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A Comparison of the Motor Development of Deaf Children of Deaf Parents and Hearing Parents

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ABSTRACT

Differences in linguistic, cognitive, and social skills are known to exist between Deaf children of Deaf parents and hearing parents; differences in motor development, however, are not known between the two groups. This study was designed to compare the motor development of 14 Deaf children of Deaf parents and 15 Deaf children of hearing parents. The 11 girls and 18 boys were 4-9 years old; 16 were in the 4-6 age group, and 13 were in the 7-9 age group. The Test of Gross Motor Development (TGMD) was used to assess the motor development of 29 participants who attended two schools for students who are Deaf. Modifications to the procedure for administering the TGMD included visual demonstrations, the use of signing to communicate instructions, and video recordings of performance. The results of the study indicated no significant differences on motor development between Deaf children of Deaf parents and Deaf children of hearing parents.

DEDICATION

This is dedicated to my incredible parents, Gary and Harriet Volding, for their unconditional love and support; they have been the foundation to my successes. I am forever grateful to have them on my team as co-captains in life.

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CHAPTER I

INTRODUCTION

Background

Motor Development

From regarded researchers such as Piaget's (1952) developmental learning theory, to Gallahue & Ozmun's (1998) phases of motor development, motor development is recognized as an integral part of the total developmental process.

Starting from infancy throughout adulthood, there are four identifiable phases of motor development: reflexive, rudimentary, fundamental, and specialized (Gallahue, 1989). These phases may not be skipped. They provide a baseline for diagnosing and/or assessing an individual's maturation and development. For example, if fundamental motor patterns such as catching, kicking or hopping are not demonstrated during the typical age period, motor difficulties may exist. Such patterns are the foundation for learning more complex games, sports and dance skills later in life (Branta, Haubenstricker, & Seefeldt, 1984; Rarick, 1981).

Unlike members of most populations with disabilities, most who are Deaf do not want 'person who is Deaf' terminology used to describe them. Many Deaf individuals prefer to be called a 'Deaf person' rather than a 'person who is Deaf', (Craft & Lieberman, 2000, p.171). The use of the upper case "D" in the word "Deaf" is a succinct proclamation by the Deaf that they share a culture and a language - sign language (Dolnick, 1993).

It has been recognized that motor development at each phase "is influenced by factors within the task, the individual, and the environment" (Gallahue, 2000 p. 279). This knowledge becomes useful for tracking similarities or differences among children's movement; and if necessary, will help physicians, parents and teachers assess and set proper goals and expectations for the child's needs and interests. Furthermore, Gallahue (2000, p.279) notes that "attainment of the mature stage is influenced greatly by opportunities for practice, encouragement, and instruction in an environment that fosters learning." Unfortunately, not every child is exposed or has sufficient opportunities for exploration and play, which may be detrimental to the child's future. Research shows that without attainment of the fundamental skills, children often experience a high failure rate both in school and on the playground, (Reid, 1987; Brown & Brown, 1996). Furthermore, a child who has not developed satisfactory fundamental movements may display a poorer social development and lower self-concept (Brown & Brown, 1996; Gallahue, 1982; Malina & Bouchard, 1991; Reid, 1987; Williams, 1983).

Gallahue (2000) suggests there may be a biological basis for the development of certain movement patterns due to phylogenetics. Since phylogenetic skills appear automatically and in a predictable sequence, an individual's heredity of phylogenetic skills may contribute significantly to movement skill development throughout life.

Typically, the central nervous system is maturing and developing up until the age of eight. By this age, children have acquired many of the skills that will allow them to compete successfully in athletics. Given the importance of fundamental motor skills and play in the motor development of young children, it is imperative that physical educators provide instructional programs that offer and nurture these experiences.

Several federal laws require all children to receive a proper and effective physical education program. Laws related to the Individuals with Disabilities Education Act (IDEA, OSE/RS, 1998) define physical education as the "development of (a) physical and motor fitness, (b) fundamental motor skills and patterns, and (c) skills in aquatics, dance, and individual and group games and sports (including intramural and lifetime sports)". In effect, services are required for all children with disabilities. This includes children with hearing impairments and deafness. Starting from infancy, one may conclude that an essential component of physical education is the attainment of motor skills and abilities.

