GENERALITY VERSUS SPECIFICITY IN MOTOR PERFORMANCE OF EDUCABLE AND TRAINABLE MENTALLY RETARDATES

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CHAPTER I

INTRODUCTION

Considerable interest was aroused during the 1950s and 1960s regarding the issue of generality versus specificity of motor skills and motor performance. The issue was evident in the extensive research studies which were conducted and published relating to generality versus specificity (Bachman, 1961). Generality theory holds that an individual's motor make up is comprised of a single, all encompassing motor ability (Magill, 1980) and the individual's motor behaviors and motor competencies are based on that global motor ability. According to Schmidt (1982), this global motor ability is sometimes referred to as "athletic ability," "coordination," "motor ability," or, as it more often is called, a "general motor ability." The individual's proficiency level in that motor ability greatly influences the ultimate success that the individual can attain in pursuing any motor skill (Magill, 1980). Advocates of the idea of generality claim that there is a significant relationship among a variety of motor skills within individuals. Consequently, an individual's rank, be it high or low, on a particular motor skill could be a precise predictor of that individual's rank on any other motor skill (Smith, 1973). In such a manner, if a person is characterized as having a high level of general motor ability, then that person would be predicted to achieve success in any motor or movement activity (Schmidt, 1982). In examining the validity of the generality theory, Oxendine (1967) reported that most of the research evidence strongly supports the concept of specificity in motor performance, rather than that of generality.

The insignificant support of the research evidence for the generality hypothesis resulted in the proposition of an alternative hypothesis (Magill, 1980). In the late 1950s, Henry (1958) proposed the idea that motor abilities are specific to a particular task. This implies that there might be a great number of motor abilities and that these abilities are not related (Magill, 1980). Some researchers adhere to the theory of specificity, that is, they support the idea that there are statistically low interrelationships among a variety of motor abilities within individuals (Smith, 1975). This suggests that, even by knowing one's level of ability in one area, it would be impractical to predict with any confidence what that individual's ability level might be in a different area (Magill, 1980).

Each of the above hypotheses, generality or specificity in motor performance, has a great deal of importance and influence upon our educational and instructional systems. It is apparent that much research, many assessments and educational approaches, and large amounts of curriculum and program designs are based on the generality hypothesis. However, Nelson (1957) reported that the results of experimental studies and empirical evidence strongly support the specificity theory.

According to Smith (1973), research findings have a great deal of practical implication for the design and implementation of physical education programs. As referring to the regular education setting, Henry (1958) stated that curriculum planners and specialists should base their work on research findings. He also claimed that since research revealed that motor abilities such as coordination and agility are specific to the task or activity, it is no longer possible to accept the notion of generality or unitary abilities as argued by Henry (1958). Thus far the theories and research evidence are based on studies that have been done mostly with normal subjects and are made only for the regular physical education setting.

In the late 1950s, it was noted by Francis and Rarick (1959), that few studies were conducted regarding the motor characteristics of the mentally retarded. Also, it was claimed by the authors that curriculum planners did not have enough information about the motor needs and abilities of the mentally retarded. In the same manner, it was reported by Kalakian and Eichstaedt (1982) in the early 1980s that, although much information is at hand regarding the intellectual and behavioral characteristics of the mentally retardates, less is known about their motor performance characteristics. Kalakian and Eichstaedt (1982) also indicated that until recently much research in the physical education domain dealt mainly with physical growth and anthropometrical measures. However, little evidence is available regarding the retardates motor performance.

The need for, and the value of, factor analysis studies in the area of motor performance of the mentally retardates was mentioned by Rarick, Dobbins and Broadhead (1976). These authors indicated that only a few research studies used factor analysis in order to investigate the structure of the motor abilities in the retardates. Factor analysis studies, according to Rarick, Dobbins and Broadhead (1976), showed to be very valuable in studying the motor domain of normal individuals. The same procedures will be very effective with the mentally retarded as claimed by Rarick, Dobbins and Broadhead (1976).

The present study was designed to investigate task specificity versus generality with a mentally retarded population using a factor analysis approach. The results will provide valuable information regarding the generality/specificity issue of the motor performance of mentally retarded subjects. Such information may greatly contribute to physical education curriculum planners, physical education teachers, adapted physical education teachers, and other professionals working with the mentally retarded.

Statement of the Problem

The purpose of this study was to confirm or refute the existence of four general motor abilities within a mentally retarded population.

Pertinent Questions

1. Is there evidence to support a general motor ability named balance?
2. Is there evidence to support a general motor ability named coordination?
3. Is there evidence to support a general motor ability named kinesthesis?
4. Is there evidence to support a general motor ability named speed of movement?

Limitations

This research might be affected by the following limitations:

1. The subjects were not selected randomly.
2. Some of the motor skill tests which have been used were not

specifically designed for a mentally retarded population.

Delimitations

The research was delimitated to:

1. The group of educable and trainable mentally retarded males and females from "West Side Elementary School" in Midwest City, Oklahoma.

2. The sixteen tests that measured the four abilities named: balance, coordination, kinesthesis, and speed of movement.

3. The factor analytic approach described by Frane and Hill (1974).

Assumptions

The following assumptions were made:

1. The testing conditions were equal for all subjects during the administration of the tests.

2. The test items were understood by all subjects.

3. The tests were valid and reliable for the subjects in this study.

Definitions of Terms

1. Mental Retardation: "(1) significantly subaverage general intellectual functioning existing concurrently with (2) deficits in adaptive behavior, and (3) manifested during the developmental period" (Sherrill, 1981, p. 431).

2. Subaverage General Intellectual Functioning: "Performance which is two or more standard deviations below average on a standardized intelligence test" (Mean=100 I.Q., S.D.=15 or 16) (Sherrill, 1981, p. 431).

3. Standard Deviation: "The measure that denotes the tendency for

individual test scores to deviate from their mean (average) score. The higher the standard deviation, the more spread or varied are the scores from the average. The lower the standard deviation, the more concentrated or clustered are the scores around the average" (Kalakian and Eichstaedt, 1982, p. 336).

4. Normal Population: The "98 percent of the general population who have intelligence quotients above the 2 standard deviations below the mean cut off" (Mean=100 I.Q., S.D.=15 or 16)(Kalakian and Eichstaedt, 1982).

5. Intelligence: "An ability to act purposefully, to think rationally, and to deal effectively with the environment. It is often measured with the intelligent quotient, I.Q." (Schmidt, 1982, p. 433).

6. Mental Age: "A concrete indicator of intellectual maturity" (Kalakian and Eichstaedt, 1982, p. 338). "The single best criterion for estimating the child's academic status" (Rothstein, 1970, p. 213).

7. Prevalence: "The number of individuals in the population who currently exhibit a particular characteristic" (Blackhurst and Berdine, 1981, p. 587).

8. Incidence: "The estimates of the numbers of individuals in the population who may exhibit a particular characteristic at some time during their life time" (Blackhurst and Berdine, 1981, p. 584).

9. Syndrome: "A cluster or constellation of symptoms (Blackhurst and Berdine, 1981, p. 588).

10. Rh Incompatibility: "A condition in which the fetus has Rh positive blood and the mother has Rh negative blood. The mother consequently builds up antibodies that attack the fetus, resulting in birth defects" (Blackhurst and Berdine, 1981, p. 587).

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11. Phenylketonuria (PKU): "A genetic disorder which, if undetected, may cause mental retardation. May be detected at birth" (Blackhurst and Berdine, 1981).

12. Tay-Sach's Disease: "A progressive fatal disease occurring in infants and associated with blindness and brain deterioration" (Rottenberg, 1975, p. 326).

13. Syphilis: "A communicable veneral disease characterized by a primary sore (chancre) and subsequent involvement of all the organs of the body. It can be cured through intensive treatment" (Rottenberg, 1975, p. 323).

14. Diabetes Mellitus: "A chronic disease characterized by inability to burn up the carbohydrates which have been ingested. It is caused by insufficient production of insulin by the pancreas" (Rottenberg, 1975, p. 84).

15. Hydrocephalus: "A condition of excess cerebrospinal fluid in the brain that results in an enlargement of the head and mental retardation" (Blackhurst and Berdine, 1981, p. 584).

16. Rubella (German Measles): "A communicable disease transmitted by a virus; infection of a woman during early stages of pregnancy producing a high probability of severe handicaps of the offspring" (Blackhurst and Berdine, 1981, p. 587).

17. Learning: "A relatively permanent change in performance or behavioral potential resulting from practice or past experience in the situation. A relatively permanent change implies that performance will not be represented by momentary fluctuations and inconsistencies" (Singer, 1980, p. 9).

18. Performance: ". . . The act of performing. . . . The way in

which someone or something functions" (Morris, 1975, p. 974). "Performance may fluctuate from time to time because of the potential for many variables to operate" (Singer, 1980, p. 11).

19. Motor Learning: "The acquisition and performance of behaviors that are generally reflected by movement. Generalized skills and highly specific skills are included in the study of motor learning" (Singer, 1980, p. 12).

20. Motor Skill: "A particular act performed or . . . the manner in which it is executed." "Because it is task oriented, skill usually refers to a highly developed specific sequence of responses" (Singer, 1980, pp. 29, 31).

21. Gross Motor Skill: "Contractions and use of the large muscles of the body. The whole body is usually in movement" (Singer, 1980, p. 13).

22. Fine Motor Skill: A movement in which "certain segments of the body move within a limited area in order to yield an accurate response. The neuromuscular coordinations involved in fine motor skills are usually precision oriented and often refer to eye-hand coordination" (Singer, 1980, p. 13).

23. Motor Patterns: Characteristics that "evolve out of and are more accurate forms of motor-sensory responses." ". . . are those major motor milestones that develop within the natural sequence of events in a child's life . . . and represent simple, purposeful movement" (Seaman and Depauw, 1982, p. 35).

24. An Ability: "A hypothetical construct that underlies performance in a number of tasks or activities." "It is a relatively stable trait that is largely unmodifiable by practice" (Schmidt, 1982, pp. 395, 396).

25. Motor Ability (Athletic Ability): "It denotes the immediate state of the individual to perform in a wide range of motor skills" (Singer, 1980, p. 184).

26. General Motor Ability: "An early concept about motor abilities in which a single ability was thought to account for major portions of the individual differences in motor behavior" (Schmidt, 1982, p. 433).

27. Specificity Theory: "A theory about the structure of motor abilities in which motor tasks are thought to be composed of many independent abilities" (Schmidt, 1982, p. 433).

28. Coordination: "The ability to control the independent body parts involved in a complex movement pattern and to integrate these parts in a single, smooth, successful effort at achieving some goal" (Singer, 1980, p. 199).

29. Balance: "The ability to maintain body position" in space (Singer, 1980, p. 202).

30. Kinesthesis: Refers to "the sense providing information concerning the body's position in space and the relationship of its parts." Usually referred to as proprioception (Singer, 1980, p. 205).

31. Response Time: "The time it takes to complete an entire movement" and includes reaction time and movement time (Singer, 1980, p. 208).

32. Reaction Time: "The elapsed interval of time from the presentation of a stimulus to the initiation of a response" (Singer, 1980, p. 208).

33. Movement Time: "The time a particular action takes to be completed after it has been initiated" (Singer, 1980, p. 208).

CHAPTER II

SELECTED REVIEW OF RELATED LITERATURE

The review of the literature in this chapter consists of eight sections. The sections are: (a) mental retardation, (b) the educable and trainable mentally retarded, (c) motor characteristics of mentally retarded individuals, (d) motor abilities and motor skills, (e) taxonomy of motor abilities, (f) generality versus specificity in motor performance, (g) the generability hypothesis, (h) the specificity hypothesis, and (i) the "all-around" athlete.

Mental Retardation

During the last two decades, federal legislation has prompted extensive attention to the area of mental retardation. Mental retardation is not one unique disease, rather, it encompasses numerous symptoms and conditions which can be identified medically and psychologically (Moore and Moore, 1977).

Over the years different definitions of mental retardation have been suggested. However, the development of a widely accepted definition has not been an easy task for a variety of reasons. First, there was lack of agreement regarding the criteria to be used in order to measure intelligence and adaptive behavior; and second, measuring devices are rather imprecise. Finally, since the mentally retarded usually possess a variety of medical, psychological, educational, and sociological deficiencies, the goals and objectives of the different professional groups working with the retarded individual vary greatly (Blackhurst and Berdine, 1981).

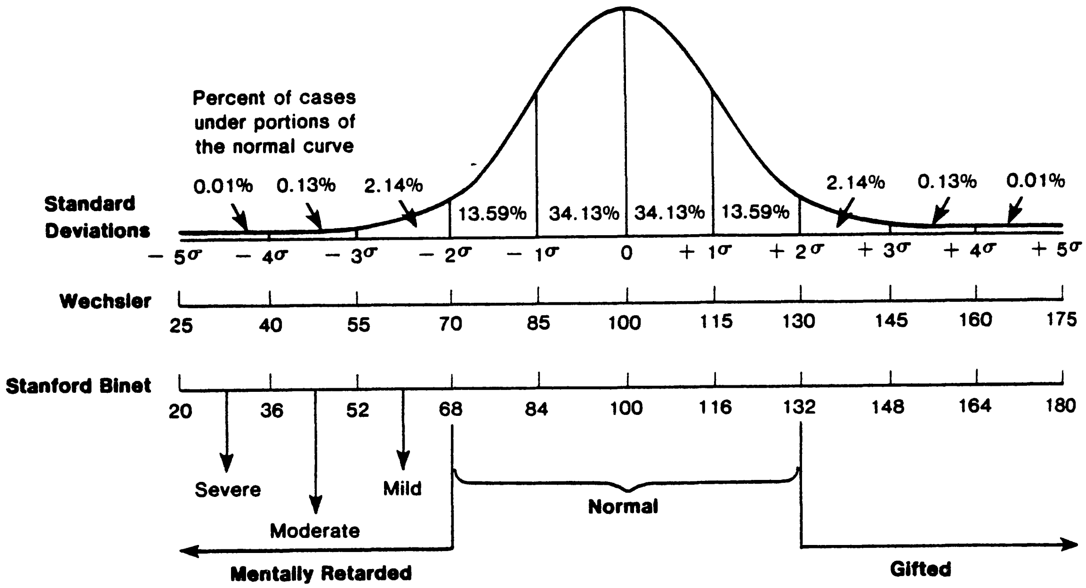
The American Association on Mental Deficiency (AAMD) developed a widely accepted definition which emphasizes the level of I.Q. test scores and data on adaptive behavior performance. The following is the 1977 AAMD definition of mental retardation:

> Mental retardation refers to significantly subaverage general intellectual functioning existing concurrently with deficits in adaptive behaviors and manifested during the developmental period (Sherrill, 1981, p. 431).

The following are the main terms included in the AAMD definition which need to be further explained:

1. General Intellectual Functioning refers to "the results obtained from administration of an individualized intelligence test" (Blackhurst and Berdine, 1981, p. 325). "Intelligence tests are used to assess the intellectual ability that theoretically determines whether a person can perform educational tasks" (Blackhurst and Berdine, 1981, p. 313).

2. Significantly Subaverage refers to I.Q. scores that are substantially below the norm. Usually defined as the scores "that fall two standard deviations below the mean or average intelligence quotient" (Jordan, 1976, p. 30). The standard deviation for the Stanford-Binet or Cattell intelligence test is 16, and a standard deviation for the Wechsler test is 15. Hence, individuals who possess an I.Q. score below 68 or 67 are considered mentally retardates (Blackhurst and Berdine, 1981) (see Figure 1).



(Source: Claudine, Sherrill. Adapted Physical Education and Recreation: A Multidisciplinary Approach. 2nd ed. Dubuque, Iowa: William C. Brown, 1981.)

Figure 1. Theoretical Distribution of IQ Scores Based on Normal Curve

3. Adaptive Behavior refers to "the effectiveness or degree with which an individual meets the standards of personal independence and social responsibility expected for age and cultural group" (Grossman, 1977, p. 11). Modern and industrialized societies usually emphasize academics, good interpersonal relationships, independence, and social skills as indicated by Salvia (1978). The American Association on Mental Deficiency describes the following four levels of adaptive behavior impairment: mild, moderate, severe, and profound (Blackhurst and Berdine, 1981). These degrees of impairment in adaptive behavior are often reported with the same terms used for intelligence. Usually, the label educable refers to those individuals with IQ scores ranging from 50 and 70-75; trainable refers to those children with IQ scores which fall

between 20-30 and 50; custodial refers to those children who possess an IQ score of 25 and below (Moore and Moore, 1971) (see Figure 2).

AAMD classification	Stanford-Binet IQ	WISC-R IQ	Educational classification
Mildly retarded	68-52	69-55	Educable mentally retarded
Moderately retarded	51-36	54-40	
Severely retarded	35-20	39-25	Trainable mentally retarded
Profoundly retarded	<20	<25	Custodial

(Source: Grossman, H. G. Manual on Terminology and Classification in Mental Retardation. Washington, D.C.: American Association on Mental Deficiency, 1977, p. 19.)

