43</td>
<td>1.96</td>
<td>0.20</td>
<td>6.55**</td>
</tr>
</tbody>
</table>

*aHigher numerical score indicates better performance.

*p<.05.

**p<.01.
motor skill performance by group (gifted and normal children) can be rejected. With consideration for the exceptions noted it can be said for the sampled children that the gifted children performed significantly better than did the normal children.

**Differences between Boys and Girls**

Means, standard deviations and F-values by sex on BOTMP items are presented in Table 4. No significant sex differences in performance are apparent. Similarly, comparisons of boys' and girls' performance on subtotals and total of the BOTMP, presented in Table 5, show no significant differences.

Sex differences on grip strength, laterality, handwriting and anthropometries are presented in Table 6. Boys performed significantly better on grip strength ($F = 17.11, p \leq .01$). This corresponds to the fact that boys are stronger than girls at all ages (Espenshade, 1960). Also, a significant difference was found on height measures between boys and girls with boys being taller ($F = 8.10, p \leq .01$). Handwriting ratings from both judges also showed significant differences between the sexes with girls being rated higher and having better handwriting than boys ($F = 5.80, p \leq .05$) and ($F = 5.20, p \leq .05$). Also, laterality measures on handedness revealed significant differences between boys and girls with girls being left-handed more than boys ($F = 9.43, p \leq .01$). Based on these data, the second null hypothesis regarding motor skill performance by sex of subject fails to be rejected for BOTMP performance, weight, body size index and laterality of eye and foot but is rejected for grip strength, weight, handwriting and hand laterality.
Table 4
Means, Standard Deviations and F-values by Sex on BOTMP Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Boys</th>
<th></th>
<th></th>
<th>Girls</th>
<th></th>
<th></th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Stan. Dev.</td>
<td>Mean</td>
<td>Stan. Dev.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>8.44</td>
<td>1.47</td>
<td>7.84</td>
<td>2.17</td>
<td>1.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4.96</td>
<td>1.71</td>
<td>4.68</td>
<td>1.93</td>
<td>0.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2.52</td>
<td>1.19</td>
<td>2.60</td>
<td>1.22</td>
<td>0.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.84</td>
<td>0.37</td>
<td>0.92</td>
<td>0.27</td>
<td>0.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2.56</td>
<td>0.71</td>
<td>2.48</td>
<td>0.65</td>
<td>0.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>11.20</td>
<td>1.32</td>
<td>10.52</td>
<td>1.71</td>
<td>2.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>2.88</td>
<td>1.05</td>
<td>2.80</td>
<td>1.11</td>
<td>0.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1.88</td>
<td>0.97</td>
<td>1.64</td>
<td>0.56</td>
<td>1.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>6.68</td>
<td>1.70</td>
<td>6.24</td>
<td>2.06</td>
<td>0.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3.60</td>
<td>0.57</td>
<td>3.76</td>
<td>0.43</td>
<td>1.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1.56</td>
<td>0.50</td>
<td>1.56</td>
<td>0.50</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1.48</td>
<td>0.65</td>
<td>1.28</td>
<td>0.61</td>
<td>1.15</td>
<td></td>
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</tr>
<tr>
<td>13</td>
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<td>1.22</td>
<td>4.52</td>
<td>1.08</td>
<td>0.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>4.40</td>
<td>1.35</td>
<td>5.12</td>
<td>1.36</td>
<td>0.65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

aHigher numerical score indicates better performance.
Table 5
Means, Standard Deviations and F-values by Sex on BOTMP Subtotals and Total

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th></th>
<th>Girls</th>
<th></th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Stan. Dev.</td>
<td>Mean</td>
<td>Stan. Dev.</td>
<td></td>
</tr>
<tr>
<td>RAS (Running Speed &amp; Agility)</td>
<td>8.44</td>
<td>1.47</td>
<td>7.84</td>
<td>2.17</td>
<td>1.22</td>
</tr>
<tr>
<td>B (Balance)</td>
<td>7.48</td>
<td>2.53</td>
<td>7.28</td>
<td>2.57</td>
<td>0.04</td>
</tr>
<tr>
<td>BC (Bilateral Coordination)</td>
<td>3.40</td>
<td>0.81</td>
<td>3.40</td>
<td>0.76</td>
<td>0.01</td>
</tr>
<tr>
<td>S (Strength)</td>
<td>11.20</td>
<td>1.32</td>
<td>10.50</td>
<td>1.70</td>
<td>2.33</td>
</tr>
<tr>
<td>ULC (Upper-Limb Coordination)</td>
<td>4.76</td>
<td>1.76</td>
<td>4.44</td>
<td>1.29</td>
<td>0.62</td>
</tr>
<tr>
<td>RS (Response Speed)</td>
<td>6.68</td>
<td>1.70</td>
<td>6.24</td>
<td>2.06</td>
<td>0.58</td>
</tr>
<tr>
<td>VMC (Visual Motor Control)</td>
<td>6.64</td>
<td>1.38</td>
<td>6.60</td>
<td>1.19</td>
<td>0.00</td>
</tr>
<tr>
<td>ULSD (Upper Limb Speed &amp; Dexterity)</td>
<td>8.80</td>
<td>1.91</td>
<td>9.64</td>
<td>2.13</td>
<td>2.55</td>
</tr>
<tr>
<td>FMC (Fire Motor Composite)</td>
<td>22.12</td>
<td>3.75</td>
<td>22.48</td>
<td>3.20</td>
<td>0.27</td>
</tr>
<tr>
<td>GMC (Gross Motor Composite)</td>
<td>30.52</td>
<td>3.92</td>
<td>29.04</td>
<td>5.51</td>
<td>1.13</td>
</tr>
<tr>
<td>Total</td>
<td>57.40</td>
<td>7.50</td>
<td>55.96</td>
<td>7.83</td>
<td>0.35</td>
</tr>
</tbody>
</table>