Physical Activity and Sport

Physical activity not only increases the physical fitness levels of students, but also their motor abilities, and social and psychological growth (Brown & Brown, 1996; Malina & Bouchard, 1991). Once success is experienced in physical activity and/or sport, the child is more likely to continue participation in physical activity and/or sport for a lifetime. Sport has been seeked as an outlet and it "has been perceived by society as an equalizer and as a means of gaining acceptance" (DePauw & Gavron, 1995, p.26). Sport touches almost everyone as a consumer, spectator and participant (DePauw & Gavron, 1995). Unfortunately, not everyone has been accepted or included in the sport arena. Individuals based on their culture, gender, ethnicity, class, or disability affiliation were limited or excluded to participation in sport (Karwas & DePauw, 1990). This has changed slowly due to the visibility of sport and the social acceptance of individuals and groups who were determined to seek entry into sport. Those with disabilities, however, were "among the last groups to seek access into the sport arena" (Depauw & Gavron, 1995, p.26).

Deaf Sport

As early as 1870, Deaf athletes became the pioneers of individuals with disabilities to become involved in organized sports (Winnick, 2000). The oldest U.S. disability sport organization was founded in 1945, American Athletic Association for the Deaf (AAAD); known today as the USA Deaf Sport Federation (USADSF). Since the formation of USADSF (formally AAAD), seven multi-sport disabled sports organizations affiliated with the United States Olympic Committee have been formed.

Deaf sport is unique to the Deaf culture; it is the most prominent social institution within the Deaf community (Stewart, 1991). "Deaf sport emphasizes the honor of being Deaf, whereas society tends to focus on the adversity of hearing loss" (Stewart, 1991, p.1). Also, Stewart (1991) identifies the importance of how sport socializes Deaf people into the hearing community and provides an equal playing field - where hearing is not significant and both groups can interact with one another in a meaningful and non-threatening manner.

"Physical educators have the extremely important role of introducing Deaf students to sport, both hearing and Deaf sport. For many Deaf students attending public schools, the majority of their exposure to Deaf culture will be through Deaf sport" (Craft, & Lieberman, 2000, p.178). The importance of sports in schools for Deaf children has proven to provide for social interactions known to help aid the children in developing a positive self appraisal of their social competence (Stewart & Stinson, 1992).

Motor Development and Deaf Children

Researchers have studied the effects deafness has on the motor development of Deaf children. Although most studies have not placed Deaf children with vestibular damage in a group separate from other Deaf children, it is generally believed that, nonvestibular impaired Deaf and hearing persons will not show delayed motor development, while vestibular impaired Deaf persons will (Schmidt, 1985). The vestibular mechanism in the inner ear governs both hearing and balance. The mechanism signals whether the head is upright, upside down, or in some other position. It is not surprising then to find delays in static and/or dynamic balance of Deaf individuals if their vestibular is damaged (Craft, 1995).

Although vestibular impairments have been found to be a determinant in delaying motor development, Dummer, Haubenstricker, & Stewart, (1996) suggest that delayed motor development may be more often caused by environmental factors than by factors related with deafness. Environmental factors such as "type of school, curricular emphasis, parenting styles, opportunities for practice and play, and motor development test procedures" (Butterfield, van der Mars, & Chase, 1993 p.2) are regarded as major contributors to motor development delays versus a child's deafness. For example segregated schools for the Deaf have, in the past, known to offer stronger physical education programs than integrated schools for Deaf and hearing children; students from residential schools show more involvement in physical activity and sport. Furthermore, parental support proves to be a strong indicator on whether Deaf children partake in physical activity or not (Ellis, 2001).

Deaf Children's Linguistic, Academic, and Social Skills

Communication between parents and Deaf children plays an essential role in the child's linguistic, social and cognitive development. Galvan (1999) and Vaccari and Marschark (1997) found that when parents have good communication skills, meaningful interactions with their Deaf child occurs at many levels. "From those interactions, Deaf children not only gain facts: they gain behavioral and cognitive strategies, knowledge of self and others, and a sense of being part of the world" (Vaccari & Marschark, 1997, p.793). Subsequently, effective communication with Deaf children is more likely from Deaf parents than from hearing parents; Stinson (1994) added that interactions between Deaf children and Deaf parents are more natural, where a diverse and rich language may be shared.