Figure 2. American Association on Mental Deficiency Retardation Levels

Adaptive or maladaptive behavior, and social maturity or immaturity can be measured by standardized social maturity and adaptive behavior developmental scales. Such scales present an inclusive summary of characteristics of individuals categorized in the mild, moderate, severe, and profound level of retardation (Sherrill, 1981) (see Figure 3).

4. The "developmental period" refers to "the period between the child's birth and tenth birthday" (Blackhurst and Berdine, 1981, p. 325). However according to others it refers to the eighteen years of life (Sherrill, 1981).

Several other definitions and explanations of mental retardation have been offered:

> A state of incomplete mental development of such a kind and degree that the individual is incapable of adapting

	Pre-school Age 0–5 Maturation and Development	School Age 6–21 Training and Education	Adult Age 21 and Over Social and Vocational Adequacy
Level I, Mild	Can develop social and communication skills. minimal retardation in sensorimotor areas; often not distinguished from normal until later age.	Can learn academic skills up to approximately sixth grade level by late teens; can be guided toward social conformity; "educable"	Can usually achieve social and vocational skills adequate to minimum self-support but may need guidance and assistance when under unusual social or economic stress.
Level II, Moderate	Can talk or learn to communicate; poor social awareness; fair motor development; profits from training in self-help, can be managed with moderate supervision.	Can profit from training in social and occupational skills, unlikely to progress beyond second grade level in academic subjects; may learn to travel alone in familiar places	May achieve self-maintenance in unskilled or semi-skilled work under sheltered conditions: needs supervision and guidance when under mild social or economic stress.
Level III, Severe	Poor motor development: speech is minimal; generally unable to profit from training in self-help; little or no communication skills.	Can talk or learn to communicate; can be trained in elemental health habits, profits from systematic habit training.	May contribute partially to self-maintenance under complete supervision can develop self-protection skills to a minimal useful level in controlled environment
Level IV, Profound	Gross retardation. minimal capacity for functioning in sensorimotor areas needs nursing care.	Some motor development present. may respond to minimum or limited training in self-help	Some motor and speech development; may achieve very limited self-care. needs nursing care.

(Source: Sherrill. Dubuque, Iowa: William C. Brown Co., 1981.)

Figure 3. Adaptive Behavior Developmental Scale

> himself to the normal environment of his fellows in such a way as to maintain existence independently of supervision, control, or external support (Tredgold, 1937, p. 6).

> A retarded individual is one who has a limited repertory of behavior shaped by events that constitute his history (Bijou, 1966, p. 2).

> The condition which accounts for the lower end of the curve of intellectual abilities (Jordan, 1976, p. 2).

> Mental retardation is not a single disease entity. It is rather the result of hundreds of diseases and conditions each unique enough to be medically or psychologically identifiable. Some of these conditions are heredity; most are not. Some are clearly understood in terms of origin and process; most are not. Many are preventable in terms of present knowledge; most are not (Moore and Moore, 1977, p. 3).

> Mental retardation is not an isolated phenomenon. Since it is mainly associated with central nervous system damage or maldevelopment, it is not unusual for other handicapping conditions associated with central nervous system pathology to be concomitant (defects in vision, hearing, and speech as well as cerebal palsy) (Moore and Moore, 1977, p. 6).

The definition of mental retardation usually includes not only the mental component but many other psychological, medical, educational and sociological deficiencies as well. Such aspects require the input and services of teachers, physicians, psychologists, and social workers (Blackhurst and Berdine, 1981). This is why a team approach or a multidisciplinary approach is best when dealing with the problems of a mentally retarded child.

In order to be able to plan programs and to provide adequate services for the mentally retarded, it is necessary to estimate the number of mentally retarded individuals in our society. Although it is not an easy task to determine precisely the prevalence of mental retardation, the consensus is that the incidence of mental retardation in the population is 3 percent, and the prevalence is 1 percent as reported by Jordan et al. (1970). This implies that for every 100,000 people in a city, approximately 1,000 individuals are mentally retarded (Blackhurst and Berdine, 1981). Also, about 25 children in a community of 1,000 school-age children are mildly retarded, four moderately retarded, and one severely or profoundly retarded as indicated by Sherrill (1981). It is quite helpful to have these estimates presented with a breakdown by age and level of retardation (see Figure 4).

1970 Census	*Population*	*Under 21 years*	*21 years and over*
Total population	*203.3 million*	*80.5 million*	*122.7 million*
Retarded population	*6.1 million*	*2.4 million*	*3.7 million*
Profoundly retarded about 1.5%	92,000	36,000	56,000
Severely retarded 3.5%	214,000	84,000	130,000
Moderately retarded 6%	366,000	144,000	222,000
Mildly retarded 89%	5.4 million	2.1 million	3.7 million

(Source: National Association for Mentally Retarded Citizens. Facts on Mental Retardation. Arlington, Texas: National Association for Retarded Citizens, 1973.)

Figure 4. Prevalence of Retardation by Age and Level

The incidence of mild retardation in lower socioeconomic and cultural levels is greater than in the middle-class level (Sherrill, 1981). The President's Committee on Mental Retardation (1976) reported that 75 percent of the mentally retarded children in our society are from urban and rural poverty areas (Seaman and Depauw, 1982, p. 84). However, the incidence of severely and profoundly retarded is quite similar for all socio-economic groups as reported by Sherrill (1981).

Mental retardation, as with many other conditions, may be the result of either one factor or a combination of several factors (Seaman and Depauw, 1982). Most etiological classifications tend to categorize mentally retarded individuals into two main groups. The first group include individuals for whom the exact cause of retardation is elusive and could not be identified (Blackhurst and Berdine, 1981). The AAMD categorized these causes as being the result of "other conditions" and "environmental influences." The "other conditions" category, according to Sherrill (1981) includes individuals in which the cause of the retardation is not known; there is no history in the family of any subnormal functioning and there is no evidence to confirm the existence of an associated psychosocial factor. The "environmental influences" category, according to Sherrill (1981), include retardation resulted from lack of stimulation, sensory deprivation, lack of attention, significant deficiencies with special senses, and severe environmental conditions. It was reported by Cratty (1980), that about 90 percent of the mentally retarded individuals are placed in that category, while the remaining 10 percent are placed in the second group in which the causes of the mental retardation are known and can be identified.

The main identifiable causative factors of mental retardation are usually classified as those affecting before birth (prenatal), during birth (natal or perinatal), or after birth (postnatal) (Moore and Moore, 1977).

Prenatal Conditions. Included in prenatal causes are: (1) inherited or genetic conditions and (2) conditions during pregnancy which result in a damage of the child's brain. Some of the inherited or genetic conditions causing mental retardation during the prenatal period include: (1) dominant gene disorders such as tuberous sclerosis and neurofibromatosis, resulting in severe retardation (Moore and Moore, 1977); (2) recessive gene defects might cause nutritional disorders: phenylketonuria (PKU), affects the metabolism of proteins (Robinson and Robinson, 1976); Glactosemia, affects the metabolism of carbohydrates; and Tay-Sachs, affects the metabolism of fats (Robinson and Robinson, 1976; and Telford and Sawrey, 1977). Most of these conditions usually result in rare incidents of severe mental retardation which most likely exist among the institutionalized retarded population (Sherrill, 1981); and (3) chromosomal abnormality, which includes conditions that might be the cause of gene mutation, radiation, drugs or viruses as suggested by Seaman and Depauw (1982). The most common chromosomal abnormality is Down's syndrome, which was first identified by a British physician, Langdon Down, in 1866. Since the common physical attributes of individuals with Down's syndrome remind him of oriental people, he labeled the condition as Mongolism (Moore and Moore, 1977). Down's syndrome may be the result of the following: (1) trisomy, an extra chromosome 21, resulting in the child's having forty-seven rather than the normal forty-six chromosomes; (2) translocation, in which the child has forty-six chromosomes, but a portion of chromosome 21 attaches with another chromosome, usually number 15 or 22; (3) mosaicism, a condition in which the individual has cells with the normal number of chromosomes (forty-six), and others having cells of forty-seven or forty-five chromosomes (Moore and Moore, 1977). Down's syndrome children constitute approximately 10 percent of the moderately-to-severely mentally retarded population as suggested by Blackhurst and Berdine (1981). The risk of having a child with a Down's syndrome is increased among pregnant women between the ages of forty and forty-five (Moore and Moore, 1977). In order to determine the risk of carrying a child with Down's syndrome or other genetic disorder, a pregnant woman can have a test called Amniocentesis. The test consists of the examination of a small portion of the amniotic fluid which surrounds the fetus in the womb (Blackhurst and Berdine, 1981).

Other conditions during pregnancy which result in mental retardation are as follows: (1) prenatal and maternal infections such as German Measles (rubella) during the first three months of pregnancy, and syphilis that can injure the fetus (Wheeler and Hooley, 1976); (2) maternal disease, that might cause several complications during pregnancy such as a serious kidney disease or diabetes melitus (Blackhurst and Berdine, 1981); (3) intoxication, which implies factors such as Rh incompatibility, drugs, alcohol, tobacco, and exposure to radiation during pregnancy (Moore and Moore, 1977); (4) gestational disorders, which include atypical periods of pregnancy or gestation as being either too short resulting in prematurity, or too long resulting in postmaturity. Among these disorders, a low birth weight is also included (Sherrill, 1981); (5) unknown prenatal conditions usually involve congenital cerebal defects such as microcephalus (small head) and hydrocephalus (Seaman and Depauw, 1982).

Perinatal Conditions. Trauma and injury at birth are the main causes of retardation during the labor and delivery. Such conditions can be the result of prolonged labor due to improper positioning of the baby in the womb, or because of discrepancy between the size of the infant's head and the mother's pelvis which might cause brain damage (Moore and Moore, 1977). Another trauma during delivery is being referred to as asphyxia. In this situation, the baby suffers from lack of oxygen due to the compression of the umbilical cord which restricts the flow of placental blood and it's vital oxygen. Another reason might be due to other mechanical problems that prevent the baby from breathing upon birth (MacMillan, 1977).

Postnatal Condition include such factors as: meningitis which is the inflamation of brain tissues leading to mental retardation during childhood; brain injuries due to accident or child abuse; or due to lack of oxygen to the brain as a result of gas poisoning (Kirk, 1972). Other postnatal factors include environmental influences such as sensory deprivation, neglect or other adverse conditions that are not due to brain damage or genetic abnormalities. Finally, mental retardation may result following psychiatric disorders in cases where there is no evidence of cerebal deficiency (Seaman and Depauw, 1982).

It is extremely important to be aware of the above causes or incidents that might lead to mental retardation. Knowledge in that area can contribute significantly to a decrease, and many times, to prevent mental retardation and other related handicapping conditions.

The Educable and Trainable Mentally Retarded

The mentally retarded child possesses the same learning style and difficulties as those with the normal child. However, there is a difference of degree between the two in the following: "the rate of acquisition of skills; the generalization and transfer of acquired skills; and in paying attention to tasks" as suggested by Blackhurst and Berdine

(1981, p. 326). This section of the chapter will review the characteristics of educable and trainable mentally retarded children. The subjects in this study were selected from these two categories of mental retardation.

The educable mentally retarded child is also labeled as the mildly retarded, a classification suggested by the AAMD. Usually the educable child is not identified as being retarded during infancy and preschool years, since the child is not asked to perform highly demanding or complicated intellectual tasks. However, the child is often recognized as being retarded during the school years in which developmental delays are apparent and problems are noticed during the learning process (Kirk and Gallagher, 1979). The etiology of the educable retarded is mostly a combination of genetic and poor social and economic conditions in which pathological conditions are not apparent (Kirk and Gallagher, 1979).

The trainable mentally retarded child is also labeled as moderately retarded according to the AAMD classifications. The child is usually identified as retarded during early childhood, when developmental delays are most likely to appear in the areas of language acquisition and motor pattern development as indicated by Cratty (1980). The etiology of the trainable retarded might be a singular or a combination of relatively rare neurologic, glandular, or metabolic defects (Kirk and Gallagher, 1979). A high percent of Down's syndrome children are classified within the moderate-trainable level of retardation (Cratty, 1980). Children with Down's syndrome, according to Blackhurst and Berdine (1981), constitute approximately 10 percent of the moderately-to-severely mentally retarded population.

The IQ scores of the educable mentally retarded child range between

50 and 70-75 (Moore and Moore, 1977). The mental age expectancy level of educable child is ranged from 8 to 12 years as reported by Kalakian and Eichstaedt (1982). Usually, educables are placed in regular classes combined with support services such as part time attendance in a resource room. Some educable students may attend special classes for academic subjects; but then they join the regular classroom for art, music, or physical education (Blackhurst and Berdine, 1981). It was noted by Kirk and Gallagher (1979) that the educable child has the potential for development in the following: (1) educability in the academic subjects at the primary and advanced elementary levels; (2) in social endeavors, the child can be adjusted to the mainstream of society and finally to be an independent individual in the community; and (3) in the occupational area, the child can gain skills, so he/she can be economically independent. Overall, the goals of programs for the educable child are aimed toward the development and acquisition of academic, vocational, social and recreational skills. Such skills will allow the child to be an independent and productive in adulthood (Moore and Moore, 1977).

The IQ scores of the trainable child usually range from 25-30 to 50 (Moore and Moore, 1977). The mental age expectancy of the trainable child ranges from 3 to 7 years as noted by Kalakian and Eichstaedt (1982). The educational setting of most of the trainable children is a full time self-contained special classes in regular or special schools. The goals of programs for the trainable child are usually focused on the development of self help skills, basic communication skills, and vocational skills, so that the child will be able to work and be placed successfully in a supervised or sheltered workshop setting (Moore and Moore, 1977). Many of the trainable adults may acquire the life-care skills, so they are able to live in a group home or in supervised apartment living units (Blackhurst and Berdine, 1981).

Motor Characteristics of Mentally Retarded Individuals

The following will review research studies and related literature since the 1930s, in order to gain some insight about the motor domain of the mentally retarded.

In an effort to describe the motor characteristics of the mentally retarded, Thedgold (1937) suggests that these children possess deficiency in the fine motor skills involving the hand and the fingers. Also, he claims that these individuals show clumsiness and uncoordinated patterns in locomotor activities. In a study of manual dexterity, Neeman (1968) used the Purdue Peg Board test. The findings indicated that the retarded subjects scored significantly less than normals. Sloan (1951) used the Lincoln revision of the Osertsky test of motor proficiency with mentally retarded and normal subjects. The author found that the normals achieved significantly higher scores than the retardates on all the six subtests of the Osertsky test named: general static coordination, dynamic manual coordination, general dynamic coordination, speed of movements, ability to perform simultaneous movement, and skynkinesia (superflous side movements).

In a study conducted by Howe (1959), the purpose was to compare educable mentally retarded children (IQ mean = 67.5) and normal public school children on eleven motor tasks (sargent jump, balancing, tracing speed, tapping speed, grip strength, zig-zag run, fifty-yard dash, squat-thrust, ball throw, and paper and pencil maze). Howe (1959) reported that for boys, the normal subjects scored significantly higher than the retarded subjects on each of the eleven motor tasks. For girls, differences favored the normal subjects for all tasks, and all except grip strength and accuracy in throwing a ball at a target. Also, the findings of that study showed that the mentally retarded children had difficulties in balancing on one foot. Only two of the 43 children, according to Howe (1959), could balance for one minute while most of them could balance for little more than 20 seconds. In a study conducted by Cratty (1967) with mentally retarded children, only 80 percent were able to balance on one foot with their arms folded across their chest for a period of five seconds, where only 20 percent of the trainable could perform the same task. In the same manner the educable children achieved higher scores on tasks related to body awareness and laterality as reported by Cratty (1967).

In relation to reaction time, Cratty (1980) indicated that most studies revealed that retarded children and youth react slower to stimuli than do normals and that reaction time tends to last longer when the task to be executed and/or the stimuli to be reacted to is made more complex. Physical education teachers should consider such findings when working with the mentally retarded in terms of the speed of stimuli presentation or the demonstration of visual displays.

It was reported in the literature (Sherrill, 1981), that the most extensive research in the motor domain of the mentally retarded children was conducted by Lawerence Rarick, a professor at the University of California at Berkeley. In a study conducted by Francies and Rarick (1959), the motor performance of 284 public school educable children (IQ = 50-90), with a chronological age range from 7½ years to 14½ years was investigated. The authors measured those motor abilities which previous research reported as being important in predicting overall motor ability—strength, speed, power, agility, and balance. Francis and Rarick (1959) found that the mentally retarded group scores were significantly behind published standards of those of normal children. Based on the same study, Francis and Rarick (1959) reported that the data collected from this mentally retarded group yield that the motor performances of mentally retarded cluster similarly as these of normals, because when the interrelationships among scores on the selected motor tests were examined, the interrelationships among particular variables were similar to those reported for normals, as reported by Rarick, Dobbins and Broadhead (1976). Studies conducted with normal individuals have yielded that both gross and fine motor skills are rather specific in nature as claimed by Francis and Rarick (1959).