^Higher numerical score indicates better performance.
### Table 6
Means, Standard Deviations and F-values by Sex on Grip Strength, Laterality, Handwriting and Anthropometrics

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th></th>
<th></th>
<th></th>
<th>Girls</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean$^a$</td>
<td>Stan. Dev.</td>
<td>Mean$^a$</td>
<td>Stan. Dev.</td>
<td>F value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grip Strength</td>
<td>15.88</td>
<td>3.62</td>
<td>11.76</td>
<td>3.28</td>
<td>17.11**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td>131.48</td>
<td>6.09</td>
<td>126.56</td>
<td>5.90</td>
<td>8.10**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>59.64</td>
<td>9.54</td>
<td>56.40</td>
<td>10.10</td>
<td>1.40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Size Index</td>
<td>2.24</td>
<td>0.25</td>
<td>2.29</td>
<td>0.31</td>
<td>0.47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Height/Weight)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwriting (Judge 1)</td>
<td>8.80</td>
<td>1.89</td>
<td>9.84</td>
<td>1.40</td>
<td>5.80*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handwriting (Judge 2)</td>
<td>9.04</td>
<td>1.94</td>
<td>9.96</td>
<td>1.39</td>
<td>5.20*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laterality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye</td>
<td>1.56</td>
<td>0.50</td>
<td>1.64</td>
<td>0.48</td>
<td>0.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foot</td>
<td>2.00</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand</td>
<td>2.00</td>
<td>0.00</td>
<td>1.72</td>
<td>0.45</td>
<td>9.43**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^a$Higher numerical score indicates better performance.

* $p<.05$.

** $p<.01$. 
Two measures showed an interaction of the effects of groups and sex on the outcome. Upper limb speed and dexterity (Subtest 8) showed a significant interaction of these two variables on the measure of upper limb speed and dexterity ($F = 5.74, p \leq .05$). The results indicate that within the gifted group, males and females tended to perform similarly on this measure with the mean performance of gifted males being 9.77 and the mean performance for gifted females being 9.33. However, within the group of normal subjects, there was a significant difference between the performance of boys and girls on this item with the boy's mean performance being 7.76 which is considerably lower than the girl's mean performance on this item which was 9.92. Interestingly, the girls from the normal group performed slightly better on this item than either sex in the gifted group.

The other variable that showed an interaction of the effects of group and sex was the measure of laterality of hands ($F = 6.55, p \leq .01$). Within the normal group, all males were right handed (mean = 2.0) and most females were also right handed (mean = 1.92). Among the gifted group, males all showed a preference for their right hand (mean = 2.0) but within the group of gifted girls, half showed a preference for the left hand (mean = 1.5).

There were no interactions of the effects of race and group or race and sex.

**Correlations between Variables**

The GLM (General Linear Models) procedure of the SAS statistical program at Iowa State University was used. This technique allows for the
unequal division of races in the individual cells and accounts for this difference when computing the various totals. Coefficients of correlations between BOTMP Subtotals, grip strength, laterality, handwriting and anthropometrics are presented in Table 7. It can be noted that the results of the correlation matrices parallel those obtained from the F-tests reported earlier. Range of coefficients was from -.97 to +.89. The highest positive correlation was found between the total score on the Bruininks-Oseretsky Test of Motor Proficiency and the Gross Motor Composite score (.89). The highest negative correlation (-.97) was found between weight of the subject and body size index (calculated by height/weight).

Group (normal or gifted) correlated with a number of variables including 5 subtests and 2 composite scores of the Bruininks-Oseretsky Test: Running Speed and Agility (r = -.37, p ≤ .01); Balance (r = -.27, p ≤ .05); Bilateral Coordination (r = -.36, p ≤ .01); Strength (r = -.27, p ≤ .05); Response Speed (r = -.43, p ≤ .01); Gross Motor Composite (r = -.44, p ≤ .01) and Fine Motor Composite (r = -.40, p ≤ .01). Handwriting ratings also correlated with group (Judge 1: r = -.30, p ≤ .05; Judge 2 = r = -.42, p ≤ .01). Hand preference correlated significantly with group (r = .28, p ≤ .05).