Deaf children's intelligence may be related to early communication. When Deaf children are exposed to early communication/sign language with Deaf parents, they perform stronger academically compared to Deaf children with hearing parents (Ritter-Brinton & Stewart, 1992). Several researchers have consistently reported that Deaf children of Deaf parents score higher on Performance IQ tests than Deaf children of hearing parents (Brill, 1969; Conrad & Weiskrantz, 1982; Kusche, Greenberg & Garfield, 1983; Meadow, 1968; Ray, 1982; Ritter-Brinton & Stewart, 1992; and Sisco & Anderson, 1980). Essentially, the cognitive development of Deaf children can be associated with parental hearing status.

Early communication is also a key factor for social development in Deaf children. Children who have learned positive social-communication skills within the family are more prepared to interact socially with success (Hadadian & Rose, 1991). Unfortunately, most hearing parents have poor sign language skills, which in turn, inhibits optimal social interactions with their Deaf child (Vaccari & Marschark, 1997).

Although parent's sign language abilities play a vital role in the Deaf child's social development, parental involvement in physical activities and structured physical education programs are also strong influences (Ellis, 2001). It is necessary for parents and teachers to be involved in physical activity as well as provide meaningful activities. This increases the chances that the child will become involved in physical activities; if this occurs, the child's social development will inadvertently be enhanced (Anderssen & Wold, 1992; Biddle & Goudas, 1996; Dempsey, Kimiecik, & Horn, 1993; Freedson & Evenson, 1991; McCullaugh, et al., 1993; McMurray, et al., 1993; Moore, et al., 1991).

The most prominent social institution within the Deaf community is Deaf sport (Stewart, 1991). Researchers Dummer, Haubenstricker, & Stewart (1996) addressed in their study how the development of fundamental motor skills of Deaf children leads to greater participation in Deaf sports as well as opportunities for social interaction. Stewart (1991, p.2) expresses how significant Deaf sport is to Deaf culture; "Deaf sport is a social institution within which Deaf people exercise their right to self-determination through organization, competition, and socialization surrounding Deaf sport activities".

Estimates from the Annual Survey of Deaf and Hard of Hearing Children and Youth (Gallaudet Research Institute, 2001) showed 92% of Deaf children are from families where both parents are hearing, and 4% of Deaf children are from families where both parents are Deaf (Mitchell, and Karchmen 2002). Such data results are important when researching Deaf children's abilities. Researchers Mitchell and Karchmen (2002) state "the prevalence of Deaf children born to Deaf parents (deaf-of-deaf) is important because it is often cited when describing linguistic and educational advantages, along with social and cultural differences, associated with Deaf children born to Deaf parents compared to Deaf children of hearing parents."

Statement of the Problem

It is estimated that over 17 million Americans have hearing losses, of which 2 million (about 1 person in 8) are profoundly Deaf (Kottke & Lehmann, 1990). The prevalence of profound deafness among children in the United States is approximately 1 in 1,000. Of the children in educational programs for the Deaf, only 4 to 6 percent have Deaf parents; therefore more than 90% of Deaf children have hearing parents (Gallaudet Research

Institute, 2001). Most Deaf children of Deaf parents (dc/dp) function better than Deaf children of hearing parents (dc/hp) academically (e.g. Brill, 1969; Meadow, 1968; Ritter-Brinton & Stewart, 1992), linguistically (e.g. Vacarri & Marschark, 1997), and socially (e.g. Butterfield et.al., 1993). Studies in motor development, however, have not made such a distinction between Deaf children who have Deaf parents and Deaf children who have hearing parents.

Clearly, motor development is important for children to develop for they typically evolve into more mature patterns that can be used in sport and recreation activities. The foundation of motor development is especially important to Deaf children because better skills lead to participation in Deaf sports as well as more opportunities for social interaction (Dummer, Haubenstricker, & Stewart, 1996).