Rarick and his colleagues (1970), conducted one of the most extensive and comprehensive research projects with mentally retarded children in the area of motor performance. The sample included 4,000 educable mentally retarded children with an IQ range of 50 to 80, and a chronological age range from 8 years to 18 years. Rarick, Widdop and Broadhead (1970) used the American Association for Health, Physical Education, and Recreation (AAHPER) Youth Fitness Test, which was modified for use with the educable mentally retarded children. The AAHPER Physical Fitness Test Battery is designed to assess: gross motor performance such as muscular strength, speed of movement, agility, coordination, and endurance as indicated by Rarick, Widdop and Broadhead (1970). The scores achieved by the mentally retarded group on the above variables were compared to the performances of children of normal intelligence of the same age and sex. The findings yielded that the mean scores of the educable performances were significantly lower, 85 percent of the time than the scores achieved by normal children. The inferiority of the mentally retardates, according to Rarick, Widdop and Broadhead (1970) found mostly in the 300 yard shuttle run, broad jump, softball throw, and fifty-yard dash. The authors could not conclude as to whether the lower scores of the retardates were due to inappropriate placement of these children in physical education programs, or due to a variety of neurological impairments as suggested by Cratty (1980).

It was reported by Rarick, Dobbins and Broadhead (1976) that only few researchers used factor analysis studies in order to investigate the nature of motor abilities and perceptual-motor functions of the mentally retarded. Vandenberg (1964) factor analyzed the data he collected from testing 434 institutionalized and public school retardates and normal children, on the Lincoln Osertsky Test. The analysis yielded eight factors involving the following as main components: speed of movement, balance, dynamic coordination, and age. Clausen (1966) tested 276 mentally retarded children and youth, and 112 normal subjects on 33 motor and mental tasks. Factor analysis yielded the following factors: general ability, general intelligence (intellectual-perceptual and spatially related intellectual), visual acuity, auditory acuity, reactive motor speed, cutaneous space discrimination, kinesthesis, steadiness, eye-hand coordination, hand dominance, and strength of grip. According to Clausen (1966) the main difference between the normals and the retardates sample was that the degree of generality and magnitude of variance accounted for by the general ability factor was greater in the retardates than in the normals.

In a highly sophisticated factor analysis study conducted by Rarick, Dobbins and Broadhead (1976), the sample composed of 406 chidlren, 270 young educable retardates with a chronological age of 6 through 13 years, and 145 normal children. The results obtained from 47 physical and motor performance measures of the normals and retardates were factor analyzed. The factor structures obtained on the group of normal children and the group of retardate subjects were significantly similar as suggested by Rarick, Dobbins and Broadhead (1976). Also, the authors concluded that in these particular groups of normals and retardates, there was less specificity in motor performance than has been reported in factor analytic studies on older subjects. In summarizing their study, Rarick, Dobbins and Broadhead (1976) claimed that it is apparent that on the majority of the motor tasks, most of the retarded boys and girls "were exceeded by 80 to 90 percent of the normal children of the same age and sex" (p. 114). These findings are generally consistent with previous research studies.

Sherrill (1981) listed the following facts about the motor characteristics of the mentally retarded which were inferred from the extensive research work conducted by Rarick with retarded children aged 6 and up:

1. Generally, normals and educable and trainable retardates have similar factor structure of motor abilities. The following factors should be considered when planning the physical education curriculum: body fat, fine-motor coordination, gross limb-eye coordination and balance.

2. Motor deficiency is more apparent as the level of retardation increases. There is no cause and effect relationship between the two, but they go together.

3. Trainable mentally retardate children are found to be 2 to 4 years behind normal children in the same age on most measures of motor

performance. The delay tend to increase as the child grows.

4. The main two factors a teacher needs to consider while teaching motor skills are attention span and the child's level of comprehension rather than execution. These facts have implications for teachers when introducing new tasks.

5. There is a low positive relationship (0.10-0.30) between motor performance and intelligence with the retardates. Balance tasks and tasks requiring the use of fine visual-motor coordination found to correlate highest with intelligence as reported by Sherrill (1981).

In reference to the importance of the motor domain especially with the mentally retarded child, Kalakian and Eichstaedt (1982) indicated that mentally retarded children are more similar to their normal peers in physical attributes and motor performance than in any other domain. The motor domain, according to Kalakian and Eichstaedt (1982), provides the retarded child the best avenue for achievement and success. The motor deficiencies which exist within the retardates are due to lack of opportunities rather than lack of potential as suggested by Kalakian and Eichstaedt (1982).

Such an optimistic attitude regarding the potential of the mentally retarded child, mainly in the motor domain, might contribute greatly to the overall development of the retarded.

Motor Abilities and Motor Skills

Motor abilities and motor skills are very often used interchangeably. However, it is much more convenient to identify each term separately (Fleishman, 1966). The term ability indicates a more global trait of the individual which is derived from certain response consistencies on a particular motor task (Fleishman, 1966). According to Schmidt (1982) ability can be thought of as a hypothetical construct that reflects performance in a variety of motor tasks and motor activities. Also, motor ability is the direct psychomotor state of an individual to engage in these motor tasks and motor activities (Singer, 1980). An ability is usually considered to be a relatively fixed characteristic or trait that contributes to performance in certain ways (Schmidt, 1982). Many of the motor abilities are learned during the years, but to a large extent, their development occurs during childhood and adolescence. For some abilities development is more influenced by the genetic construct of the individual than of learning factors. Fleishman (1966) concluded that the development of abilities, to some degree, is the product of both learning and heredity. Schmidt (1982) stated that motor abilities, to a large extent, are fixed constructs that are unmodifiable by experience or by frequent practice. Abilities, according to Schmidt (1982) represent the underlying features that an individual has, and they determine the level in which a motor task is being performed. As such, abilities also can be viewed as restricting the actual performance or as determinates of the ultimate success an individual can gain while engaged in motor skills or athletic endeavors (Schmidt, 1982).

The term skill, according to Singer (1980), to some degree can be compared to the term learning, because both of the terms possess the difficulty of being assessed and interpreted. The term skill can be interpreted or defined differently by different people or in different events (Singer, 1980). The term can indicate a distinct action that have been carried out or the degree of competency with which one has performed a particular task or several tasks (Fleishman, 1966).

A great number of activities are described as skills, or are viewed as skills and the ultimate level of competency reached by an individual determines a level of skill (Singer, 1980). Skill is task oriented and being a skillful person means that a person has gained the sequence of motor responses for a specific task (Fleishman, 1966). The implicit assumption is that skills can be thought of as basic abilities when involved in complex activities. Therefore, these basic abilities may have a great deal of importance in gaining competency in other motor skills as well (Fleishman, 1966).

Skill, as stated by Singer (1980), is a relative quality. Hence, it is not to be described or defined in fixed terms. Skill can also be demonstrated by performance which also points out what has been learned. According to Singer (1980), psychological and emotional factors have a great amount of influence upon performance and skill. As opposed to abilities, skills are modified by practice and experience. However, because skilled movements are not found to be inherited as suggested by Schmidt (1982), they require long periods of practice and experience in order to master them.

The method of measuring or evaluating mental or psychomotor abilities is much more controversial among testing experts than it is with measuring a particular skill or a competency in a specific subject matter (Singer, 1980). Since abilities are assumed to underly the ultimate success of an individual in pursuing motor tasks, a valid and reliable assessment technique of an individual's abilities is still quite desirable. Consequently, these abilities could be a valuable indicators of task proficiency (Singer, 1980). The process of measuring a skill is an easier task than that of measuring an ability since skills are much more distinct features that can be observed, where abilities are more hypothetical constructs (Singer, 1980). According to Singer (1980), abilities can be delineated by subjective observation, or statistical techniques, such as correlational and factor analysis models.

Most often abilities are derived from the analysis of the individual's patterns in carrying out motor responses on several groups of tasks (Schmidt, 1982). Correlations are used as the most common method of abilities measurements. In the case of a high relationship between two motor tasks, the assumption is that there is a common feature that underlies both motor tasks. This common feature is assumed to be the so called ability (Schmidt, 1982). However, there is not a known absolute right way to measure an ability (Singer, 1980). According to Singer (1980), the ability score in published materials is actually a score given for a particular motor test or motor skill.

Taxonomy of Motor Abilities

The education of the whole person is the concern of many educators and curricular planners. An individual behavior is most often classified and described by referring to the cognitive, affective, psychomotor and the physical domains as the main categories (Magill, 1980).

The cognitive domain includes the person's mental and intellectual manipulations. Guilford (1959) suggested that there are over a hundred human abilities in the cognitive domain. Benjamin Bloom (1956) developed a taxonomy in which he described the objectives that can be attained by the operation of the cognitive domain. Bloom's taxonomy promotes a better comprehension of the cognitive domain since it places the different cognitive operations in a sequential order from simplest to most complex (Magill, 1980).

The affective domain contains the human feelings and emotional states. Recently social psychologists works have provided significant evidence to support the idea that our affective behavior, to a large extent, is a learned behavior (Magill, 1980). Magill (1980) mentioned the efforts made by Krathwohl, Bloom, and Masia in the early 1970s to categorize the affective behaviors in the same method it has been done in Bloom's taxonomy with the cognitive domain.

Movement is the most common feature in the psychomotor domain. The terms motor domain and psychomotor domain are usually used interchangeably. However, the psychomotor domain indicates a simultaneous activation of both the cognitive and the movement operations. There are numerous skills and motor behaviors that signify the psychomotor domain. Magill (1980) claims that the composite structure of most of the motor skills prevented as successful a production of a taxonomy in the psychomotor domain as those in the cognitive and the affective domains. A taxonomy is a system in which different elements are classified and organized in an orderly manner. According to Schmidt (1982) a taxonomy "is a classification scheme that can be used to assign items in a set into various categories" (p. 412). Schmidt (1982) mentioned the common classification methods in motor learning such as open versus closed skills and continuous versus discrete skills. However, more comprehensive methods of skills categorization have been developed. The classifications in these schemes are based on the underlying structure of the abilities involved in motor tasks (Schmidt, 1982).

Magill (1980) described the systematic categorization of motor abilities that have been developed by Guilford in the late 1960s.

Guilford (1958) identified six major factors as underlying most of the motor skills. The factors are as follows: speed, strenght, impulsion (the speed in which movements are activated from fixed positions), precision, flexibility, and coordination (Magill, 1980, p. 8). Another method of classification of motor abilities described by Magill (1980) was developed by Elizabeth Simpson in the mid 1970s. Simpson (1974) listed the following stages from sense organ stimulation to motor acts origination: (1) Sensory stimulation, arousal of the sensory organs as a result of a stimulus or stimuli, (2) set, the state of being ready for the performance of a particular act, (3) guided response, the motor act of an individual after he or she have been instructed or after he or she made self evaluation as compared to a given model or criteria, (4) mechanism, the individual attained some degree of competency where the motor response became to be a habit, (5) complex overt response, the individual reached the level of being skillful since she or he succeeded to perform a complex movement pattern, (6) adaptation, activating motor responses to answer the needs of new demanding situations, and (7) origination, initiating new motor acts and movement responses (Magill, 1980, p. 7).

Edwin Fleishman (1970) used a different approach while he developed a taxonomy of motor behaviors. According to Magill (1980), the taxonomy designs of Simpson and Bloom tended to aid in the development of educational objectives whereas Fleishman's method is directed more toward motor abilities (Magill, 1980). Fleishman (1975) identified the following four categories for classifying tasks:

1. The behavior description approach in which people are being observed while pursuing motor tasks,

2. The behavior requirements approach in which the series of motor responses needed for a successful completion of a task are identified,

3. The ability requirement approach in which the underlying abilities needed to perform motor tasks are identified through the factor analytic statistical approach,

4. The task characteristics approach in which a motor task is explained as the required conditions to start a motor response (Fleishman, 1975).

The research conducted by Fleishman (1975) proposed to analyze psychomotor tasks and the human abilities underlying them by using the ability requirement approach. The tasks have been described, contrasted and compared based on the underlying abilities that a given motor response demands from the performer (Fleishman, 1975). These motor abilities are thought of as stable features of the individual performing the task. Fleishman (1975) assumed that certain tasks will demand specific abilities in order to attain the ultimate success in performance. Motor tasks demanding the same abilities would be classified in the same category or would be proposed as identical (Fleishman, 1975).

Edwin Fleishman has conducted numerous related experimental factor analytic studies over a long period. Fleishman (1975) proposed to identify the underlying abilities (factors) for a series of perceptual-motor performances (Fleishman, 1975). Underlying abilities that contributed to the performance of complex psychomotor responses and a variety of skills required by pilots were examined by Fleishman and Hemple (1956). Later, Fleishman suggested a classification scheme of human psychomotor behavior which will serve as a reference and common language practical to various fields (Fleishman, 1975).

The experimental battery, which was composed of more than 200 different psychomotor tasks, was administered to thousands of subjects (Singer, 1980). The interrelationships among the motor patterns were studied through a factor analysis method. After the examination of a wide variety of motor tasks, Fleishman (1975) stated that he was certain that motor performance is attributed to a very small number of abilities (Fleishman, 1975). The following list of abilities has been identified by Fleishman (1975):

1. Control precision, the ability to perform extremely controlled and accurate movements involved with groups of large muscles.

2. Multi-limb coordination, the ability to control the acts of several limbs in the same time.

3. Response orientation, the ability to choose and perform the proper direction of response from several alternatives.

4. Reaction time, the ability to react to a stimulus.

5. Rate control, the ability to make continuous anticipations and adjustments, and timing judgement, relative to change in speed and direction of a continuously moving object.

6. Speed of arm movement, the rate in which a gross upper limb movement can be made regardless of precision or accuracy.

7. Manual dexterity, the ability to make skillful, controlled arm-hand manipulations of large objects under speed conditions.

8. Finger dexterity, the ability to make high skilled, controlled manipulations of very small objects, mainly using the fingers.

9. Arm-hand steadiness, the ability to perform accurate and controlled arm-hand positioning movements with a minimum use of speed

and strength.

10. Wrist-finger speed, the ability to tap very quickly the wrist and the fingers.

11. Aiming, the ability to aim accurately and rapidly to a target (Singer, 1980, p. 194).

In addition to the above perceptual motor abilities, Fleishman (1965) postulated nine "physical proficiency" abilities. Compared with the perceptual motor abilities, these abilities are more related to the physical and structural features of the human body (Schmidt, 1982). Also, they are most likely to be associated with athletic endeavors and gross motor movements (Singer, 1980). The underlying abilities identified by Fleishman (1969) are:

1. Static strength, the greatest amount of power that can be exerted against a fixed object.

2. Dynamic strength, "muscular endurance in exerting force repeatedly."

3. Explosive strength, the ability to use power effectively in a sudden bursting motor response.

4. Trunk strength, resistance of the trunk muscles.

5. Extent flexibility, the ability to bend or stretch different parts of the body.

6. Dynamic flexibility, the ability to flex the trunk repeatedly and rapidly.

7. Gross body coordination, the ability to integrate the acts of several body parts simultaneously.

8. Gross body equilibrium, the ability to maintain body position in space while blindfolded.

9. Stamina, the ability to undergo physical strain (Magill, 1980, p. 200).

Several comments regarding these abilities have been made by Magill (1980). Magill (1980) argued that the set of abilities have been identified by Fleishman are not complete or representative sample of all possible abilities underlying motor performance. According to Magill (1980) Fleishman's identified abilities are confined within the kinds of tests that have been used. It cannot be proposed that the underlying abilities that have been inferred from the motor tests that were administered by Fleishman comprise all human motor abilities. In order for these motor abilities lists to be completed Magill (1980) suggests that other motor tasks that exist should be included. Also, he claimed that the identified abilities are, to a great extent, independent, and as such, the rank of a person on a test of one ability, by no means can help to predict the rank of that person on a test of another ability. However, Magill (1980) concluded that the underlying lists should be appreciated and recognized as a significant contribution to the understanding of human motor behavior (Magill, 1980).

Although Fleishman (1975) and others have attempted to classify motor abilities, Singer (1980) proposed that there are at least four factors that appear to be of most interest to motor learning researchers named: coordination, kinesthesis, balance, and speed of movement (Singer, 1980). Singer (1980) noted that these four motor factors can be used in research projects as follows: (1) as learning tasks, (2) for establishing ability norms, (3) for determining task specificity versus generality, and (4) for predicting how well someone will learn and perform in a given activity (Singer, 1980, p. 198).