Sex of subjects correlated significantly with height (r = -.38, p ≤ .01), grip strength (r = -.51, p ≤ .01), handwriting (r = .30, p ≤ .05) and measures of hand laterality (r = -.40, p ≤ .01). It is interesting to note that race of the subject (only blacks and whites were represented in this particular sample) did not correlate with any of the measures although this may be because the small number of blacks and
Table 7
Correlations between BOTMP Subtotals, Grip Strength, Laterality, Handwriting and Anthropometrics

<table>
<thead>
<tr>
<th>Group</th>
<th>Group&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Sex&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Race&lt;sup&gt;c&lt;/sup&gt;</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>.04</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Race</td>
<td>-.25</td>
<td>-.08</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Running Speed &amp; Agility</td>
<td>-.37**</td>
<td>-.16</td>
<td>.01</td>
<td>--</td>
</tr>
<tr>
<td>Balance</td>
<td>-.27*</td>
<td>-.03</td>
<td>-.21</td>
<td>.31*</td>
</tr>
<tr>
<td>Bilateral Coordination</td>
<td>-.36*</td>
<td>.00</td>
<td>-.09</td>
<td>.25</td>
</tr>
<tr>
<td>Strength</td>
<td>-.27*</td>
<td>-.22</td>
<td>.14</td>
<td>.53**</td>
</tr>
<tr>
<td>Upper Limb Coordination</td>
<td>.18</td>
<td>-.10</td>
<td>-.14</td>
<td>.06</td>
</tr>
<tr>
<td>Response Speed</td>
<td>-.43**</td>
<td>-.11</td>
<td>.25</td>
<td>.42**</td>
</tr>
<tr>
<td>Visual Motor Control</td>
<td>-.17</td>
<td>-.01</td>
<td>.17</td>
<td>.14</td>
</tr>
<tr>
<td>Upper Limb Speed &amp; Dexterity</td>
<td>-.16</td>
<td>.20</td>
<td>-.16</td>
<td>.05</td>
</tr>
<tr>
<td>Gross Motor Composite</td>
<td>-.44**</td>
<td>-.15</td>
<td>-.07</td>
<td>.76**</td>
</tr>
<tr>
<td>Fine Motor Composite</td>
<td>-.40**</td>
<td>.05</td>
<td>.10</td>
<td>.31*</td>
</tr>
<tr>
<td>Total Score</td>
<td>-.42**</td>
<td>-.09</td>
<td>-.03</td>
<td>.63**</td>
</tr>
<tr>
<td>Height</td>
<td>.00</td>
<td>-.38**</td>
<td>.08</td>
<td>.28*</td>
</tr>
<tr>
<td>Weight</td>
<td>.11</td>
<td>-.16</td>
<td>-.08</td>
<td>.14</td>
</tr>
<tr>
<td>Body Size Index (HW)</td>
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<td>.09</td>
<td>.09</td>
<td>-.14</td>
</tr>
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<sup>a</sup>Negative correlations favor gifted group.

<sup>b</sup>Negative correlations favor males.

<sup>c</sup>Negative correlations favor blacks.

*p ≤ .05.

**p ≤ .01.
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dNegative correlations favor left-sidedness.

*p ≤ .05.

**p ≤ .01.
whites in the sample is a limitation on the accuracy of correlational coefficients.

The BOTMP subtests correlated significantly with each other in many instances, particularly those that assessed the same general area of motor performance (either gross or fine). The part-whole correlations within the BOTMP are spurious because the individual parts are all included in the total BOTMP score. Running Speed and Agility correlated significantly with Balance \( (r = .31, p \leq .05) \); Strength \( (r = .53, p \leq .01) \); Response Speed \( (r = .42, p \leq .01) \); as well as the Gross Motor Composite \( (r = .76, p \leq .01) \); the Fine Motor Composite \( (r = .31, p \leq .05) \); and the total score on the BOTMP \( (r = .63, p \leq .01) \). Balance correlated significantly with Bilateral Coordination \( (r = .27, p \leq .05) \); Upper Limb Coordination \( (r = .27, p \leq .05) \); and Response Speed \( (r = .36, p \leq .01) \). The Balance subtest score also correlated significantly with the Gross Motor Composite \( (r = .76, p \leq .01) \); the Fine Motor Composite \( (r = .33, p \leq .01) \); and the Total Scores \( (r = .69, p \leq .01) \). Bilateral Composite was shown to correlate significantly with Gross Motor Composite \( (r = .45, p \leq .01) \); Fine Motor Composite \( (r = .31, p \leq .05) \); and the Total Score \( (r = .43, p \leq .01) \). Interestingly, Bilateral Coordination also showed significant correlation with handwriting ratings from both judges \( (r = .28, p \leq .05) \). Finally, the Bilateral Coordination subtest showed a positive correlation with measures of eye laterality \( (r = .31, p \leq .05) \). The Strength subtest score correlated significantly with Response Speed \( (r = .42, p \leq .01) \); as well as with the Gross Motor Composite \( (r = .68, p \leq .01) \); Fine Motor Composite \( (r = .40, p \leq .01) \); and the Total Score on the test \( (r = .66, p \leq .01) \). Height \( (r = .40, \)
p \leq .01) and weight (r = .35, p \leq .01) were positively correlated with Strength. Thus, body size also was positively correlated with Strength (r = -.32, p \leq .05) since it involves the height and weight variables. Finally, grip strength was positively correlated with the score on the Strength subtest from the BOTMP (r = .43, p \leq .01).