Since Deaf sport plays such a prominent role in the Deaf culture, motor skill development has an impact on the Deaf child's future. According to IDEA, physical educators, early childhood specialists, and adapted physical educators must provide appropriate motor programming for children who are developmentally delayed; hence, educators must be aware that Deaf children may or may not show delays in motor development.

Although research upon academic, linguistic, and social development of Deaf children of Deaf parents and Deaf children of hearing parents present considerable differences, research comparing the motor development of Deaf children of Deaf parents and hearing parents is unavailable.

Purpose of the Study

The purpose of this study was to compare the motor development of Deaf children of Deaf parents and hearing parents.

Research Hypothesis

It was hypothesized that Deaf children of Deaf parents will exhibit significantly higher gross motor development scores than Deaf children whose parents hear.

Operational Definitions

Deaf

The use of the upper case "D" is a succinct proclamation by the Deaf that they share more than a medical condition; they share a culture and a language (Dolnick, 1993). A hearing loss that is so severe that the student is unable to process language through hearing, with or without the use of an amplification device, (IDEA, 1997).

deaf

A hearing loss in which hearing is so severe that the student is unable to process language through hearing, with or without the use of an amplification device (IDEA, 1997).

Fundamental movement

Basic movement skills which are building blocks for more highly developed and refined motor skills (Winnick,2000).

Hard of hearing

Individuals who have residual hearing, generally by use of a hearing aid, which enable successful processing of linguistic information through audition (Eichstaedt & Kalakian, 1993, p.348).

Gross motor development

"The skillful use of the total body in large muscle activities that require temporal and spatial coordination of movement of a number of body segments simultaneously" (Williams, 1983, p.10). The term refers to skills used to transfer the body from one location to another and to propel and receive objects (Ulrich, 1985).

Locomotor movement (TGMD)

Measures the run, gallop, hop, leap, horizontal jump, skip, and slide skills that move the center of gravity from one point to another (Ulrich, 1985).

Object control (TGMD)

Measures the two-hand strike, stationary bounce, catch, kick and overhand throw skills that project and receive objects (Ulrich, 1985).

Test of Gross Motor Development (TGMD)

A test that evaluates the gross motor functioning of children 3 to 10 years of age. Twelve gross motor skills frequently taught and measured to children in preschool, early elementary, and special education (Ulrich, 1985).

Assumptions

1) The Deaf children in the study are similar to other Deaf children of the same age and gender.
2) Both test administrators used the same procedures when administering the TGMD.
3) Presence of the video camera did not affect the motor performance of the children.
4) Each child in the study understood the directions for each test item in the TGMD.
5) Each child in the study performed the best to his or her ability on all test items in the TGMD.

Delimitations

1. All students in the study were either enrolled at The Rochester School for the Deaf or St. Mary's School for the Deaf.
2. This study was delimited to twenty-nine Deaf children.

3. All participants came from a segregated school setting.
4. This study was delimited to Deaf students who were four to nine-years-old.

Limitations

2. The sample size was low in this study.
3. The sample was an opportunistic group.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Research studies on Deaf children's motor development will be reviewed in this chapter. Also, educational placement, communication, parental relationships, and Deaf children's linguistic, academic, and social skills will be reviewed.

Motor Development

In 1964, Myklebust assessed the balance and locomotor coordination of 75 Deaf and 275 hearing children. Deaf children were inferior to hearing children on locomotor coordination as measured by a rail walking test; furthermore, the balance performance of the Deaf children as measured by the rail walking test was significantly inferior to that of hearing peers. Myklebust (1964) also assessed simultaneous motor control, manual dexterity in motion, general coordination, manual dexterity and overflow. The Deaf children performed 18 months below the hearing children on general coordination, simultaneous motor control, and static balance. On the other hand, the Deaf children were well within the norms on overflow and dynamic manual dexterity items.