Generality Versus Specificity in Motor Performance

The controversy over the issue of generality versus specificity has been in existence for many years. Some of the motor learning researchers propose that there exists a global, general motor ability, where others argue that there are a great number of specific motor abilities (Magill, 1980). After surveying the trends in research, Cratty (1964) noted that the issue of generality versus specificity is evident since the 1900s. Research studies which are more subjective in nature in the early part of the 1900s, suggested that certain general features in motor performance do exist. Later, during the 1930s as cognitive abilities were evaluated apart from motor skills and as more objective devices to measure motor performance were innovated, research studies pointed out that motor abilities are specific in nature (Cratty, 1964).

During the 1950s and 1960s, a considerable interest has been focused on the issue of generality versus specificity that was significantly evident in research studies conducted in that period (Magill, 1980). During that time, the existence of general intellectual ability was very questionable (Schmidt, 1982). With regard to motor skills, the questions aroused, to a large extent, after the completion of two significant projects: (a) the research project on motor abilities factor structure conducted by Franklin Henry and his students at the University of California, Berkeley, and (b) the extensive research study which examined individual differences among pilots conducted by Edwin Fleishman and his associates through the U.S. Air Force (Schmidt, 1982). These two research projects significantly contributed to advance the study of human motor behaviors. Even though these two programs used extremely different research methods and techniques, they significantly added to the comprehension and to the clarification of the notions of generality and specificity in motor performance (Schmidt, 1982).

Since the 1960s, the debate over the issue has lessened in intensity. However, the question of which notion is valid has never been clarified (Magill, 1980). According to Magill (1980) the best evidence to demonstrate the unresolved question can be found in most of the test and measurement textbooks in physical education. These books present "such tests as McCloy's General Motor Ability Test, Cozen's Athletic Ability Test, and Barrow Motor Ability Test" (Magill, 1980, p. 205). The purpose of these tests is to examine an individual's motor ability. However, Magill (1980) criticized the way in which these tests are constructed. On the completion of the test battery, the examiner calculates only one score which is assumed to be an indicator of the individual's motor ability. Based on these results, physical education teachers place their students in homogeneous ability groups. However, when individual differences on specific motor tasks are considered, these tests are not considered to be reliable and they should not be used as suggested by Magill (1980). After reviewing numerous research studies dealing with the issue of generality versus specificity, Henry (1958) claimed that the idea of specificity resulted in trauma as is the case with accepting any new theory. However, we cannot ignore such a theory (specificity) since it has been confirmed for a long time. He asked curriculum planners to consider the specificity theory while planning educational programs.

The Generality Hypothesis

In the early part of the twentieth century, and to a large extent, in the present, the notion of general motor ability represented the idea that the human motor behavior was based on a single and very general motor ability (Schmidt, 1982). This global motor ability is sometimes referred to as "athletic ability," "coordination," "motor ability," or as it more often is being called "general motor ability" (Schmidt, 1982, p. 397). The individual's proficiency level in that general motor ability, greatly influences the ultimate success an individual can attain in pursuing any motor skill (Magill, 1980).

Advocates of the idea of generality claim that there is a significant relationship among a variety of motor skills within individuals. Consequently, an individual level of proficiency on one motor skill could be an accurate predictor of that individual level of proficiency on all other motor skills (Smith, 1973). This point of view, according to Smith (1973), implies that teaching is a very simple task since the results of a single motor ability test gives the teacher indication about the ability level of their students on all other motor tasks. Also, the grouping and teaching of students would then become a relatively easy task (Smith, 1973).

The notion of generality of motor skills exists for quite a long time according to Lotter (1961) and it is quite often mentioned in the physical education literature. Brace (1927) mentioned that there is a basic motor ability that all individuals use while they learn and perform motor activities. Nash (1951) suggested that development of general motor coordination is one of the most important objectives of physical education. Larsen (1951) stated that general motor ability is the individual's ability in features assumed to underlie motor responding such as muscular strength, muscular power, muscular endurance, coordination, agility, and balance.

These notions which were developed in the early part of the twentieth century were influenced, according to Schmidt (1982), from the common observations (on playgrounds, in athletics, etc.) that certain individuals have had a success in any motor tasks they tried (so-called "all around athletes"), while other individuals could not perform well at any motor task they tried. These "accidental" observations according to Schmidt (1982) can explain the assumption about the underlying feature that resulted in high correlations among the various athletic tasks. The assumption that a general motor ability exists was influenced, to a large extent, by the similar research studies which have been done to examine cognitive abilities in the 1930s, as suggested by Schmidt (1982). Intelligence was the prominent concept that derived from these research projects that studied cognitive abilities. During the 1930s and 1940s the measures of intelligence quotient (I.Q.) were constructed, and education professionals strongly convinced that the result of an IQ test could be a reliable predictor of a person's potential success in any life endeavor (Schmidt, 1982, p. 397). IQ was constructed as a score of the hypothetical general mental ability. It was believed that the level of that mental ability had a significant impact on the ultimate level of success a person could attain in most of the mental tasks in which he was engaged (Schmidt, 1982).

Famous physical education professionals such as C. H. McCloy (1934), David Brace (1927), and Harold Barrow (1973) were mentioned by Magill

(1980) as being strong advocates and supporters of the notion of general motor ability. Their tests have been designed to examine an individual's present motor ability level as well as estimating the success of the individual in athletic events as suggested by Magill (1980).

The prominent device for evaluating generality of motor ability was developed by McCloy (1934). He proposed the "General Motor Capacity Test" as evaluating general motor ability. McCloy suggested that motor capacity composed of "a person's inborn, hereditary potentialities for general motor performance" (Magill, 1980, p. 206). The general motor capacity test developed by McCloy paralleled the Stanford-Binet intelligence test. "McCloy's Test," according to Baumgartner and Jackson (1975), included variables of size and maturity, arm strength, agility, motor educability, intelligence and motor patterns involving sprinting, jumping, and throwing.

The review of the research studies related to the issue of generality versus specificity revealed insignificant support for the existence of a general motor ability. According to Singer (1980) for a long period researchers tried to confirm the existence of general motor abilities and to identify certain motor abilitiees that would be the predictors or indicators of general athletic achievement, or educability in motor skills. However, most of these researchers' works confirmed the notion of specificity of motor tasks (Singer, 1980).

In spite of the research findings, the popularity of the generality hypothesis continues to exist. Magill (1980) proposed that the reason the generality hypothesis is still in existence, is because its appealing nature. Motor tests based on the generality theory are also appealing because they are convenient. Although these tests are not reliable in predicting specific motor skills, their usage has not diminished (Magill, 1980).

The Specificity Hypothesis

In the early part of the twentieth century, Thorndike proposed the "stimulus-response theory of connectionism learning" which was greatly used by later psychologists (Smith, 1973). The stimulus-response theory emphasized the notion of specificity by demonstrating certain behavior to a specific stimulus. According to Smith (1973) the idea of specificity of motor ability is well known to psychologists, and physical education researchers continued the work of Thorndike.

In the late 1950s Franklin Henry (1958) proposed the memory-drum theory of neuromotor action, which suggests that human motor abilities are task specific and are not general to a variety of tasks. According to that theory, the known level of proficiency in one motor task absolutely cannot be a reliable predictor of the individual's potential level of proficiency in another motor task (Magill, 1980). The specificity theory, as proposed by Henry (1958), also emphasizes the fact that even two motor tasks appear to be very similar, there might be a zero correlation between them (Magill, 1980).

The memory-drum theory proposed by Henry (1960) is neurologically oriented and assumes that when an individual learns a motor skill, a specific neural pattern is stored on a so-called "memory-drum," comparable to a computer program in the higher centers of the nervous system. According to that theory, the appropriate stimuli will call the stored neural pattern into operation and a well-coordinated motor act will be accomplished (Singer, 1980). It is an important assumption of the memory-drum theory that only certain motor skills are stored, and that different motor skills have different neural patterns (Singer, 1980). If a given motor skill is not "etched" on the memory-drum, it's execution will be awkward or poorly coordinated (Singer, 1980).

On the basis of the memory-drum theory, Henry (1958) stated that a general motor ability does not exist; rather each individual possesses many specific motor abilities. The amount and the kinds of these specific motor abilities are, to a great extent, different from person to person. The theoretical basis of Henry's specificity theory suggests that the validity of tests which measure general motor ability or general motor capacity are quite questionable. According to Lotter (1961) a test which measures general motor abilities usually includes only a sample of all the possible specific abilities, hence it can be valuable only in setting up a standard or a criterion that relates only to these specific abilities that have been used as the sample. According to Henry (1958), a high rank that a person reaches on a general motor ability indicates that this person scores very high on many specific motor abilities. On the other hand, a low rank that a person reaches, indicates that that person has only a few well coordinated specific motor skills stored on his memory-drum (Henry, 1958). Henry (1958) proposed that repeated practice of a motor act develops and improves only that specific act that is repeated. Also, the level in which different individuals with different motor abilities improve by practice is specific to the skill having been performed and it by no means can indicate the rate of improvement in other skills (Henry, 1958).

Evidence to support the specificity theory has been amounted through the design of correlational and factor analysis studies. The underlying assumption on which these studies have been based was that human motor abilities are specific and unrelated, hence the correlation between any two or more motor abilities would be close to zero (Magill, 1980). According to Smith (1973), research studies have been done in the field of motor learning significantly support the hypothesis that motor abilities are highly specific to the task performed or reached. Smith (1973) mentioned several researchers and the findings of their studies as they related to the issue of generality versus specificity in motor learning. Bachman (1961), after conducting an extensive study with 320 subjects concluded that such features as general motor coordination do not exist. Also, there is not global ability of motor learning; rather the motor abilities are specific to the tasks performed in both, performance and learning motor skills. Since the results of the study revealed a correlation little more than zero between performance of the two motor tasks, the author concluded that such findings supported the specificity theory (Smith, 1973). Smith (1959) examined the relationship between the rate of learning to swim and general motor capacity. He found that general motor capacity is a very poor predictor of a person's rate in learning to swim (Smith, 1973). An investigation by H. G. Seashore (1942) studied the relationship between fine and gross motor abilities. It was concluded that there was very low relationship between the two, hence, prediction about gross motor abilities based on fine motor abilities might not be reliable. In 1934, Rogsdate and Breckenfield tested junior high school boys in a number of football, baseball, basketball, and track skills. As a result of finding low interrelationships, they concluded that it is not logical to talk of a general motor ability. Factor analytic study examined the interrelationships of gross motor skills was conducted by Johns (1935). He factor analyzed the performance of over 2,000 college men. All the intercorrelations were quite low, hence, he reported lack of any relationships among the variety of motor abilities studied which supported the specificity theory (Johns, 1935). Cumbee in 1954 and 1957 attempted to find a standard definition of motor coordination. She factor analyzed 22 motor ability test items after a wide range of motor coordination tasks were administered. Most of the factor loadings were very low which indicated a significant support for the specificity hypothesis. Fleishman (1958) investigated 24 fine motor tasks which revealed a high level of specificity (Singer, 1980). Singer (1966) examined the type of relationship between throwing and kicking skills. He calculated correlations "for all the possible limb combinations." Singer (1966) concluded that great specificity existed among the limb relationships (Singer, 1980, p. 188).

Reaction time and speed of movement are two motor abilities, according to Smith (1973), that have a significant impact on the potential success of an individual in a wide variety of motor activities. According to Smith (1973), findings of experimental studies done in relation to these two tasks strongly support the specificity theory. Lotter (1960) conducted a study with a sample of 80 college men. Lotter (1960) recorded the highest rates of discrete leg and arm movements which were identical to the body motions in kicking a football and throwing a baseball. He concluded that motor abilities that contribute in the performance of fast movements are, to a great extent, task specific and they do not exist as a speed factor that can be evaluated in a general speed ability test (Smith, 1973). A similar conclusion was obtained by Smith (1961) who found very low intercorrelations between the speeds of forehand and backhand tennis type arm actions and forward and backward kicking movements (Smith, 1973).

Most of the reaction time and movement time findings derived from laboratory experiments have shown lack of relationship between the two factors (Singer, 1980). In the same manner, the ability to react fast and the ability to move fast are, to a large extent, unrelated (Smith, 1973). Using college varsity swimmers as subjects, Groves (1973) recorded the reaction time from the time of the shot fired to the first noticeable movement. Then movement time was measured from the first movement until the subject's feet left the edge of the pool. The findings revealed a very low relationship between movement time and reaction time as reported by Singer (1980).

Overall, the evidence and findings obtained from studies dealing with the generality versus specificity issue, result in questioning the generality theory. Smith (1973) criticized the continuing use of test batteries such as the General Motor Educability and General Motor Ability and Capacity, based on the "outdated" generality theory rather than on scientific evidence. Smith (1973) continued on to suggest that:

> At the tails of the normal curve of the distribution of physical skill, extremely motor gifted and retarded individuals often will display a fairly homogenous high or low level in specific motor skills which could be interpreted as evidence for a General Motor Ability. However, these individuals are virtually motor ability "freaks" when compared to the heterogeneous scatter of motor abilities which are common to individuals who represent the bulk of the normal population (p. 25).

The teaching and coaching professions would be a very easy task to pursue if the generality hypothesis had been confirmed by experimental studies. The ranking procedures of students in different task activities would be similar and very easy. Since there would not be any considerations for individual differences in performing different motor tasks (Smith, 1973). But, since there is no such thing as general motor ability, it makes teaching and coaching a much more demanding task and needs much more considerations in regard to grouping and teaching students (Smith, 1973).

Overall, the review of the related literature suggests that motor abilities are highly specific to the motor task performed, and the relationship among a variety of motor tasks is zero or a little more than that.

The "All-Around" Athlete

The evidence supporting the specificity hypothesis in regard to motor skills and motor abilities does not explain the "all-around" athlete phenomenon. Most of the research studies confirmed the existence of many independent abilities. The question which instantly arises is how does one individual come to be so skillful on a wide variety of sport events? Also, how do these individuals seem to have little difficulty in achieving a high level of success in every sport they are engaged with? According to Magill (1980), if a person possessed a wide range of high level abilities, his success potential on a wide variety of sports activities would also be very high. Also, the underlying abilities needed for a high level of performance in any given sport are very significant in anticipating the degree of success in that sport (Magill, 1980). According to Singer (1980), the probability of success in several sport events increases only when distinct factors are in operation. He described these underlying factors as follows:

1. Ample experience and practice in broad range of motor skills

which will contribute to the acquisition of nobel but related skills.

2. Genetic component that determines the individual's potential in motor skill acquisition.

3. Participating in sport events demanding related motor skills increases the athlete's potential of accomplishment as suggested by Singer (1980). According to Schmidt (1982), several other factors might contribute to the fact that there are children doing well in all sports while others don't succeed in any sport. He suggests that parental encouragement, body composition and nutrition, and personality characteristics are among these forces that determine the child's potential in a variety of sport events.

It was claimed by Singer (1980) that the so-called "all-around" athletes are rare individuals and their motor capabilities are the exception rather than the rule. However, these athletes can be considered as individuals characterized with a higher level, and a greater amount of motor abilities than the average individual possesses. Also, the all-around athletes have usually attained the highest level of success at sports events that require the underlying abilities which the athlete possesses to a significant or high degree (Magill, 1980).

Summary

The review of the literature revealed information about the different components which are included in the most widely accepted definition of mental retardation. Also, different classifications used to categorize mentally retarded individuals were mentioned. The prevalence and incidence estimates of retarded individuals in our society were reported, so it will be easier to plan and establish services and programs for that population. In addition, a comprehensive review of the prenatal, perinatal, and postnatal causes of mental retardation were indicated. It was emphasized that mental retardation is a condition which usually results due to combination of symptoms rather than one unique cause. A short review was presented regarding the level, educational setting, and main goals of programs for the educable and trainable mentally retarded. In an effort to integrate some information about the motor characteristics and the motor domain of the mentally retarded, research studies and related literature were reviewed. The information repeatedly revealed the inferiority of the retardates in terms of motor performance gains. The findings in relation to the specificity and generality theory were very few in relation to the retardates. However, it was indicated that the factor structures of the mentally retarded children were not different, but similar to those factor structures of normal children.

The review of the literature also reported the basic concepts and terms related to motor performance. However, the main review centered around the issue of generality versus specificity. The term motor ability indicates a global trait of the individual which is thought of as a hypothetical construct. The term skill can indicate a distinct action that has been carried out or the degree of competency with which one has performed a particular task or several tasks. Abilities can be delineated by general analysis and subjective appraisal, or statistical techniques, such as correlational and factor analysis models, where skills can easily be measured by an observation. The development of a taxonomy in the psychomotor domain by Fleishman, Singer, Guilford, and others has not been as successful as those in the cognitive and affective domains. However, their work significantly contributed to the comprehension of human motor behavior. The controversy about the existence of a general motor ability or a multitude of specific motor abilities has existed for many years. Advocates of the idea of generality claim that there is a significant relationship among a variety of motor skills within individuals. There has been very little evidence reported in the research literature to support the generality hypothesis. According to specificity theory, the individual possesses many specific motor abilities which are very independent. Hence, a high rank that a person reaches on one motor task, by no means can predict his rank on another motor skill. The evidence from the research literature strongly supports the specificity theory and suggests a questioning of the concept which proposes the existence of a general motor ability. However, questions related to the "all-around athlete" usually arise. The explanation of the "all-around athlete" phenomenon lies in underlying factors such as experience, motivation, genetic determinants and related sports that offer a greater probability for success in a wide range of physical activities for the athlete.