The Upper-Limb Coordination subtest significantly correlated with height of the subject (r = .40, p \leq .01) and with BOTMP Total Score (r = .30, p \leq .05). Response Speed subtest scores correlated significantly with the Gross Motor Composite (r = .53, p \leq .01); Fine Motor Composite (r = .63, p \leq .01) and the Total Score (r = .63, p \leq .01). Response Speed also showed significant correlation with handwriting rating by judge 2 (r = .32, p \leq .05) and with grip strength (r = .31, p \leq .05).

The Visual Motor Control subtest of the BOTMP showed significant positive correlations with the Fine Motor Composite score (r = .66, p \leq .01) and the Total Score (r = .43, p \leq .01). Also, handwriting ratings by both judges were shown to correlated significantly with Visual Motor Control (r = .36, p \leq .01; r = .37, p \leq .01). Upper Limb Speed and Dexterity subtest scores were shown to correlate significantly with the Fine Motor Composite score (r = .68, p \leq .01) as well as the Total Score (r = .46, p \leq .01). Also, Upper Limb Speed and Dexterity correlated significantly with the laterality measures on handedness (r = -.29, p \leq .05).

The Gross Motor Composite score correlated significantly with the Total Score (r = .89, p \leq .01) as well as with the Fine Motor Composite score (r = .48, p \leq .01). Gross Motor Composite scores also were shown
to significantly correlate with the handwriting ratings by judge 2 ($r = .28, p \leq .05$) and with grip strength ($r = .28, p \leq .05$). The Fine Motor Composite score correlated significantly with the Total Score ($r = .77, p \leq .01$). Significant correlations were also shown between Fine Motor Composite scores and handwriting ratings by both judges ($r = .28, p \leq .05$; $r = .38, p \leq .01$). Grip strength also was shown to be significantly correlated to fine motor composite scores ($r = .27, p \leq .05$). Finally, laterality measures on handedness were significantly related to Fine Motor Composite scores ($r = -.30, p \leq .05$).

The total score on the Bruininks-Oseretsky Test significantly correlated with handwriting ratings by judge 2 ($r = .39, p \leq .01$) and grip strength ($r = .35, p \leq .01$).

Height was shown to be significantly correlated with weight ($r = .65, p \leq .01$) and body size index ($r = -.52, p \leq .01$). Height was correlated significantly with grip strength ($r = .60, p \leq .01$). Weight was shown to be significantly correlated with body size index ($r = -.97, p \leq .01$) and with grip strength ($r = .45, p \leq .01$). Body size index (height/weight) was shown to be correlated with grip strength ($r = -.35, p \leq .01$). Lastly, handwriting ratings by judge 1 and judge 2 were shown to be significantly correlated ($r = .88, p \leq .01$).

On the bases of the above stated correlational data, the third null hypothesis regarding no relationships between variables is rejected.
The purpose of this investigation is to compare motor skills of gifted children and normal children. Results will be discussed in three sections: 1) results of statistical analysis, 2) educational implications 3) research implications.

**Results of Statistical Analysis**

The results of this investigation indicate several significant differences between groups of gifted and normal children. In the area of gross motor ability, group means differed significantly for the Running Speed subtest, Balance subtest and Bilateral Coordination subtest. Children in the gifted group performed better than those of the normal group. This certainly is in contrast to the stereotype of clumsiness and awkwardness as characteristics of gifted children. In the area of fine motor ability, the Response Speed subtest showed significantly different group means with the gifted children performing better than the normal children.

The overall total scores on the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) instrument that assessed general motor proficiency differed significantly with the gifted children performing better. This finding would appear to "soften" the statement of Seagoe (1974) that there is often a big discrepancy between the motor skills and intellectual level in gifted children. Perhaps the recently increased research findings regarding the importance of motor skills in the total development of the individual have precipitated changes in the
educational programming of all children (especially the gifted) that have caused these differences between motor abilities and cognitive abilities to decline.

Significant differences between the sexes did not exist on the BOTMP performance. This supports the statement and purpose of Bruininks (1978) that stress the non-sexist nature off the test. However, significant sex differences did exist regarding height and grip strength where means for boys were higher. This finding agrees with the overall findings of Espenschade (1960) that boys tend to be taller, larger and stronger during the early childhood years. In the current study, boys on the average weighed more but the final analysis did not show the mean weight for boys being higher than girls which was probably due to the inclusion of three female children in the sample who were considerably overweight. With a small sample (n = 50), these subjects comprised enough of the total to account for the lack of difference in the two means. Girls did perform significantly better than boys on handwriting measures which is consistent with the stereotypes and expectations typically held of girls compared with boys. It is widely accepted that girls are neurologically advanced over boys which would indicate that their fine motor control would also be better. In this research, fine motor performance scores correlated significantly with handwriting ratings which would substantiate this finding.