Boyd (1967) conducted a comprehensive study of balance, motor skill abilities, and motor skill development. The participants included 90 Deaf and 90 hearing children all between the ages of eight and 10. Boyd (1967) assessed the children using the Bruinick's Oseretsky Scale. The results for the eight-year-old children showed significant differences on static balance, with the Deaf children showing a deficit. There were significant differences for locomotor coordination and dynamic balance. Furthermore, the Deaf children scored higher in manual dexterity speed.

Carlson (1972) conducted a motor abilities study in 1969 at Kansas School for the Deaf. Forty-eight participants, ages five to 10 were evaluated on the Brace Motor Ability Test. The test items included the straight line walk, single and double heel-click, sit-up, kneel and up, three dip, full-left and right turn, knee dip, jump-foot, heel-stop, stand, tip-up, and single leg-squat tests. Carlson found little difference between Deaf boy's and Deaf girls' motor abilities. The scores of the five to seven-year-old Deaf children were significantly lower than the scores of the normative sample (Brace, 1927); however, no significant differences were found between the scores of the eight-year-old Deaf children and the scores of the normative sample on measures of motor ability.

The psychomotor performances of 11 Deaf and hearing impaired preschool children was assessed with the Geddes Psychomotor Inventory (1977). All of the children were four to six-years of age. The test items included static balance, body awareness, locomotion and dynamic balance, manipulation, and body mechanics. Most of the Deaf or hard of hearing preschool children demonstrated normal motor development to their same age hearing peers. Two out of the four who had exhibited delays in balance skills had had meningitis; "this supported the rationale that there was a relationship between etiology of meningitis and specific balance difficulties (Geddes, 1978, p.291). Geddes (1978) speculated that the functional delays were attributed to the children's lack of play experience and training rather than to deafness or hearing disorders. Three of the children functioned above age in the locomotor and manipulative tasks.

Brunt and Broadhead (1982) assessed the motor performances of 154 Deaf and hearing impaired children ranging in age from seven to 14 years, including 26 Deaf children seven and eight-years-old. The motor performance results from this study were compared to the score of hearing children on the short form of the

Brunicks-Oseretsky Test of Motor Proficiency (Brunicks, 1978). The test consists of 14 items organized into 8 sub-tests of motor proficiency: running speed and agility, balance, bilateral coordination, strength, upper-limb coordination, response speed, visual-motor control, and upper-limb speed and dexterity. The results showed that seven and eight-year-old Deaf children were below the mean in balance, bilateral coordination, and response speed. Performance on items of static and dynamic balance for both female and male Deaf children were significantly lower than their hearing peers. These findings parallel those of Myklebust (1964).

Butterfield (1983) assessed 132 Deaf and hard of hearing children, ages three to 14, using the balance items from the Bruinicks-Oseretsky Test of Motor Proficiency (Bruinicks, 1978), and all test items from the Ohio State University Scale of Intra Gross Motor Assessment (OSU-SIGMA); (Loovis & Ersing, 1979). Butterfield (1983) found six significant results: (1) degree of hearing loss only affected the performance of motor skills on the kicking task; (2) advanced chronological age showed an improvement on all balance tasks and 10 fundamental motor skills; (3) significant differences with regard to etiology (genetic, idiopathic, rubella, meningitis, and other) were found only for static balance; the genetic group was superior to the idiopathic group; (4) no significant differences were found between males and females on the balance tasks and fundamental motor skills; (5) a significant relationship was found between static and dynamic balance and the performance of hopping, jumping, skipping, stair climbing, running, throwing, catching, striking, and kicking; and (6) significant differences were found between age groups on static and dynamic balance. Butterfield (1983) concluded that the participants who performed at mature levels had the greatest degree of hearing loss.

Several investigations of Deaf children in the Netherlands were conducted by Wiegersma and van der Velde (1983). All studies showed poorer performance for the Deaf and hard of hearing children when compared to hearing children on measures of balance, and motor development. One study (1977) compared 25 Deaf children to 31 hearing children ages eight to 10, on test items selected from various assessment instruments. The participants included 32 Deaf children ages six to eight. Both studies produced similar results: Deaf children showed delays in dynamic coordination and physical fitness compared to hearing children. Another study consisted of 55 Deaf children, six to 10 years old, who had experienced prenatal and perinatal complications; however, no obvious physical disabilities were present. Results showed that the performance of the six to eight-year-old Deaf participants was inferior to that of the same age hearing participants; nonetheless, cutting out circles, jumping, and right leg skipping performances yielded no significant differences. The fourth study compared 19 healthy Deaf children to hearing children eight to 10 years of age. Significant differences were observed in movement time between the Deaf and hearing children; however, no significant difference was noted in reaction time.