CHAPTER III

METHODS AND PROCEDURES

The procedures that were used in this study are described in terms of: a) the selection of subjects, b) research design, c) operational procedures, d) standard instructions, and d) statistical analysis.

Selection of Subjects

The author had contacted the principal of West Side Elementary School which is located in Midwest City, Oklahoma, to obtain permission for the students to participate in this study as subjects. Letters were then distributed to the students' parents explaining the study rationale and the measuring procedures. Each parent was asked to sign their approval or disapproval regarding each child's participation as a subject in the study. Finally, the subjects for the study included 90 educable and trainable mentally retarded children. The IQ's of these children were between 40 and 79 with a chronological age range of 6 years to 13 years.

Research Design

A correlational survey approach was used to confirm four general motor abilities using the mentally retarded population (Fox, 1964). The group was administered 16 motor skill tests.

The following tests were administered to measure the ability named speed of movement:

1. The Nelson Hand Speed of Movement Test was administered to measure the speed of movement of the upper limb (hand) in response to a visual stimulus. Face validity and a reliability coefficient of .89 were reported by Johnson and Nelson (1979).

2. The Nelson Foot Speed of Movement Test was administered to measure the speed of movement of the lower limb (foot) in response to a visual stimulus. Face validity and a reliability coefficient of .85 were reported by Johnson and Nelson (1979).

3. The Nelson Both Hands Speed of Movement Test was administered to measure the upper limb speed of movement in response to a visual stimulus. Face validity and a reliability coefficient of .75 were reported by Johnson and Nelson (1979).

The following tests were administered to test the ability named kinesthesis:

1. Horizontal Space Test was administered to measure the capability to position the finger, while blindfolded, to a mark previously indicated by the testor. "Validity and reliability of the test are accepted at face value" as reported by Jensen and Hirst (1980, p. 169).

2. Pedestrial Test of Size was administered to measure the ability of the performer to position the feet (lower limb) while blindfolded. "Validity and reliability of the test are accepted at face value" as reported by Jensen and Hirst (1980, p. 169).

3. Large-Small Test was administered to measure size perception with blindfolded subjects. The test was suggested by Kalakian and Eichstaedt (1982).

The last ten tests measured the abilities named balance and coordination and were taken from the Hughes Basic Gross Motor Assessment

(BGMA) (Hughes, 1975). The BGMA "was designed for evaluating motor performance of children having minor motor dysfunction" (Hughes, 1975, p. 7). It "has been developed primarily for use in educational environments by physical education teachers, special education teachers, nurses, physical therapists, and occupational therapists" (Hughes, 1975, p. 8). According to Hughes (1975) "the BGMA is a motor test having standard procedures based on gross motor performances demonstrated by 1260 normal school children ages 5 years 6 months to 12 years 5 months" (Hughes, 1975, p. 9). Content validity was established by a panel of six professionals, construct validity and concurrent validity were reported by Hughes (1975). A test-retest reliability coefficient of .97, interrater reliability of .97, and the internal consistency coefficient of .71 for the entire test battery were reported by Hughes and Riley (1981).

The following tests were administered to measure the ability named balance:

1. Static Balance--Left Leg-Arms Down was administered to measure the capability to "maintain" the "body in upright position without movement through space" (Hughes, 1975, p. 17).

2. Static Balance--Right Leg-Arms Down was administered to measure the capability to maintain the body in space but with the right leg (Hughes, 1975).

3. Static Balance--Left Leg-Arms Crossed was administered to measure the capability to maintain the body in space while the arms are crossed over the chest (Hughes, 1975) "which adds mild stress to balance mechanisms"(Hughes and Riley, 1981, p. 505).

4. Static Balance--Right Leg-Arms Crossed was administered to measure the same capability as the above but with the right leg (Hughes, 1975).

5. Dynamic Balance--Walking Forward was administered to measure "postural stability in motion" (Hughes, 1975, p. 18).

6. Dynamic Balance--Walking Backward was administered to measure postural stability in motion while relying on proprioceptors for body orientation in space (Hughes, 1975).

The following tests were administered to measure the ability named coordination:

1. Ball Catch was administered to measure eye-hand coordination while anticipating and controlling a moving object (Hughes, 1975).

2. Ball Throw was administered to measure hand-overall body coordination and eye-hand coordination (Hughes, 1975).

3. Ball Dribble was administered to measure eye-hand coordination while bouncing and catching to self (Hughes, 1975).

4. Target Throwing was administered to measure the capability "to focus on a target visually and to project an object through space with proper force, accuracy, and coordination to successfully hit the target" (Hughes, 1975, p. 18).

The last ten tests which are described above were especially designed for use with special populations (Hughes, 1975). The author used the tests from the BGMA which were designed for children 5 years 6 months to 6 years 5 months, to assure their suitability for the subjects of the study. The first six tests which are described above were not especially designed for the mentally retarded. However, the author used these tests for the following reasons:

1. Lack of valid and reliable measuring devices in the literature for speed of movement ability and kinesthesis ability with the mentally retardates.

2. The selected tests were designed for normal children from age six and up; hence it was assumed that they could be adapted reasonably for the educable and trainable mentally retarded group.

3. The author administered the tests to the preliminary sample to assess their suitability to the group under study.

Operational Procedures

The testing administration procedures lasted for two days. The testing took place during the physical education lessons and three classes were tested in each day. There were 15 students in each class.

All tests were administered in the school gymnasium which was prepared prior to the subjects' arrival. Four testing stations were set up and each of the stations was arranged to measure each of the four motor abilities named: speed of movement, kinesthesis, balance, and coordination. A fifth station was set up in the center of the gym and it was called a "play" station.

After the arrival of the class, the students had been told by their physical education teacher that they were going to have "game-stations" with no reference to the word "testing." The students were then directed to one of the four stations. There were 3 to 4 students in each station at one time. However, all tests were administered individually by the testor in each station.

The testing schedule was arranged so that the children had about 5 minutes to rest between tests. The testing procedures were set up so that a child could observe the test being administered to his friends prior to taking the test himself. In that way, the child could be oriented with the task and hopefully reduce the anxiety level he might have about a particular task. Also, it provided the children with a rest period between tests. The children not being tested remained seated and observed or were playing in the play station which was set up in the center of the gym. The children remained quiet and were in no sense a distractive influence on the child being tested. It was assured that the child fully understood the nature and demands of the test before the test was administered.

Overall, five persons were envolved in the testing, one at each testing station, and a supervisor who was responsible for coordinating the testing procedures and managing the "play" station.

Procedures for Training Testors

Three weeks prior to the actual data collection process, the author visited with the testors and explained to them the rationale and the purpose of the study. Each of the testors then received from the author a testing kit. Each testing kit included: a written description of the tests; illustrations of the tasks to be performed; operational procedures; and standard instructions for each test.

After a week of reviewing the testing materials, the author visited again with the testors. This time the testors practiced the testing administration process by testing each other. The author observed and made comments when it was needed.

One week prior to the actual data collection, each testor practiced on 4 to 5 children, from 6 years to 7 years of age.

The testors were all college graduates with considerable experience in working with children. The testors included two physical education teachers, two adapted physical education teachers, and one therapeutic recreation specialist. All of the testors established good rapport with the children and were able to gain the confidence of the children. The testing administration process was very close to ideal for field testing of this type.

Testing Operational Procedures

The operational procedures for each test are described as follows:

Speed of Movement Tests

1. The Nelson Hand Speed of Movement Test: The subject was sat "with his preferred forearm and hand resting comfortably on the table. The tips of the thumb and index finger" were held "in a ready to pinch position about 3 or 4 inches beyond the edge of the table. The upper edges of the thumb and index finger" were "in a horizontal position." The testor then held the ruler "near the top, letting it hang between the subject's thumb and index finger." The subject then was "directed to look at the Concentration Zone (which was a black shaded zone) and was "told to reach by catching the" ruler "(by pinching the thumb and index finger together) when it was released." "The score was read just above the upper edge of the thumb" (Johnson and Nelson, 1979, pp. 247-248). Ten trials were given. The three slowest and the three fastest were discarded, and an average of the middle four was recorded as the score. The number of inches that the ruler was allowed to fall before being caught on each trial was converted by the following method as suggested by Lockhart and Johnson (1977, p. 158).

$$s = \frac{1}{2}\,gt^2; \qquad \text{therefore} \qquad t = \sqrt{\frac{2s}{2}}$$

[s = distance in inches (that the ruler falls); t = time (what you are looking for); g = acceleration due to gravity which is measured as 32 feet per second/per second]. In order to convert inches to feet and to put s and g in the same parameter the following formula was suggested by Lockhart and Johnson (1977, p. 158).

$$t = \sqrt{\frac{s}{6g}}$$

2. <u>The Nelson Foot Speed of Movement</u>: The subject was sat with his foot on the table. The table was "about one inch from the wall. The subject positioned his foot so that the ball of the foot was held about one inch from the wall with the heel resting on the table about 2 inches from the edge." The testor then held the ruler "next to the wall so that it was hung between the wall and the subject's foot." The subject then looked at the Concentration Zone and was told "to react, when the ruler is dropped, by pressing the stick against the wall with the ball of his foot." The score was read "just above the end of the big toe." Number of trials and scoring procedures were the same as with the hand speed of movement test (Johnson and Nelson, 1979, p. 248).

3. <u>The Nelson Both Hands Speed of Movement Test</u>: The subject was sat at a table "with his hands resting on the edge of the table. The palms were facing one another with the inside border of the little fingers along two lines which were marked on the edge of the table 12 inches apart." The testor held the ruler "near its top so that it was hung midway between the subject's palms." After the preparatory command "ready" was given, the ruler was released and "the subject was attempting to stop it as quickly as possible by clapping the hands together." The score was read "just above the upper edge of the hand

after the catch." Number of trials and scoring procedures were the same as with the above tests (Johnson and Nelson, 1979, pp. 248-249).

Kinesthesis Tests

1. Horizontal Space Test: A yardstick was "placed on the wall so that it was at approximately eye level while the student was in the sitting position." The subject sat on the chair facing the yardstick. "While blindfolded" the subject attempted "to point the index finger of the right hand to the mark on the yardstick indicated" previously "by the testor." The "score is the deviation from the mark measured to the nearest quarter inch. The final score is the total of the deviations on the three trials" (Jensen and Hirst, 1980, p. 171).

2. Pedestrial Test of Size: A yardstick was placed on the floor. Then, while blindfolded the subject tried "to spread the heels so that the inside of the heels were twelve inches apart." The subject had "three trials and the score for each trial was the distance that the heels deviated from the preferred distance of twelve inches, measured to the nearest quarter inch. The final score was the total of the scores on the three trials" (Jensen and Hirst, 1980, p. 169).

3. Large-Small Test: While the subject was blindfolded he was given two balls similar in every way except size. The subject had to identify the larger ball (Kalakian and Eichstaedt, 1982). The score was the number of correct answers out of three trials.

Scoring procedures for the last ten tests were "determined on the basis of quality of performance." "Good performance without any of the listed deviations" on the BGMA worksheet received "a score of three." "Each deviation subtracts one point from the total score for that subtest.

Point scores for each test are as follows: 3 = good (no deviations); 2 = fair (one deviation); 1 = poor (two deviations); 0 = unable to perform the task or more than two deviations" (Hughes, 1975, p. 13).

Balance Tests

1. Static Balance--Left Leg-Arms Down: The subject was "expected to stand in the 18 inch square of the testing area designated by the taped lines. Following the testor's demonstration and instruction the child was to stand . . . on the left leg with the right leg flexed at the knee to an angle of 90 degrees. The arms were relaxed at the sides for ten counted seconds. The hip was not to be flexed and the body was to be maintained in an upright and steady position" as suggested by Hughes (1975, p. 46). The subject should evidence general steadiness without any of the "following deviations for the ten second period: (a) leans flexed leg against the supporting leg, (b) excessive arm movement, (c) excessive body sway, and (d) shifts to maintain balance by jumping on supporting leg" (Hughes, 1975, pp. 48-49). All scores with lettered deviations were recorded.

2. Static Balance--Right Leg-Arms Down: This test was administered and scored the same as the above test but with the right leg (Hughes, 1975).

3. Static Balance--Left Leg-Arms Crossed: This test was given the same as the Static Balance--Left Leg test but the arms were held crossed over the chest (Hughes, 1975).

4. Static Balance--Right Leg-Arms Crossed: This test was administered the same as the above test but with the right leg (Hughes, 1975).

5. Dynamic Balance-Walking Forward: "Following the testor's demonstration," the subject was "to leave the square where the" four previous tests "have been performed, and to walk forward" in a heel-toe pattern on the marked line which was two inches wide and ten feet long. "Performance should have been smooth, steady and without" any of the following deviations: (a) turns feet out instead of keeping them straight on the line, (b) turns feet in instead of keeping straight on the line, (c) large steps, (d) excessive arm movements with or without excessive body sway, (e) moves fast, and (f) cannot stay on line (Hughes, 1975, pp. 56-59).

6. Dynamic Balance-Walking Backwards: Following the testor's demonstration the subject was to walk backwards with a heel-toe pattern on the marked line which was two inches wide and ten feet long. Performance should have been smooth, steady and without any of the deviations listed on the above test, including one more deviation which is: "Looks back while moving backwards" (Hughes, 1975, p. 59).

Coordination Tests

1. Ball Catch: The subject was to stand in the 18-inch square marked on the floor and the examiner should have been in a position which was at 8 feet distance from the subject. The "7-inch diameter ball should" have been caught by the child "with two hands." "The ball" should have been "caught with a firm grasp of the two hands." The subject should have been "demonstrated control of the ball with the hands." Subjects "were expected to watch the ball carefully and to anticipate the flight of the ball as it was coming to them." Performance should have been without any of the following deviations while the

subject caught the ball for six times: (a) stiffly extends arms and catches on chest, (b) poor position of fingers, (c) eyes do not follow the ball, and (d) one side catch only (Hughes, 1975, pp. 71-74).

2. Ball Throw: Testor and subject were to stand in the same position and at the same distance as in the above test. Subject was to throw the ball to the testor with an "underhand toss" using two hands six times. "Throwing should" have been "coordinated and accurate and the ball should" have been thrown "directly to the" testor without any of the following deviations: (a) poor coordination, (b) lacks strength, and (c) poor aim (Hughes, 1975, pp. 71-72, 74).

3. Ball Dribble: The subject was to perform the task which was the "bounce-catch" "for six catches of ball bounced to self." The task should have been performed "with control and without" any of the following deviations: (a) uneven push on the ball, (b) poor timing or rhythm problems, and (c) unable to coordinate hands (Hughes, 1975, pp. 71-72, 74-75).

4. Target Throwing: Subject was "to stand for this task of throwing the six bean bags into the taped target on the floor at" a 6-foot distance "from the target." Subject was "required to throw each of the 6 bean bags into the 18 inch square target which was taped on the floor." "The underhand throwing pattern demonstrated by the" testor was "expected to be smooth and coordinated with at least four bean bags landing in (or touching) the square and without any listed deviation." The subject was "not to slide any bean bag toward the target and the bean bags were to remain exactly where they fell until all bean bags were tossed." The task should have been performed without any of the following deviations: (a) poor adjustment, (b) lacks ease and coordination in

toss, (c) uses two hands, and (d) hurls bean bag overhand (Hughes, 1975, pp. 64-66).

Standard Instructions

The standard instructions used for each test are described as follows:

Speed of Movement Tests

1. The Nelson Hand Speed of Movement Test: Following the testor demonstration, the subject was requested to sit on the chair which was by the side of the table, while the testor was standing by the side of the subject.

Testor. "Please sit with your preferred arm resting on the tape, which is marked on the top of the table."

The subject then extended his hand just beyond the edge of the table.

Testor. "Sit comfortably and naturally."

The testor then checked to see if the subject assumed a comfortable and natural sitting posture.

Testor. "Hold the tips of the thumb and index finger in a "ready to pinch" position."

The testor then checked to see if the subject's thumb and index finger were in a horizontal position. The testor then held the ruler "near the top, letting it hang between the subject's thumb and index finger. The Base Line should have been even with the upper surface of the subject's thumb" (Johnson and Nelson, 1979, p. 246).

Testor. "Look at the Concentration Zone."

The testor then pointed with his finger on the Concentration Zone.