Looking at the correlational relationships between the individual items of motor proficiency, the subtest scores, the composite scores and the total score on the BOTMP, it is evident that there are many significant inter-correlations which confirm the results of Bruininks
Many of the BOTMP scores also correlated with other variables. Group of the subject (gifted or normal) correlated significantly with four of the subtests and with gross and fine motor composite scores as well as with the total scores, showing gifted children to be better than normal children on all of these measures. This finding agrees with the conclusions of Ismail and Gruber (1967) who found that a definite relationship exists between intellectual level and motor skills and abilities and with Bruininks (1978) who states that this test is suitable for measuring motor abilities of special groups of students. Also, group of the subject correlated with handwriting ratings, with the gifted children being more proficient in this area which also agrees with the finding that group correlated significantly with fine motor composite scores. Interestingly, group correlated with hand laterality measures, showing that in this study more gifted children were left handed than normal children and all of these were girls. The researcher feels that this result bears replication. The total percentage of left-handed subjects in this study is 14%. This seems high considering the sample size (n = 50), especially since left-handed people comprise 7-10% of the total population in the United States (Burns, 1974). The researcher speculates that a larger percentage of left-handed individuals may become apparent since generally educators have departed from the practice of forcing everyone to write with their right hands and encouraging left-handed children to learn to be proficient with their right hand instead.

Interestingly, the laterality measures on eyes and feet did not correlate significantly with many other variables. All subjects showed a preference for their right foot in the kicking task which bears
replication. Eye laterality only significantly correlated with the Bilateral Coordination subtest. Given, the low inter-correlation with the other variables, the researcher does not feel that these measures added any significant findings to the study and suggests that different assessments be added to the data from a standardized test in future research.

Grip strength correlated significantly with many of the individual items as well as both the fine and gross motor composite scores and the total score from the BOTMP. Also, grip strength was significantly correlated with the anthropometric variables of height, weight and body size index. The researcher feels this is a valuable assessment to include when looking at motor ability of children. Also, this supports the statement of Jones (1949) that grip strength is indicative of general body strength and is highly correlated with other static strength measures.

**Educational Implications**

According to Bruininks (1978), educators are becoming more aware that motor development is related to general health, social and occupational adjustment and more attention is being focused on the relationship of motor development to academic performance. Much research effort is needed in this area and the present study has undertaken only a small part of the larger problem. This investigation of motor abilities of gifted and normal children did confirm differences between the two groups with the gifted children being better on many tasks. However, the educational needs that these differences create are not being met. For
instance, Seagoe (1974) and Confessore and Confessore (1981) conclude that teachers give little reinforcement for the physical accomplishments of gifted children and in fact through these actions may be unintentionally encouraging these children to avoid physical activity.

With the general trend in our society at present where serving gifted children in the public schools is becoming more common, it is certainly necessary to be meeting all the needs of this group, not just intellectual aspects. Encouraging the concept of developing the "whole child" as is done with "normal" children is equally as important (if not more so) for gifted children. Educators and administrators need to be aware of this and plan for it in their programs for gifted and talented education. According to Seagoe (1974) if physical development of gifted children is to be encouraged then programs need to provide experiences which develop integration between body and mind in these children with nonnormative development patterns.

It seems as important to educate the parents of gifted children about the importance of physical and motor experience and development. Hurlock (1972) emphasizes the importance of motor development in a child's life including its effects on good health, self-concept, socialization, independence and emotional stability. Parents may be particularly prone to increased expectations of their child in the area of intellectual functioning when they have (or believe they have) a gifted child. These increased expectations may not carry over into the area of motor functioning and bring on the "self-fulfilling prophecy effect," which according to Gephart and Antonoplus (1969), involves the transmission of expectancy of the children in such a way that it alters
the normal functioning of the child. Thus, parents of gifted children need to be educated regarding the importance of motor development in their children and they must be taught to promote and encourage these type of experiences along with expanding the intellectual environments of their children.

Other educational implications of this research include the ability to make more effective decisions regarding the physical education programs that are most appropriate for gifted children. After doing this type of assessment, specific areas which are behind developmentally in particular children can be targeted and addressed, thus assuring that the necessary program adjustments can be implemented. As mentioned by Bruininks (1978) the results of broad sampling of motor tasks among groups of special students can be used in a variety of ways including: 1) assessing motor status prior to instruction, 2) grouping students by motor ability to assure more effective instruction, and 3) assessing the effectiveness of an instructional program. Each of these areas would be especially important when working with and planning for gifted and talented children.

Research Implications

In considering the present study, several limitations are present. Paramount among these is that of sample size and method of subject selection. Generalizations of findings to population groups thus is limited. Varying criteria of identification for participation in gifted programs also is a limitation in grouping for the research. Both school districts used the same IQ cutoff scores to determine the top 5%
of the students, utilizing the Stanford-Binet IQ Tests as their assessment device. However, the Des Moines Public Schools augmented this information by basing their decisions also on creativity measures and more extensive teacher nominations which the Ankeny School District did not employ. The subjects tested might best be considered representative of midwestern middle size urban children which is obviously a limiting factor. Also, using the Des Moines and Ankeny area provided certain limitations regarding the socio-economic status of the sample. Similar studies in this area with larger samples more representative of the entire American school population would be recommended. Finally, in regards to sample a more diverse representation of races would be desirable. This would allow for more accurate generalizations.