Butterfield, van der Mars, and Chase (1993) compared the fundamental motor skill performances of Deaf and hearing children ages three to eight. The study evaluated 54 Deaf children and 56 hearing children on the Ohio State University Scale of Intra Gross Motor Assessment (OSU-SIGMA); (Loovis & Erving, 1979). The OSU-SIGMA is a criterion referenced tool with four levels of development for each of 11 fundamental motor skills (Butterfield, van der Mars, & Chase, 1993, p.2). The results showed that mature performances were achieved by Deaf and hearing children at an earlier age in walking, stair-climbing, throwing, striking, and skipping. Furthermore, mature performances in catching, kicking, jumping, hopping, and running were generally associated with more advanced chronological age. Butterfield, et al. stated, "Although differences may exist in motor development of Deaf and hearing children, the overall rate of motor development by the two groups appears comparable" (1993, p.5). Since these findings indicated that delays in motor development cannot be attributed to deafness per se, researchers suggest external factors such as the child's school, parenting styles, and opportunities for practice and play should be included in future investigations on Deaf children's motor development.

Researchers Dummer, Haubenstricker, and Stewart (1996) found that Deaf children performed better than the normative sample (Ulrich, 1985) in both locomotor and object control sub-skills. These results are similar to those of Geddes (1978) and Butterfield (1983). Dummer, et al. (1996) suggested that the four-year-old Deaf children, may have performed better than the normative sample because they had already started their formal schooling by attending motor movement/physical education classes. If this is true, the advantages of preschool and early intervention programs for young Deaf children may eliminate potential or existing developmental delays. This study indicated that when compared to the normative sample (Urich, 1985) Deaf children acquire skill in running, sliding, and galloping at younger ages, skill in hopping and jumping at the same age, and skill in skipping and leaping at later ages; such results suggest how "it is appropriate to compare the performance of Deaf children on fundamental motor skills to the norms of children who can hear on tests such as the TGMD" (Dummer, et al., 1996 p.413).

Balance remains to be a contributing factor to Deaf children's delays in motor skill performance. It is believed that Deaf children with vestibular etiology are likely to have balance problems. Motor and developmental delays are likely to occur from these balance problems (Craft, & Lieberman, 2000). Not all motor skill outcome depends on balance alone. This may determine why some research may or may not conclude that Deaf children's motor development are equivalent to same age hearing peers. For example, Goodman and Hopper (1992) conclude from the various studies examining Deaf children's physical fitness and motor skill performance, that Deaf children do not fare well to their hearing peers. On the contrary, Schmidt (1985) addresses how Deaf children (with the exception of vestibular etiology) exhibit no difference in motor performance compared to hearing children in the regular physical education classroom.

Also, Winnick and Short (1986) generally found no significant difference in fitness scores between hearing and Deaf students, however, they did find a significant difference in sit-up scores. In any case, Geddes (1978) addressed how research has been limited to balance skills and to select physical fitness or motor skills.

Ellis, et al., (2000) found grip-strength performances by hearing and Deaf children from a residential school equivalent to one another. According to some experts, Deaf children may have greater opportunities to develop motor skills and physical fitness in residential schools for the Deaf; an environment where sports and physical education opportunities are designed for all students (Butterfield, 1991; Stewart, McCarthy, & Robinson, 1988). Winnick (2000 p.173) adds, "Given equal opportunity to learn movements and participate in physical activity, Deaf children should equal their same age peers in motor skills". Interestingly, Deaf children tend to be more prone to lower fitness levels associated with low activity lifestyles. Jansma and French (1992) identify such a need where a program is valued and adequately meeting the student's individual physical needs.