Testor. "I am going to drop the ruler after the signal 'Ready.' When the ruler is released you need to react by catching the ruler. Pinch your thumb and index finger together when the ruler is released. We will practice three times and then I will measure how fast you are catching the ruler." "Ready?"

The testor then dropped the ruler. "The subject should have not looked at the testor's hand; nor was he allowed to move his hand up or down while attempting to catch the falling" ruler (Johnson and Nelson, 1979, p. 247).

Testor. "Good, thank you."

The testor then read the score "just above the upper edge of the thumb" and recorded it on the scoresheet (Johnson and Nelson, 1979, p. 247).

2. The Nelson Foot Speed of Movement Test: Following the testor demonstration, the subject was requested to sit on the table which was about one inch from the wall. The testor was standing by the side of the table.

Testor. "Please sit with your preferred foot resting on the table."

The testor then helped the subject to "position his foot so that the ball of the foot was held about one inch from the wall, with the heel resting on the table about two inches from the edge" (Johnson and Nelson, 1979, p. 248).

Testor. "Is that position comfortable for you?"

Testor then helped the subject to adjust his position. The testor then held the ruler "next to the wall so that it was hung between the wall and the subject's foot with the Base Line opposite the end of the big toe" (Johnson and Nelson, 1979, p. 248).

Testor. "Look at the Concentration Zone."

The testor then pointed with his finger on the Concentration Zone.

Testor. "I am going to drop the ruler after the signal 'Ready'. When the ruler is released you need to react by pressing the ruler against the wall with the ball of your foot. We will practice three times and then I will measure how fast you are catching the ruler." "Ready?"

The testor then dropped the ruler. "The subject should have not looked at the testor's hand; nor was he allowed to move his foot up while attempting to catch the falling ruler" (Johnson and Nelson, p. 247).

Testor. "Good, thank you."

The testor then read the score just above the end of the big toe when the foot was pressing the ruler to the wall and recorded it on the scoresheet (Johnson and Nelson, 1979, p. 247).

3. The Nelson Both Hands Speed of Movement Test: Following the testor demonstration, the subject was requested to sit on the chair facing the table "with his hands resting on the edge of the table" (Johnson and Nelson, 1979, p. 248).

Testor. "Please put your hands along the two lines which are marked on the edge of the table."

The testor then checked to see if the palms were "facing one another with the inside border of the little fingers along the two lines which were marked on the edge of the table 12 inches apart." The testor then held the ruler "near its top so that it was hung midway between the subject's palms. The Base Line should have been positioned so it was leveled with the upper boarders of the subject's hands" (Johnson and Nelson, 1979, pp. 248-249).

Testor. "Look at the Concentration Zone."

The testor then pointed with his finger on the Concentration Zone.

Testor. "I am going to drop the ruler after the signal 'Ready'. When the ruler is released you need to react by clapping your hands together. Don't allow your hands to move up or down when you are clapping the hands together. We will practice three times and then I will measure how fast you are catching the ruler." "Ready?"

The testor then dropped the ruler.

Testor. "Good, thank you."

The testor then read the score "just above the upper edge of the hand" and recorded it on the scoresheet (Johnson and Nelson, 1979, p. 249).

Kinesthesis Tests

1. Horizontal Space Test: Following the testor demonstration, the subject was requested to sit "on the chair facing the yardstick" which was placed on the wall (Jensen and Hirst, 1980, p. 171).

Testor. "Please sit on the chair in a comfortable manner."

The testor then checked to see if the yardstick was placed at approximately the student's eye level while the student was in the sitting position.

Testor. "I am going to point on a mark, on the yardstick. Then, I will blindfold you and you will try to point your index finger to the mark on the yardstick that I have indicated."

The testor then indicated a mark on the yardstick, while he assured that the subject is looking at the right mark.

Testor. "This is the mark that I will ask you to point for me when you will be blindfolded."

The testor then blindfolded the subject.

Testor. "Please point your index finger to the mark on the yardstick that I have just indicated."

The subject then pointed his index finger and the testor recorded the score which was the deviation from the desired mark.

Testor. "Good, thank you."

There were three trials without any practice trials as suggested by Jensen and Hirst (1980).

2. Pedestrial Test of Size. Following the testor demonstration, the subject was requested to stand in front of the yardstick which was placed on the floor.

Testor. "Please stand comfortably and face the yardstick."

The testor then stood on the other side of the ruler and faced the subject.

Testor. "I am going to spread my heels so they will be 12 inches apart. Then, I will blindfold you and you will try to spread your heels so they will be 12 inches apart."

The testor then spread his heels so that they were 12 inches apart.

Testor. "Please look and try to remember this length."

The testor then blindfolded the subject.

Testor. "Please spread your heels so they will be 12 inches apart."

The subject then spread his heels and the testor recorded the score which was the distance that the heels deviated from the preferred distance of 12 inches.

Testor. "Good, thank you."

There were three trials without any practice trials as suggested by Jensen and Hirst (1980).

3. Large-Small Test: Following the testor demonstration, the subject was requested to stand and face the testor.

Testor. "Please stand comfortably and face me."

The testor then held the two balls which were similar in every way except size.

Testor. "I am going to blindfold you and then I will put a ball in each of your hands."

The testor then blindfolded the subject and put a ball in each of the subject's hands.

Testor. "Please raise the hand with the larger ball."

The testor then recorded the score which was the number of right answers out of three trials.

Testor. "Good, thank you."

Balance Tests

1. Static Balance--Left Leg-Arms Down: Subject was "requested to stand in the 18 inch taped square" while the testor was "facing the subject at a distance of approximately three feet." If the subject had great difficulty in maintaining balance, then the testor stood close enough to give support during the test. Before the testor gave directions, he taped a "small piece of masking tape on the toe of the" subject's "right shoe, and another piece on the toe of" his "left shoe" (Hughes, 1975, p. 47).

Testor. "Please stand inside this square. I would like to see if you can bend your knee like this and stand on one leg."

The testor then demonstrated "by standing on the right leg with the left leg flexed at the knee to 90 degrees. The subject could then mirror the movement and balance on the left leg holding the right leg flexed." The testor then returned "to the original position in front of the subject when it appeared that the child understood the task clearly. This first instruction period considered a warm-up for the subject to get the "feel" of the movement as suggested by Hughes (1975, p. 47).

Testor. "I would like to have you be sure that your arms are at your sides. When I say go, please bend the leg which has tape on the toe of the shoe and stand on the other leg while I count to ten. Please look at this point while I am counting." (Hughes, 1975, p. 47).

The testor then indicated the point, "previously determined, which" was "directly in front of the" subject, about "ten feet away at the subject's eye level for the subject to focus upon during the ten second count (Hughes, 1975, p. 47).

Testor. "Go."

The examiner began "to count aloud as soon as the subject assumed the test position." Counts were "made by use of a stop watch." While the subject "was maintaining balance during the count," the testor made "observations for deviations in the steadiness and when the task was completed the score" have been recorded on the scoresheet (Hughes, 1975, p. 48).

Testor. "Good, thank you."

2. Static Balance--Right Leg-Arms Down: Subject was "requested to stand in the 18 inch taped square" in the same manner as in the above test (Hughes, 1975, p. 47).

Testor. "Please stand inside the square. I would like to see if you can bend your knee like this and stand on one leg." (Hughes, 1975, p. 47).

The testor then demonstrated by standing on the left leg with the right leg flexed at the knee to 90 degrees.

Testor. "I would like to have you be sure that your arms are at your sides. When I say go, please bend the leg which does not have tape on the toe of the shoe and stand on the other leg while I count to ten. Please look at this point while I am counting" (Hughes, 1975, p. 47).

The testor then indicated the "point for the subject to focus upon during the 10 second count" (Hughes, 1975, p. 47).

Testor. "Go."

The testor then counted and observed for deviation in the same manner as in the above test (Hughes, 1975).

3. <u>Static Balance--Left Leg-Arms Crossed</u>: Subject was requested to stand in the square in the same manner as in the above test.

Testor. "Now, let us see if you can do this balance differently. Please cross your arms like this. We will try 10 counts while you stand on one leg with your arms held this way, bend your knee on the side where there is tape on your shoe. Let's have you try it on one leg before we do the counting" (Hughes, 1975, p. 48).

The testor then demonstrated "the position of arms folded across the chest." Then the testor flexed his left knee and stood on the right leg. Subject then mirrored that position and stood on his left leg (Hughes, 1975).

Testor. "I would like to have you be sure that your arms are folded across your chest. When I say go, please bend the leg which has the tape on the toe of the shoe and stand on the other leg while I count to ten. Please look at this point while I am counting" (Hughes, 1975, p. 47).

The testor then indicated the point for the subject to focus upon during the 10 second count.

Testor. "Go."

The testor then began to count aloud as soon as the subject assumed the test position, and observed for deviations in the same manner as in the above test (Hughes, 1975).

4. Static Balance--Right Leg-Arms Crossed: Subject was requested to stand in the same manner as in the above test.

Testor. "Please stand inside this square. I would like to see if you can cross your arms like this. Bend your knee on the side where there is no tape on your shoe. Let's have you try it on one leg before we do the counting" (Hughes, 1975, p. 48).

The testor then demonstrated the position of the arms which were folded across the chest. Then the testor flexed his right knee and stood on the left leg. Subject then mirrored that position and stood on his right leg.

Testor. "I would like to have you be sure that your arms are folded across your chest. When I say go, please bend the leg which does not have the tape on the toe of the shoe and stand on the other leg while I am counting" (Hughes, 1975, p. 47).

The testor then indicated the point for the subject to focus upon during the 10 second count (Hughes, 1975).

Testor. "Go."

The testor then began to count aloud as soon as the subject assumed the test position and observed for deviations in the same manner as in the above test (Hughes, 1975).

5. Dynamic Balance-Walking Forward: The testor demonstrated heel-toe walking forward along the ten foot long line taped on the floor.

Testor. "Please watch as I walk this line. I put the heel of one foot to touch the toe of the other foot as I walk on the line to the end. I am looking at that point as I walk" (Hughes, 1975, p. 56).

The testor then "carefully placed heel to toe while was walking and kept eyes focused on the point previously designated" for the subject (Hughes, 1975, p. 57).

Testor. "Now let's give you a turn to walk this line up to the end. Watch this point here" (Hughes, 1975, p. 57).

The subject then walked the line in a heel-toe pattern. As the child performed the task the testor observed for deviations as suggested by Hughes (1975, p. 57).

Testor. "Good, thank you."

6. Dynamic Balance-Walking Backward: The testor demonstrated heel-toe walking backward along the ten-foot-long line taped on the floor.

Testor. "Please watch me as I walk this line. I put the toe of one foot to touch the heel of the other foot as I walk on the line to the end. I am looking at that point as I walk."

The testor then carefully placed toe to heel while was walking backwards.

Testor. "Now let's give you a turn to walk this line up to the square. Watch this point here" (Hughes, 1975, p. 57).

The subject then walked the line backwards in a heel-toe pattern. As the child performed the task the testor observed for deviations (Hughes, 1975).

Testor. "Good, thank you."

<u>Coordination Tests</u>

1. <u>Ball Catch</u>: The testor stood at 8 feet distance from the subject who was standing in the 18 inch square taped on the floor.

Testor. "I am going to toss this ball to you for you to catch with two hands. We will practice one time and then count how many catches you make of six trials" (Hughes, 1975, p. 72).

The testor then used "two hands and an underhand style," threw "the ball to the child for one practice." The ball was "then thrown to the child" for "six times" (Hughes, 1975, p. 72). Testor then observed the child catching for deviations (Hughes, 1975).

Testor. "Good, thank you."

2. <u>Ball Throw</u>: The testor and the subject were standing in the same manner as in the above test.

Testor. "Please throw the ball back to me using both hands and throw it underhand as I will show you. We will practice one time" (Hughes, 1975, p. 72).

The testor then used "two hands and an underhand style, threw the ball to the" subject. The subject then threw the ball for six times to the testor. The testor then observed the child throwing for deviations (Hughes, 1975, p. 72).

Testor. "Good, thank you."

3. Ball Dribble: The testor and the subject were standing in the same manner as in the above test.

Testor. "Please watch me bounce the ball in front of my feet and I will catch it. Now I will throw the ball to you and you bounce it in front of your feet and catch it. Practice this one time and then we will count how many catches you make out of six trials" (Hughes, 1975, p. 72).

The testor demonstrated the task "and then tossed the ball to the subject and observed for performance deviations as the subject bounced the ball and caught it" (Hughes, 1975, p. 73).

Testor. "Good, thank you."

4. Target Throwing: The testor asked the subject to stand at six foot distance from the target.

Testor. "Please stand here beside me and watch as I toss six bean bags into your square" (Hughes, 1975, p. 64).

The testor then "tossed each bean bag into the square." Then the testor moved "forward to the square and picked up the six bean bags." The testor "then faced the child who" is in his place to perform the task (Hughes, 1975, p. 65).

Testor. "Now it's your turn to throw six bean bags. I will toss them to you one at a time" (Hughes, 1975, p. 65).

Testor then tossed "one bean bag at a time to the subject. Observations of performance deviations were then made as the subject tossed each bean bag as closely as possible into the square. Each bean bag must remain in place it landed until all have been tossed. This is done so that the child may judge each throw from the position of the bean bags already tossed" (Hughes, 1975, p. 65).

Testor. "Good, thank you."

Statistical Analysis

The statistical technique used to confirm the four general motor abilities was a confirmatory factor analysis suggested by Frane and Hill (1974) in the "Annotated Computer Output for Factor Analysis." The scores of the 16 tests representing the general motor abilities named balance, coordination, kinesthesis, and speed of movement were used as dependent variables.

A factor analysis was performed using principal components as the method of extraction, in both the first and second run. Varimax rotation was used in the first run, where oblique rotation was used in the second run.

CHAPTER IV

RESULTS AND DISCUSSION

Results

This research was designed to confirm or refute the existence of four general motor abilities using a mentally retarded population. Ninety educable and trainable mentally retarded males and females served as subjects in the study. Each subject was administered the sixteen motor tests representing the four motor abilities under study. The subjects were tested individually. This chapter presents the results of the statistical analysis of the data.

The statistical technique that was used to confirm or refute the existence of the four general motor abilities was a confirmatory factor analysis suggested by Frane and Hill (1974) in the Annotated Computer Output for Factor Analysis. The scores of the 16 tests representing the general motor abilities named balance, coordination, kinesthesis, and speed of movement were used as the dependent variables. Factor analysis summarized these 16 test scores by means of four factors. Factor scores could be used in place of the 16 test scores for further analysis.

Two computer runs were made using the factor analysis BMDP4M program from the Annotated Computer Output for Factor Analysis (Frane and Hill, 1974). All analyses were done on the IBM 3081D computer at Oklahoma State University. Each run provided new information and was helpful in making decisions regarding the number of factors, the method of factor extraction, and the method of rotation (Frane and Hill, 1974).

The first run used simple choices, which were also the assumed options in the program. Principal components were used as the method of extraction. The number of factors chosen was equal to the number of eigenvalues greater than one (Frane and Hill, 1974).

Initially the analysis of the frequency distributions deleted one of the kinesthesis tests. The "Large Small" test was deleted because it had no variability. No variance was shared between the "Large Small" test and the other two kinesthesis tests, hence, it could not correlate with the other two tests.

The mean and the standard deviation for the scores of the selected variables were computed. The results of the calculated means and standard deviations for the group under study are presented in Table I. The results showed a wide range of scores between the smallest values and the largest values in most of the variables under study. Such a range indicated a large degree of variability in the motor performance of the educable and trainable children who participated in the study.

These results indicated that each variable was suitable for factor analysis since none of the means was so close to the minimum or maximum values. In addition, the range of most of the variables was quite large and it usually was 0-3 which represented the variability of the variable scores. Also, the variables found to be suitable for factor analysis at that point, since the coefficients of variation are all much larger than .00001 (Frane and Hill, 1974). There was quite a high level of confidence about the numerical precisi[illegible] of the

TABLE I

UNIVARIATE SUMMARY STATISTICS

No.	Variable	Mean	Standard Deviation	Coefficient of Variance	Smallest Value	Smallest Standard Score	Largest Value	Largest Standard Score
1	H Speed	0.31520	0.05314	0.168602	0.1614	-2.89	0.4330	2.22
2	F Speed	0.34342	0.05979	0.174116	0.1909	-2.55	0.4330	1.50
3	B Speed	0.33594	0.06113	0.181966	0.16164	-2.86	0.4330	1.59
4	Space	4.15556	2.45367	0.590454	0.0	-1.69	18.0000	5.64
5	Size	6.72222	4.22414	0.628384	1.0000	-1.35	19.0000	2.91
6	L Arm D	2.05556	1.12541	0.547495	0.0	-1.83	3.0000	0.84
7	R Arm D	1.96667	1.12629	0.572692	0.0	-1.75	3.0000	0.92
8	L Arm C	1.92222	1.09368	0.568965	0.0	-1.76	3.0000	0.99
9	R Arm C	1.90000	1.04988	0.552568	0.0	-1.81	3.0000	1.05
10	F Walk	2.06667	0.80448	0.389265	0.0	-2.57	3.0000	1.16
11	B Walk	1.61111	0.72970	0.452916	0.0	-2.21	3.0000	1.90
12	Catch	2.36667	0.90504	0.382412	0.0	-2.61	3.0000	0.70
13	Throw	2.41111	0.80580	0.334203	0.0	-2.99	3.0000	0.73
14	Dribble	1.90000	1.28998	0.678936	0.0	-1.47	3.0000	0.85
15	T Throw	2.47778	0.85101	0.343457	0.0	-2.91	3.0000	0.61

*Cases with zero weight are not included.

correlation matrix that would be completed as suggested by Frane and Hill (1974).