The present study has approached the area of motor skills development merely from the standpoint of comparing various measurements of these traits between gifted and normal children at a singular and specific time period. Several other possibilities would seem evident and highly desirable in view of the lack of information in this area. Longitudinal study of the development and change of such skills from infancy through adolescence on a comparison basis between gifted and normal children would be needed to better identify and confirm the theorized stages. Experimentally designed research is needed to determine the true benefits of various perceptual motor and physical training programs, particularly within the gifted population. Studies which are developmental in nature are needed to further probe the relationship between motor skills and intellectual ability as well as academic performance.
In designing the present study, the investigator became aware of a need for the development of additional standardized instrument for the assessment of motor skills. Many of the available tests are 40 to 50 years old and obviously don't make use of information gained through research over that time period. Assessments of hand laterality, handwriting grip strength and height and weight would be examples of areas that need to be included on these devices along with the measures of the various factors involved in motor skills such as strength, balance, speed, and coordination.

The problem of inferring the presence or lack of motor ability on the basis of one set of overt responses would seem to be an inherent problem in the study. Repeated measures of the subjects would be desirable and may erase some of the effects of a "bad day," fatigue, mood difference, physical status (feeling well), stress and seasonal or time of day variations.

Studies such as the present one will lead to further understanding of the motor abilities and development of normal children and particularly of gifted children. The quantity and quality of assessments used needs to be explored to provide a more adequate and accurate understanding of children in the area of motor skill development and its relationship to intellectual abilities and academic success.
The purpose of the current investigation was to study motor skills of gifted children and compare them with normal children. Three specific null hypotheses were proposed:

1. There is no significant difference between motor skill performance as measured by the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP), grip strength, height, weight, handwriting or laterality measures of the sampled group of gifted compared to normal subjects.

2. There is no significant difference between motor skill performance as measured by the BOTMP, grip strength, height, weight, handwriting or laterality measures of the sampled group of boys compared to girls.

3. There are no significant relationships between any variables including group and sex.

To investigate motor skills, assessments were made on gifted and normal children in a school setting. The measures included the Short Form of a standardized test (Bruininks-Oseretsky Test of Motor Proficiency), grip strength measured by a hand dynamometer, handwriting ratings by two independent judges, laterality measures as well as height and weight data. Twenty-five seven year old normal children were randomly drawn from 2nd grade classrooms in the participating schools to get a final sample of 13 males and 12 females. A sample of 7-year old gifted children was chosen from two cooperating school districts to arrive at a final group of 12 males and 13 females. The researcher and
an assistant completed the measurements and assessments individually on each child during a 20 minute period in the school gym.

After the data were obtained, scores on the individual items, subtest scores and composite totals were ascertained. Handwriting was rated by two independent judges on a pre-determined 12 point scale. The statistical treatment used to assess the data was Pearson product moment correlations and analysis of variance (ANOVA). The .01 and .05 levels were chosen as the determinants of significance.

Significant differences for the two groups of children were found for several individual items on the BOTMP. Gifted children performed significantly better on subtest of running speed, balance, bilateral coordination and response speed. On overall ratings of the fine motor ability, gross motor ability and general motor proficiency the gifted children performed significantly better than the normal group. Gifted children also were consistently rated higher on handwriting ability than the normal children. Sex differences in performance were not significant for any parts of the BOTMP. However, boys were taller than girls and also showed greater strength as measured by the hand dynamometer. Girls were consistently better on handwriting ratings. These findings allowed the rejection of the first null hypothesis and the rejection of the second null hypothesis for grip strength, height and hand laterality but not for the other measures.

Correlational data on the different variables showed several significant correlations and thus allowed for the rejection of the third null hypothesis.

It was concluded by the investigator that there are significant
differences in motor performance and abilities between gifted and normal children.
REFERENCES


Malpass, L. F. Responses of Retarded and Normal Children to Selected Clinical Measures. American Journal of Mental Deficiencies, 1960, 64, 1012-1015.


Seagoe, M. *Some learning characteristics of gifted children*. In R. Martinson (Ed.), *The identification of the gifted and talented*. Ventura, California: Office of Ventura County Superintendent of Schools, 1974.


ACKNOWLEDGEMENTS

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Many thanks to the principals, secretaries and teachers who willingly helped to locate the children needed for the study. A special thanks goes to the children who participated in the study as they willingly left their classrooms to perform their skills for me.