Educational Placement

The United States statistics for 1994 indicate that approximately 30,347 children who are Deaf or hard of hearing (70%) are educated similar to their hearing peers in public schools, and an estimated 12,704 children who are deaf or hard of hearing (30%) attend residential or day schools for the Deaf (Moores, 1996). Stewart, (1991, p.1) addressed that Deaf school's "physical education programs are likely to be more comprehensible and tailored specifically to prepare Deaf students for lifelong involvement in sports". This suggests that less than one third of Deaf students are more likely to receive an effective physical education program where they are provided with the opportunities to develop motor skills to their full potential.

Physical education programs must provide activities "that will give Deaf children an appreciation for the value of being physically active and help them better handle the physical rigors they will face as adults" (Stewart & Ellis, 1999 p.317). Interestingly, Schmidt (1985) stated that the most crucial problem faced by physical education instructors of the hearing impaired is communication. Physical educators need to use sign language and other forms of visual instruction simultaneously with instruction. Schmidt also suggests for teachers to use visual aids such as sign language, sport specific words, speech reading and demonstrations whenever possible. Furthermore, the teachers are encouraged to learn a composite of approximately 45 signs as a basis and tool for effective communication. Eichstaedt and Seiler, (1978), state how communication is vital for regular physical educators to use in an effective and effortless manner with Deaf or hearing impaired students. Physical education instructors who are not fluent in sign language will most likely rely on the use of visual cues rather than auditory cues. According to Graziadei (1998), this method does not allow the Deaf student to fully learn the conceptual aspects of physical education. The physical education teacher should be able to assess the Deaf student's ability to use American Sign Language (ASL) to express concepts. For this to occur, the teacher needs to be able to express and understand that concept in ASL (Galvan, 1999). Lieberman, Dunn, and van der Mars, (2000), also suggest that peer tutor programs be created in hearing schools. While such programs have been shown to improve physical activity for Deaf students, new opportunities for positive socialization among peers develops (Lieberman et al., 2000).

Communication

"Deafness is primarily a disability of communication rather than a disability of motor performance" (Dummer, Haubenstricker, & Chase, 1996, p. 413). Galvan (1999), Newport (1988), and Singleton (1989) discussed the importance of early communication with Deaf infants and toddlers. Their findings supported the importance of early parental signing. The infant begins to learn a language from their innate strategies which in turn "will start the process of analyzing the pieces of the sign that he or she can perceive" (Galvan, 1999). Moores (1996) suggested that most Deaf children do not receive early communication since the majority comes from families of hearing parents who were not prepared. Parents/Guardians, and teachers must be aware of language delays with students who are Deaf or hearing impaired.

Several studies have examined parental (majority were hearing mothers) communication and its affects with their Deaf child. Woods (1991) suggests that Deaf children experience developmental delays because of problems of communication from hearing adults, not because Deaf children lack a language of thought. Such communication difficulties faced by hearing adults are stemmed from the struggle to pass on their knowledge, skill and understanding. More often than not, Deaf parents are more skillful than hearing parents when communicating with their child who is Deaf. They (deaf parents) share with their child an effective mode of communication where their interactions are smoother and more natural, while a variety of topics may be shared (Stinson, 1994). Woods (1991) stresses how hearing parents or teachers all too often take too much control when communicating with Deaf children; this holds true whether that communication takes place in Signed English, signed supportive English, or speech. In addition, children exposed to too much control (whether hearing or Deaf children) over a long period of time, become passive, unmotivated and poor at self-regulation in learning and problem solving (Woods, 1986).

Parental Relationships

Parents and children need "to develop a reciprocity in their visually based interactions, through attention-switching and turn-taking" (Vaccari & Marschark, 1997, p. 799). In Desselle's (1999) study, results showed the more the parents conversed using sign language, the higher the self-esteem scores; incidentally, the higher reading levels of the Deaf child, the higher their self-esteem. Furthermore, Deaf children of Deaf parents were found to have higher self-esteem than Deaf children of hearing parents (Harris, 1978; & Meadow, 1967). An interrelationship between self-esteem, language, psychosocial, and cognitive functioning was identified by Leigh (1977). Coopersmith (1967) and Felker (1974) supported the direct effects child-rearing experiences have on the development of the child's self-esteem, behavior and cognition. Furthermore, Mindel and Vernon (1971), and Schlesinger and Meadow (1972), identified why Deaf parents tend to be more accepting than hearing parents of their child's deafness and how this impacts the child's development.