The computed correlation matrix is presented in Table II. Most of the correlation coefficients were above 0.3 and/or above 0.5. This suggested that a useful summary of the variables could be obtained through factor analysis as suggested by Frane and Hill (1974). High correlations were expected because the variables were task related. If most of the correlations were less than 0.3 it would question the reliability of the gross motor tests used and the suitability of the data for factor analysis (Frane and Hill, 1974).

The squared multiple correlations (SMC) of each variable with all other variables were computed and are presented in Table III.

The squared multiple correlations indicated the degree to which each variable could be predicted from all the other variables. The squared multiple correlations of the "space" and "size" variables were quite low when compared to all the other variables. This fact made them suspect regarding suitability for factor analysis. They were suspect since one of the underlying assumptions required for factor analysis is that every variable is strongly correlated with some other variable or variables (Frane and Hill, 1974).

The communalities obtained from the first factor analysis are presented in Table IV. For each variable, the communality is the proportion of variance of that variable that can be explained by four factors (Frane and Hill, 1974).

These communalities made it possible to conclude that the 15 variables were suitable for factor analysis. Even the variables "space" and "size" that were suspected of being unsuitable for factor analysis

TABLE II

CORRELATION MATRIX

		H Speed 1	F Speed 2	B Speed 3	Space 4	Size 5	L Arm D 6	R Arm D 7	L Arm C 8	R Arm C 9	F Walk 10	B Walk 11	Catch 12	Throw 13	Dribble 14	Throw 15
H Speed	1	1.000														
F Speed	2	0.729	1.000													
B Speed	3	0.770	0.745	1.000												
Space	4	0.266	0.177	0.221	1.000											
Size	5	0.314	0.308	0.221	0.300	1.000										
L Arm D	6	-0.465	-0.487	-0.463	-0.215	-0.311	1.000									
R Arm D	7	-0.385	-0.418	-0.436	-0.153	-0.257	0.764	1.000								
L Arm C	8	-0.512	-0.454	-0.518	-0.205	-0.292	0.752	0.728	1.000							
R Arm C	9	-0.535	-0.487	-0.572	-0.234	-0.315	0.727	0.723	0.796	1.000						
F Walk	10	-0.381	-0.449	-0.484	-0.182	-0.355	0.517	0.598	0.555	0.567	1.000					
B Walk	11	-0.313	-0.321	-0.429	-0.148	-0.331	0.423	0.476	0.469	0.447	0.619	1.000				
Catch	12	-0.434	-0.426	-0.424	-0.178	-0.214	0.553	0.464	0.426	0.465	0.414	0.388	1.000			
Throw	13	-0.377	-0.291	-0.314	-0.243	-0.237	0.421	0.337	0.406	0.315	0.373	0.428	0.531	1.000		
Dribble	14	-0.342	-0.342	-0.419	-0.261	-0.240	0.422	0.415	0.385	0.358	0.396	0.436	0.484	0.537	1.000	
T Throw	15	-0.375	-0.284	-0.285	-0.187	-0.206	0.359	0.263	0.282	0.306	0.281	0.303	0.572	0.628	0.361	1.000

TABLE III

SQUARED MULTIPLE CORRELATIONS (SMC) OF EACH VARIABLE WITH ALL OTHER VARIABLES

Variable	SMC
1 H Speed	0.70148
2 F Speed	0.65153
3 B Speed	0.72988
4 Space	0.16638
5 Size	0.26470
6 L Arm D	0.71930
7 R Arm D	0.69820
8 L Arm C	0.73425
9 R Arm C	0.73425
10 F Walk	0.55277
11 B Walk	0.48242
12 Catch	0.52558
13 Throw	0.56459
14 Dribble	0.43032
15 T Throw	0.49523

TABLE IV

COMMUNALITIES OBTAINED FROM FOUR FACTORS AFTER ONE ITERATION

Variable	Communalities*
1 H Speed	0.8478
2 F Speed	0.8067
3 B Speed	0.8284
4 Space	0.6342
5 Size	0.6357
6 L Arm D	0.7467
7 R Arm D	0.8087
8 L Arm C	0.7766
9 R Arm C	0.7810
10 F Walk	0.6008
11 B Walk	0.5109
12 Catch	0.6669
13 Throw	0.7552
14 Dribble	0.5180
15 T Throw	0.7184

*The communality of a variable is its squared multiple correlation (or covariance) with the factors.

showed larger coefficients than 0.4 which made them suitable for factor analysis.

The extracted factors are presented in Table V.

The assumption was to compute as many factors as there were eigenvalues greater than 1.0 as was suggested by Frane and Hill (1974). There were four eigenvalues satisfying this criterion. Seventy-one percent of the variance of all the variables was explained by the first four factors, which is quite a large percent. The overall abilities measurement was constructed from series of variables so that the variables in each series were highly related to each other. Therefore, it was expected to record a large proportion of the variance explained only by few factors (Frane and Hill, 1974).

The unrotated factor loadings for principal components are presented in Table VI.

Unrotated loadings and orthogonally rotated loadings are the coefficients obtained from the correlations of the variables with the factors. Usually the initial factor extraction does not present clear and interpretable factors (Frane and Hill, 1974). However, it could be noted that the variables "size" and "space" that previously had low squared multiple correlations, seemed to be loaded quite well on the fourth factor. Only after rotation, it was proper to name the factors. It was suggested by Frane and Hill (1974) that one of the main reasons for using the rotation is to obtain clear factors that can be named. The unrotated factor loadings can be compared with the rotated loadings that are presented later as suggested by Frane and Hill (1974).

Varimax rotation was performed to obtain a simple interpretation (made the loadings for each factor either large or small, not in-between

TABLE V

COMMUNALITIES

Factor	Variance Explained*	Commulative Proportion of Total Variance**
1	6.902307	0.460154
2	1.427606	0.555328
3	1.251758	0.638778
4	1.054275	0.709063
5	0.855750	0.766113
6	0.711755	0.813563
7	0.556412	0.850658
8	0.475157	0.882335
9	0.369934	0.906997
10	0.328333	0.928886
11	0.295045	0.948556
12	0.222319	0.963377
13	0.199578	0.976682
14	0.184441	0.988978
15	0.165329	1.000000

*The variance explained by each factor is the eigenvalue for that factor.

**Total variance is defined as the sum of the diagonal elements of the correlation (covariance) matrix.

TABLE VI

UNROTATED FACTOR LOADINGS (PATTERN) FOR PRINCIPAL COMPONENTS

Variable		Factor 1	Factor 2	Factor 3	Factor 4
H Speed	1	-0.721	0.092	0.557	-0.095
F Speed	2	-0.699	0.190	0.517	-0.122
B Speed	3	-0.740	0.193	0.474	-0.138
Space	4	-0.343	-0.214	0.219	0.650
Size	5	-0.453	-0.041	0.071	0.651
L Arm D	6	0.806	-0.174	0.249	0.069
R Arm D	7	0.766	-0.285	0.371	0.054
L Arm C	8	0.801	-0.292	0.224	0.027
R Arm C	9	0.807	-0.330	0.147	0.011
F Walk	10	0.723	-0.129	0.209	-0.134
B Walk	11	0.649	0.061	0.256	-0.145
Catch	12	0.694	0.342	0.048	0.257
Throw	13	0.621	0.595	0.094	0.082
Dribble	14	0.624	0.351	0.068	-0.026
T Throw	15	0.544	0.615	-0.021	0.207
	VP*	6.902	1.428	1.252	1.054

*The VP for each factor is the sum of the squares of the elements of the column of the factor loading matrix corresponding to that factor, the VP is the variance explained by the factor.

(Frane and Hill, 1974). The rotated loadings are presented in Table VII.

These loadings are the regression coefficients for predicting the variables from the factors. Since the rotation was orthogonal, these loadings are also the coefficients obtained from the correlations of the variables with the rotated factors (Frane and Hill, 1974). These factor loadings can be compared with the unrotated loadings. It is showed that the larger loadings are larger than before and the smaller loadings are smaller than before. That was the purpose of the rotation as indicated by Frane and Hill (1974).

The computed sorted rotated factor loadings are presented in Table VIII.

These sorted rotated factor loadings made it possible to name and to interpret the factors for the first time. In order to interpret each factor, it was required to look for variables with large loadings (Frane and Hill, 1974). The criteria for primary loadings was a coefficient of 0.50 or larger as suggested by Frane and Hill (1974). Factor 1 could be named "Balance Ability;" Factor 2 could be named "Coordination Ability;" Factor 3 could be called "Speed of Movement Ability;" and Factor 4 named "Kinesthesis Ability." It was evident that there were precisely four factors that represent the four general motor abilities that have been hypothesized at the beginning of this study.

On the completion of the first run, it was realized that the common factor analysis method was appropriate, so the number of factors were chosen, the subset of variables were selected, one variable had been deleted, and it was concluded that oblique rotation should be used as

TABLE VII

ROTATED FACTOR LOADINGS (PATTERN)

Variable		Factor 1 Balance	Factor 2 Coordination	Factor 3 Speed of Movement	Factor 4 Kinesthesis
H Speed	1	-0.224	-0.239	0.843	0.173
F Speed	2	-0.275	-0.158	0.832	0.118
B Speed	3	-0.330	-0.183	0.822	0.105
Space	4	-0.020	-0.151	0.135	0.770
Size	5	-0.258	-0.072	0.115	0.742
L Arm D	6	0.775	0.279	-0.254	-0.062
R Arm D	7	0.867	0.175	-0.161	-0.026
L Arm C	8	0.811	0.165	-0.292	-0.085
R Arm C	9	0.789	0.125	-0.363	-0.107
F Walk	10	0.676	0.220	-0.187	-0.247
B Walk	11	0.565	0.345	-0.061	-0.263
Catch	12	0.348	0.687	-0.269	0.018
Throw	13	0.211	0.822	-0.091	-0.164
Dribble	14	0.310	0.589	-0.151	-0.229
T Throw	15	0.083	0.825	-0.169	-0.051
	VP*	3.977	2.638	2.587	1.434

*The VP for each factor is the sum of the squares of the elements of the column of the factor pattern matrix corresponding to that factor. When the rotation is orthogonal, the VP is the variance explained by the factor.

TABLE VIII

SORTED ROTATED FACTOR LOADINGS (PATTERN)

Variable		Factor 1 Balance	Factor 2 Coordination	Factor 3 Speed of Movement	Factor 4 Kinesthesis
R Arm D	7	0.867	0.0	0.0	0.0
L Arm C	8	0.811	0.0	-0.292	0.0
R Arm C	9	0.789	0.0	-0.363	0.0
L Arm D	6	0.775	0.279	-0.254	0.0
F Walk	10	0.676	0.0	0.0	0.0
B Walk	11	0.565	0.345	0.0	-0.263
T Throw	15	0.0	0.825	0.0	0.0
Throw	13	0.0	0.822	0.0	0.0
Catch	12	0.348	0.687	-0.269	0.0
Dribble	14	0.310	0.589	0.0	0.0
H Speed	1	0.0	0.0	0.843	0.0
F Speed	2	-0.275	0.0	0.832	0.0
B Speed	3	-0.330	0.0	0.822	0.0
Space	4	0.0	0.0	0.0	0.770
Size	5	-0.258	0.0	0.0	0.742
	VP*	3.977	2.638	2.587	1.434

*The above factor loading matrix has been rearranged so that the columns appear in decreasing order of variance explained by factors. The rows have been rearranged so that for each successive factor, loading greater than 0.500 appear first. Loadings less than 0.2500 have been replaced by zero.

suggested by Frane and Hill (1974).

The second run embodied the conclusions from the first run. Principal components was used again as the method of extraction, with the same number of factors that have been extracted in the first run. The factors were rotated using Jennrich and Sampson's (1966) direct quartimin method of oblique rotation. It was claimed by Frane and Hill (1974) that this is one of the best methods of oblique rotation described in the factor analysis literature. The rotated factor loadings are presented in Table IX.

These factor loadings can be compared with the rotated loadings in the first run, using varimax as the method of rotation. The larger loadings are larger than before and the smaller loadings are smaller than before. The same is true about the sorted rotated factor loadings obtained in the second run, as compared to the loadings obtained in the first run.

The sorted rotated factor loadings are presented in Table X.

These sorted rotated factor loadings made the interpretation of the factors a very easy task. There were again four distinct factors that could be named according to the underlying variables and their coefficient loadings. The criteria for primary loadings was a coefficient of 0.50 or above as suggested by Frane and Hill (1974). Factor 1 could be called "Balance Ability;" Factor 2 could be named "Speed of Movement Ability;" Factor 3 could be called "Coordination Ability;" and Factor 4 named "Kinesthesis Ability." These factors are consistent with the hypothesies of generality.

The plots of the rotated factor loadings, using varimax (orthogonal) rotation, of the first run are presented in Figure 5. The plots of the

TABLE IX

ROTATED FACTOR LOADINGS (PATTERN)

Variable		Factor 1 Balance	Factor 2 Speed of Movement	Factor 3 Coordination	Factor 4 Kinesthesis
H Speed	1	0.045	0.884	-0.087	0.077
F Speed	2	-0.042	0.872	0.006	0.023
B Speed	3	-0.105	0.846	-0.014	0.002
Space	4	0.133	0.085	-0.061	0.788
Size	5	-0.174	0.017	0.071	0.746
L Arm D	6	0.780	-0.075	0.112	0.051
R Arm D	7	0.942	0.038	-0.007	0.081
L Arm C	8	0.833	-0.123	-0.031	0.022
R Arm C	9	0.793	-0.214	-0.084	-0.002
F Walk	10	0.674	-0.016	0.054	-0.164
B Walk	11	0.550	0.120	0.234	-0.189
Catch	12	0.194	-0.148	0.667	0.136
Throw	13	0.033	0.055	0.851	-0.069
Dribble	14	0.175	-0.017	0.553	-0.146
T Throw	15	-0.129	-0.073	0.883	0.044
	VP*	3.722	2.379	2.350	1.303

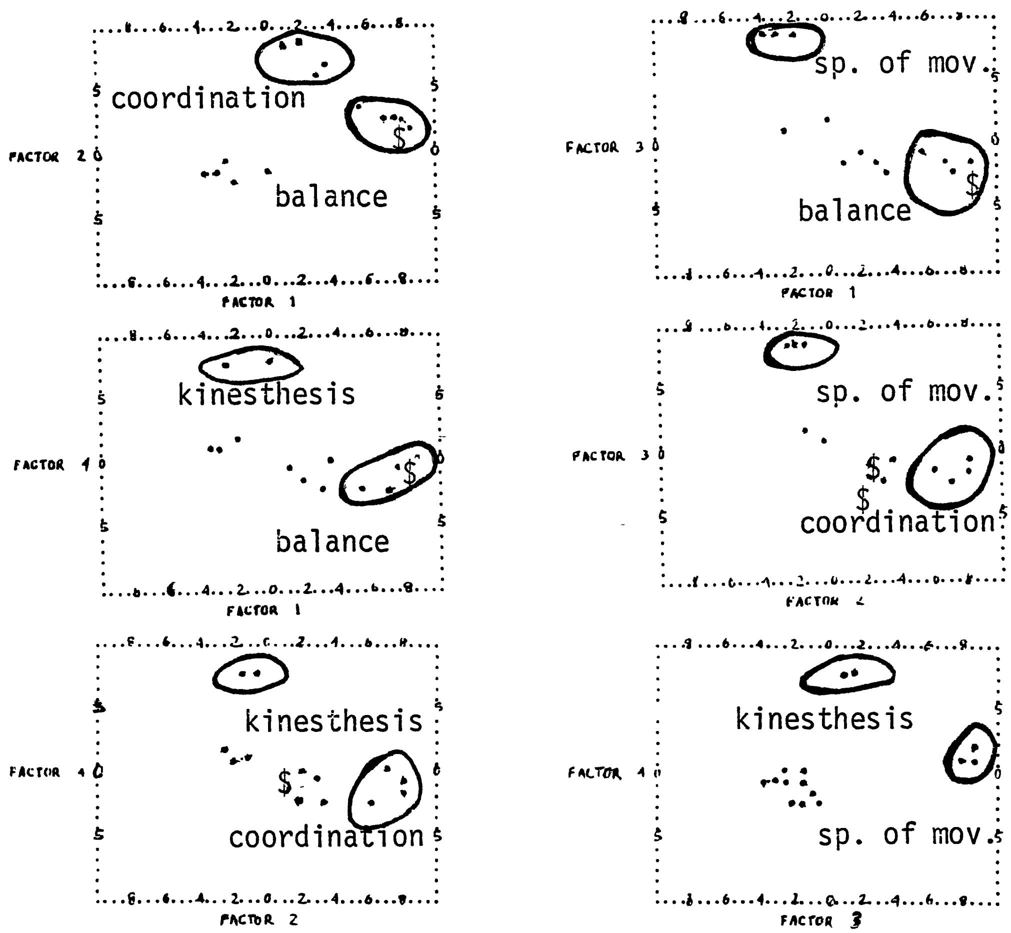
*The VP for each factor is the sum of the squares of the elements of the column of the factor pattern matrix corresponding to that factor. When the rotation is orthogonal, the VP is the variance explained by the factor.