Last but not least, my husband Glenn deserves the biggest thanks of all for his unending support, patience and financial assistance during this endeavor. I am deeply appreciative of his warm manner and unending help. I extend a warm thanks to all of our parents also for their unending guidance and love. Without them, this would not have possible. Also, thanks to all my friends and co-workers who have contributed all the bits and pieces that finally made this puzzle come together.
APPENDIX A. INITIAL LETTER TO PARENTS
January 21, 1984

Dear Parent(s):

My name is Chris Burger and I am a Ph.D. candidate in the Child Development Department at Iowa State University. I am conducting research to fulfill the requirements for my dissertation and my degree.

My topic deals with physical abilities and motor skills of elementary school children. I will be assessing fine motor skills through such tasks as handwriting, copying geometric figures, finger tapping on a table top and sorting cards. To assess gross motor skills I will measure jumping, running speed, standing broad jump distance and catching a tossed ball. Finally, I will be measuring each child's height, weight, and hand grip strength. None of these tasks will be in any way physically harmful or create risk for your child. If at any time your child requested not to do the task or to discontinue the test, I would certainly follow his/her wishes.

The testing will be done throughout the month of February in your child's school at some time during the regular school day. The total time required for testing your child will be between 15-20 minutes. I will be carrying out the testing in an available space in the school which is carpeted and free of interferences or potential hazards.

I would greatly appreciate being able to use your child in my research project. At no time will your child's name be used after the data has been collected. All subjects will be referred to with a random number.

If you have any questions I would be happy to answer them. Please feel free to contact me at work (Des Moines Area Community College) at 964-6252 or at home in Ames at 232-6360.

I thank you in advance for your cooperation and appreciate you returning this form to your child's teacher as soon as possible.

Sincerely yours,

Christine M. Burger

-----------------------
Child's name ________________________________

I _______ do/_______ do not give my permission for my child to participate in Chris Burger's doctoral dissertation research concerning physical abilities and motor skills of children.

Signed ________________________________

Date______________________________
APPENDIX B. INDIVIDUAL RECORD FORM (SHORT FORM) OF BRUININKS–OSERETSKY
TEST OF MOTOR PROFICIENCY AND ACCOMPANYING WORKSHEETS
NAME ___________________________ SEX: Boy ☐ Girl ☐ GRADE _________
SCHOOL/AGENCY ______________________ CITY ________ STATE ________
EXAMINER ___________________________ REFERRED BY ___________________________
PURPOSE OF TESTING ___________________________

Arm Preference: (circle one)
RIGHT ☐ LEFT ☐ MIXED ☐

Leg Preference: (circle one)
RIGHT ☐ LEFT ☐ MIXED ☐

TEST SCORE SUMMARY

<table>
<thead>
<tr>
<th>POINT SCORE Maximum</th>
<th>STANDARD SCORE (Table 27)</th>
<th>PERCENTILE RANK (Table 27)</th>
<th>STANINE (Table 27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHORT FORM .......... 98</td>
<td>___________________________</td>
<td>___________________________</td>
<td>___________________________</td>
</tr>
</tbody>
</table>

DIRECTIONS

1. During test administration, record subject's response for each trial.
2. After test administration, convert performance on each item (item raw score) to a point score, using scale provided. For an item with more than one trial, choose best performance. Record item point score in square to right of scale.
3. Add item point scores; record total in square provided at end of test and in Test Score Summary section. Consult Examiner's Manual for norms tables.

NOTES/OBSERVATIONS

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

AGS
Published by American Guidance Service, Inc., Circle Pines, MN 55014
SUBTEST 1: Running Speed and Agility

1. Running Speed and Agility
   TRIAL 1: _______ seconds TRIAL 2: _______ seconds
   
   Above 11.0 10.0 9.0 8.9 8.7 8.5 7.9 7.5 7.0 6.7 6.4 6.3 6.0 5.8 5.5 Below
   New Score Point Score
   0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

SUBTEST 2: Balance

2. Standing on Preferred Leg on Balance Beam (10 seconds maximum per trial)
   TRIAL 1: _______ seconds TRIAL 2: _______ seconds
   
   New Score Point Score
   0 1 2 3 4 5 6 7 8 9 10

7. Walking Forward Heel-to-Toe on Balance Beam (6 steps maximum per trial)
   TRIAL 1: _______ steps TRIAL 2: _______ steps
   
   New Score Point Score
   0 1 2 3 4

SUBTEST 3: Bilateral Coordination

1. Tapping Feet Alternately While Making Circles with Fingers (90 seconds maximum)
   
   Fail Pass
   New Score Point Score
   0 1

6. Jumping Up and Clapping Hands
   TRIAL 1: _______ claps TRIAL 2: _______ claps
   
   New Score Point Score
   0 1 2 3 4 Above 4

SUBTEST 4: Strength

1. Standing Broad Jump (record number from tape measure)
   TRIAL 1: _______ TRIAL 2: _______ TRIAL 3: _______
   
   New Score Point Score
   0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

SUBTEST 5: Upper-Limb Coordination

3. Catching a Tossed Ball with Both Hands (5 trials)
   NUMBER OF CATCHES:
   
   New Score Point Score
   0 1 2 3 4 5

5. Throwing a Ball at a Target with Preferred Hand (5 trials)
   
   Hits
   New Score Point Score
   0 1 2 3 4 5
### SUBTEST 1: Response Speed

<table>
<thead>
<tr>
<th>Trial</th>
<th>Seconds to Wait</th>
<th>Score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice 1</td>
<td>1</td>
<td>XXXX</td>
</tr>
<tr>
<td>Practice 2</td>
<td>3</td>
<td>XXXX</td>
</tr>
</tbody>
</table>

*Record number from response speed stick in this column.

1. Rank all seven trial scores, highest to lowest, in boxes provided. The point score for Subtest 1 is the median (middle) or fourth score from the top.

### SUBTEST 7: Visual-Motor Control

#### 3. Drawing a Line Through a Straight Path with Preferred Hand

<table>
<thead>
<tr>
<th>Number of Errors</th>
<th>Above 6</th>
<th>6-25</th>
<th>26-100</th>
<th>101-200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Percent Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

#### 5. Copying a Circle with Preferred Hand

<table>
<thead>
<tr>
<th>Score</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Percent Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

#### 8. Copying Overlapping Pencils with Preferred Hand

<table>
<thead>
<tr>
<th>Score</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Percent Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

### SUBTEST 8: Upper-Limb Speed and Dexterity

#### 3. Sorting Shape Cards with Preferred Hand (15 seconds)

<table>
<thead>
<tr>
<th>Number of Cards</th>
<th>0</th>
<th>1-8</th>
<th>9-12</th>
<th>13-16</th>
<th>17-20</th>
<th>21-25</th>
<th>26-29</th>
<th>30-33</th>
<th>34-37</th>
<th>38-41</th>
<th>Above 41</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Percent Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

#### 7. Making Dots in Circles with Preferred Hand (15 seconds)

<table>
<thead>
<tr>
<th>Number of Circles with Dots</th>
<th>0</th>
<th>1-10</th>
<th>11-15</th>
<th>16-20</th>
<th>21-25</th>
<th>26-30</th>
<th>31-35</th>
<th>36-40</th>
<th>41-50</th>
<th>51-60</th>
<th>Above 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Percent Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>
SUBTEST 7: Visual-Motor Control

Item 35f / Drawing a Line Through a Straight Path with Preferred Hand

START

Number of Errors
SUBTEST 7: Visual-Motor Control

Item 5^® / Copying a Circle with Preferred Hand

Item 8^® / Copying Overlapping Pencils with Preferred Hand
SUBTEST 3: Upper-Limb Speed and Dexterity

Item 75f / Making Dots in Circles with Preferred Hand

Practice:   

Number Correct
March 11, 1984

Dear Parents:

I would like to thank you for your cooperation and your permission to let your child participate in my research project. All the testing went very well and was made easier by the cooperation I received from the school personnel. I feel that all of the children had a good time participating in the testing doing some running, jumping, throwing and writing tasks. I appreciate you allowing me to work with your children for a short time. Thanks to friendly and cooperative people like yourselves, professionals in the field of child development can expand our knowledge and share it with those who can benefit from it, including teachers, administrators and other parents. Some preliminary results of my study will be available through the principal of your child's school within four to six weeks. If you are interested I invite you to review these.

Again, thanks for your cooperation. I've certainly enjoyed working with your children.

Sincerely yours,

[Signature]

Christine M. Burger
Iowa State University
Ames, Iowa 50010
APPENDIX D. HUMAN SUBJECTS APPROVAL FORM
INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH
IOWA STATE UNIVERSITY
(Please follow the accompanying instructions for completing this form.)

1. Title of project (please type): COMPARISON OF MOTOR SKILL DEVELOPMENT BETWEEN GIFTED AND NORMAL CHILDREN

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

Christine Mayer Burger 1-23-84
Typed Name of Principal Investigator Date Signature of Principal Investigator
(h) 417 10th St. Ames 50010 232-6360 (h) 964-6252 (w)
Campus Address Campus Telephone

3. Signatures of others (if any) Date Relationship to Principal Investigator

4. ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects, and (D) covering any topics checked below. CHECK all boxes applicable.

☐ Medical clearance necessary before subjects can participate
☐ Samples (blood, tissue, etc.) from subjects
☐ Administration of substances (foods, drugs, etc.) to subjects
☐ Physical exercise or conditioning for subjects
☐ Deception of subjects
☐ Subjects under 14 years of age and/or Subjects 14-17 years of age
☐ Subjects in Institutions
☐ Research must be approved by another institution or agency

5. ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

☐ Signed informed consent will be obtained.
☐ Modified informed consent will be obtained.

6. Anticipated date on which subjects will be first contacted: Month Day Year

7. If Applicable: Anticipated date on which audio or visual tapes will be erased and/or identifiers will be removed from completed survey instruments:

8. Signature of Head or Chairperson Date Department or Administrative Unit

9. Decision of the University Committee on the Use of Human Subjects in Research:

☐ Project Approved ☐ Project not approved ☐ No action required

George G. Karns 1-27-84
Name of Committee Chairperson Date Signature of Committee Chairperson

Received JAN 24 84

Revised 6/7