TABLE X

SORTED ROTATED FACTOR LOADINGS (PATTERN)

Variable		Factor 1 Balance	Factor 2 Speed of Movement	Factor 3 Coordination	Factor 4 Kinesthesis
R Arm D	7	0.942	0.0	0.0	0.0
L Arm C	8	0.833	0.0	0.0	0.0
R Arm C	9	0.793	0.0	0.0	0.0
L Arm D	6	0.780	0.0	0.0	0.0
F Walk	10	0.674	0.0	0.0	0.0
B Walk	11	0.550	0.0	0.0	0.0
H Speed	1	0.0	0.884	0.0	0.0
F Speed	2	0.0	0.872	0.0	0.0
B Speed	3	0.0	0.846	0.0	0.0
T Throw	15	0.0	0.0	0.883	0.0
Throw	13	0.0	0.0	0.851	0.0
Catch	12	0.0	0.0	0.667	0.0
Dribble	14	0.0	0.0	0.553	0.0
Space	4	0.0	0.0	0.0	0.788
Size	5	0.0	0.0	0.0	0.246
	VP*	3.722	2.379	2.350	1.303

*The above factor loading matrix has been rotated so that the columns appear in decreasing order of variance explained by factors. The rows have been rearranged so that for each successive factor, loadings greater than 0.5000 appear first. Loadings less than 0.2500 have been replaced by zero.



*Overlap is indicated by a dollar sign.
Scale is from -1 to +1.

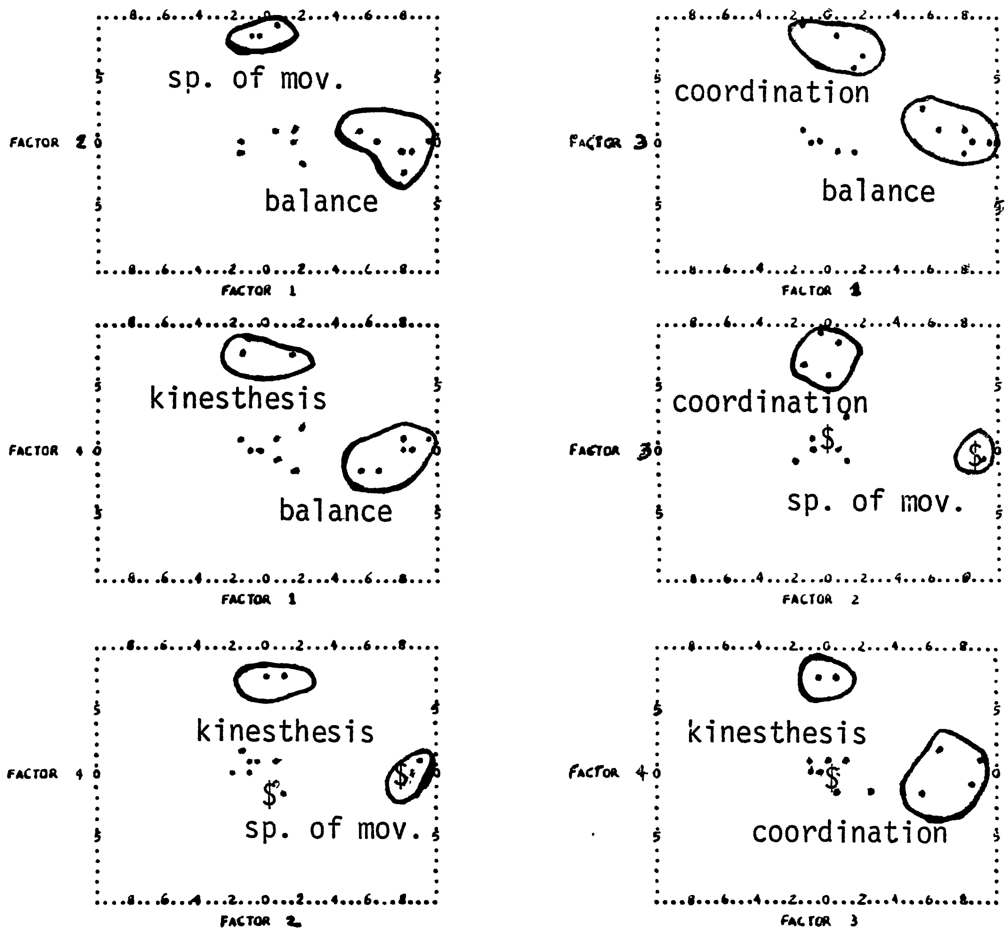
Figure 5. The Rotated Factor Loadings, Using Varimax as the Method of Rotation

rotated factor loadings, using direct quartimin rotation, of the second run are presented in Figure 6. The x's in these plots are the variables. The coordinates of a variable are its factor loadings. The axes in the plots, according to Frane and Hill (1974), were not marked by the computer so that they would not "interfere with the interpretation" (p. 17).

Comparing the plots of the first run (orthogonal rotation) to the plots of the second run (oblique rotation) it can be observed that the variables are clustered much more closer to each other, which present their relatedness in a much more clear fashion. Also, the axes of the plots in the second run are more likely to pass through the centers of the clusters. It can be explained by the fact that the "small loadings from the oblique rotation are smaller than those from the orthogonal" as suggested by Frane and Hill (1974, p. 20). Since the variable clusters of the second run are presented with much more clarity as to the degree of association of each variable with a particular factor, it was concluded that the oblique rotation is preferrable.

Discussion

The purpose of this study was to confirm or refute the existence of four general motor abilities within a mentally retarded population. The results obtained in this study for educable and trainable mentally retardates lend themselves to a comparison with the findings of other factor analysis studies, namely the study of Rarick, Dobbins and Broadhead (1976) with educable mentally retardates and normals, and the work of Fleishman (1966) with normal adolescents and young adults. The motor tasks used in those studies were mainly gross motor in nature.



*Overlap is indicated by a dollar sign.
Scale is from -1 to +1.

Figure 6. The Rotated Factor Loadings, Using Direct Quartimin as the Method of Rotation

Analysis of the data obtained in this study, using a factor analysis approach, revealed that there is no one general motor ability within the educable and trainable mentally retarded subjects studied. Rather, there is a combination of several abilities that operate to contribute to motor performance. A similar observation has been made by Singer (1980) as he was referring to the work of Fleishman with normal subjects.

The factor structure which emerged from the data obtained on the group studied conformed exactly to the hypothesized motor ability factors that underlie most individuals' motor performance. It was clear that in this sample of retardates, the four general motor abilities proposed by Singer (1980) named: coordination, balance, speed of movement, and kinesthesis existed. However, in this sample, no such clearly defined factors as response orientation reaction time, or speed of arm movement emerged, as proposed and found by Fleishman (1969). These components were revealed as a single factor named speed of movement. In the work of Rarick, Dobbins and Broadhead (1976) such a factor did not emerge. This may have been a reflection of not using motor tasks underlying such a factor.

In the work of Rarick, Dobbins and Broadhead (1976), a factor named fine visual-motor coordination factor was extracted in both normal and educable retarded groups. Such a factor underlies motor performances that require a variety of manual skills. In the work of Fleishman (1964), a similar factor was obtained and was called aiming. In the present study, a factor comprised of fine visual-motor coordination was not obtained. Rather, a general factor called coordination was extracted. However, in the works of Rarick, Dobbins and Broadhead (1976) and

Fleishman (1964) a clearly defined coordination factor was not obtained.

The hypothesized balance factor in this study was clearly observed as the measures of the four different motor tests consisting of static and dynamic balance, loaded on a single factor. In the work of Rarick, Dobbins and Broadhead (1976) the same single balance factor was obtained, although it was hypothesized by the authors that two separate factors named static balance and dynamic exist. In the work of Fleishman (1964), two separate factors of balance did emerge.

The kinesthesis factor was clearly defined in this study, although it was not mentioned or extracted in the studies conducted by Rarick, Dobbins and Broadhead (1976) and Fleishman (1964). The fact that the kinesthesis tests items loaded nicely on one factor rather than on other factors, generally suggests that such a general motor ability exists within the educable and trainable retardates studied, and that such a factor should be considered when planning motor activities for the educable and trainable mentally retardates.

As reported earlier in this text, studies conducted with normal subjects have shown that specificity rather than generality exists in the motor performance of normals. There is ample evidence to suggest that motor skills are specific in nature and that an individual's level of performance in one task would not indicate his/her level of performance in another task. However, it was noted by Singer (1980), that it is not to say that certain general motor abilities do not exist. The data in the present study offered the opportunity to determine whether the general motor abilities proposed by Singer (1980), as existing with normals, tend to hold true also for the mentally retardates.

It should be noted that it was surprising that the factor structure obtained with the group of educable and trainable mentally retardates confirmed the factor structure proposed by Singer (1980) in relation to normals. However, it seems that in this group of educable and trainable retardates, there was less specificity in motor performance than has been noted in factor analytic studies conducted with normals. The same observation has been made by Rarick, Dobbins and Broadhead (1976), as they were referring to their findings. In this study, the intercorrelations among the different tasks were so high, so that the different motor tasks clustered around four factors, showing generality, rather than splitting to form a great number of factors, as in the case of specificity. The exact reason for obtaining generality rather than specificity is not known. However, such factors as developmental or neurological limitations need further study. Also, a variety of limitations existing within the information processing channels of the subjects studied might have had an influence on possessing similar performance on a variety of tests, regardless of the fact that many specific abilities might exist within each individual.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter contains a summary of the study, the findings derived from the analysis of the data, conclusions, and recommendations.

Summary

The major thrust of this study was to confirm or refute the existence of the four hypothesized general motor abilities named: balance, coordination, kinesthesis, and speed of movement, within educable and trainable mentally retardates. While referring to normal individuals, it was indicated by Singer (1980) that "although Fleishman and others have attempted to categorize motor ability, there are at least four factors that seem to be of most interest to motor learning researchers. . . . We will identify these factors as coordination, kinesthesis, balance, and speed of movement" (p. 197). One of the four primary research purposes of tasks that are associated with these factors, as suggested by Singer (1980) would be "for determining task specificity versus generality" (p. 198).

The subjects for this study included 90 retarded males and females at the educable and trainable level, from "West Side Elementary School" in Midwest City, Oklahoma. The IQ's of these children were between 42 and 79 with a chronological age range of 6 years to 13 years. The subjects participated in this study after the author received permission from the parents of each child, and from the school's principal.

A battery of 16 gross motor tests was given to all subjects. The hypothesized factor structure constituted the basis for the selection of the tests used in the study. The hypothesized-factor structure is based mainly on the results of studies of the motor domain of normal individuals. All subjects were administered the tests individually, under the same conditions, in the school's gymnasium that was prepared for testing prior to the subjects' arrival.

Findings

The data collected in this study were analyzed and yielded the following findings:

1. Hypothesis one was confirmed, indicating the existence of a general motor ability named balance.

2. Hypothesis two was confirmed indicating the existence of a general motor ability named coordination.

3. Hypothesis three was confirmed indicating the existence of a general motor ability named kinesthesis.

4. Hypothesis four was confirmed indicating the existence of a general motor ability named speed of movement.

Conclusions

Based on the findings and within the limitations of this study, the following conclusions are made:

1. There is no one general motor ability within the group of educable and trainable retardates.

2. The factors extracted from the data obtained on the retarded group, confirmed exactly to the hypothesized factor structure in normals which involve the following general motor abilities: balance, coordination, speed of movement, and kinesthesis.

3. It was concluded that the educable and trainable males and females showed generality rather than specificity in motor performance.

Recommendations

It is the belief of the author that the main goal of educational programs designed for the mentally retarded children, is to help them develop and acquire skills and attitudes which will enable them to function independently in the mainstream of our society. It was often indicated in the literature that the psychomotor domain "offers perhaps the best single area for helping the retarded child more toward this end" (Rarick, Dobbins and Broadhead, 1976, p. 112).

In reviewing the findings of this study, the following recommendations are warranted in relation to the instructional methods to be used in physical education programs for the educable and trainable retardates:

1. The large degree of individual differences in the performance of the motor tasks in this study greatly supports the notion that these educable and trainable retardates possess a need for individualized instruction in physical education classes. The contribution of individualized instruction for normals is well documented. Such practices of individualized instruction, without any doubt, will greatly benefit the group under study on measures of motor performance as suggested by Rarick, Dobbins and Broadhead (1976).

2. If for any reason individualized instruction cannot be applied, it is recommended to assign a child to an homogeneous group in terms of measures on motor performance.

The following suggested guidelines, based on the findings of this study, which might contribute while planning motor activities for educable and trainable children:

1. Physical education programs for the mentally retarded should not be directed toward the development of motor abilities and motor skills in one specific area. Rather physical education teachers, adapted physical education teachers, special education teachers, and others should expose the retarded child to a variety of activities with the goal of developing several motor abilities rather than one general motor ability.

2. The evidence supporting the existence of a general motor ability named balance suggests that the educable and trainable retarded children need to experience and perform different motor activities which include elements of dynamic balance such as walking, running, hopping, as well as elements of static balance such as standing on one foot with eyes closed or eyes open and alike. Balance activities should constitute a large percent of the physical education curriculum, since it is "necessary for the successful performance of many gross motor skills" an individual execute in every day living routines (Singer, 1980, p. 202).

3. The evidence supporting the existence of a general motor ability named coordination suggests that the educable and trainable retarded should be exposed to a broad range of activities that encompass an eye-hand coordination, foot-eye coordination, and overall body coordination tasks. Such activities might include a variety of

experiences called "aiming to a target" in which the child is throwing or kicking an object to a target. Other experiences might include tasks in which the child does not have any control over the object that was thrown to him, and the child needs to orient himself in space so he can catch the object. Activities demanding the usage of coordination should not be ignored when planning the physical education curriculum for the mentally retarded child, since this factor determines the degree to which an individual has control of limb and body movement as suggested by Rarick, Dobbins and Broadhead (1976).

4. The evidence for the existence of a general motor ability named kinesthesis, suggests that the educable and trainable retardates should be exposed to a wide variety of activities that call upon the use of an individual proprioception, the sense which provides information as to the body's position in space and the relationship of its parts. It was reported by Singer (1980) that "the importance of proprioception in contributing to proficiency in motor performance has been noted by many researchers and instructors. The "sense of feel" enables one to direct energies elsewhere, for there is a limited amount of capacity within a person to process information" (p. 205). It is recommended that a broad range of kinesthetic elements be included in the physical education curriculum of educable and trainable individuals.

5. The evidence for the existence of a general motor ability named speed of movement with the educable and trainable retardates suggests that these children should be given ample opportunities in that area. Motor activities might involve the use of different limbs or the whole body as a reaction to different stimuli. It was reported by Cratty that "most studies indicate that retarded children and youth

react slowly to stimuli than do normals and that reaction time tends to increase when the task to be performed and/or the stimuli to be reacted to is made more complex" (p. 225). Such findings should be considered when we teach the educable and trainable retarded. Factors such as the speed of stimuli presentation and kind of stimuli should be carefully considered in order to avoid overload of the information processing channels of the child.

6. It is recommended that tests designed to measure motor abilities should also include items constructing the factors confirmed in this study: balance, coordination, kinesthesis, and speed of movement.

7. There is a need for further research in order to determine the interrelationships between the different motor ability factors and the IQ level of the educable and trainable mentally retarded.

8. There is a need for further research in order to determine the structure of motor abilities underlying the motor performance of educable and trainable mentally retardates, through the use of exploratory factor analysis.

9. Further research should be conducted in order to reveal the possible explanations for obtaining generality in motor performance with the mentally retardates rather than specificity as is the case with normals. Such studies might indicate as to whether generality was obtained because of the retardates level of intelligence, or because of fewer opportunities to participate and practice in motor activities.

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