Nonetheless, a positive attitude must first be intact. Hadadian, & Rose (1991) found when parents have a negative attitude towards their child's deafness, the child is likely to exhibit lower expressive language skills. Therefore, if positive communication skills exist, meaningful interactions are allowed between parents and children to use on a variety of levels. From those interactions, Deaf children gain facts, and behavioral and cognitive strategies. Essentially, communication makes an impact on the Deaf child's future in social emotional skills and academics (Vaccari, & Marschark 1997).

If students experience a variety of meaningful activities filled with success, this may lead them to long term psychological and social advantages (Stewart &

Ellis, 1999). Effective communication between parents and their children plays an important role for such social/emotional advantages to occur. Natural interaction strategies develop between Deaf children with Deaf parents and hearing children with hearing parents; however, Deaf children with hearing parents have a more challenging time. Many hearing parents may not be fully sensitive to their Deaf child's social and communication needs, and the discovery of their child's hearing loss may not be until two or three years of age "when many social behavior patterns already have been established" (Vaccari, & Marschark, 1997, p. 799). Such evidence is important for Deaf and hearing parents, as well as educators. "Social support is to be regarded as a cornerstone of psychosocial intervention and has to play as a great role as possible in institutional programs" (Hintermair, 2000, p. 41).

Cognitive, Language, Psychological Functioning

Once a nurturing, accepting living environment is provided for the child, cognitive abilities may be fully developed and achieved (Sisco & Anderson, 1980). The Wechsler Intelligence Scale for Children, Performance Scale (WISC-R) is a most widely used test of cognition with Deaf and hearing children (Levine, 1974). Brill (1969) and Meadow (1967) found that Deaf children of Deaf parents performed significantly better than Deaf children of hearing parents on standard intelligence tests. In 1972, Schlesinger and Meadow reported that Deaf children with Deaf parents have distinct advantages to Deaf children with hearing parents in the areas of cognition, language and psychological functioning. In Sisco, and Anderson's study (1980) they found Deaf children of Deaf parents performed significantly better than Deaf children of hearing parents on all subtests on the WISC-R, Performance Scale. They asserted that "differences in nurturing and early child-rearing experiences of Deaf children of Deaf parents may be the crucial determinant of cognitive functioning in Deaf children" (p. 923). Braden (1987) addressed how numerous independent studies (Brill, 1969; Conrad & Weiskrantz, 1982; Kusche, Greenberg, & Garfield, 1983; Meadow, 1968; Ray, 1982; Sisco & Anderson, 1980) found Deaf children of Deaf parents consistently score higher on Performance IQ tests than Deaf children of hearing parents and hearing children as well.

An explanation of the superior performance IQ's of Deaf children of Deaf parents was investigated by Braden (1987). Results showed that Deaf children of Deaf parents have faster reaction time and movement time than Deaf children of hearing parents and hearing children; it is believed that greater sign language exposure is related to faster movement time. Braden states (1987, p. 265), "Deaf children have equal or better information processing abilities than their hearing peers, yet they do not fulfill this cognitive promise. In fact, they fall behind their hearing peers in spite of their equal or better potential - an alarming, if all too common, finding". Also, Ritter-Brinton and Stewart (1992) found when Deaf children are exposed early to sign language/communication with Deaf parents, they are stronger academically compared to Deaf children who have hearing parents.

Physical Activity and Sport

Several researchers have found a strong indication that parent involvement and encouragement in physical activities increases chances that their child will participate as well (Anderssen & Wold, 1992; Biddle & Goudas, 1996; Dempsey, Kimiecik, & Horn, 1993; Freedson & Evenson, 1991; McCullaugh, et al., 1993; McMurray, et al., 1993; and Moore, et al., 1991). For many Deaf children of Deaf parents, an awareness of the existence of organized Deaf sport programs occurs at a very young age; such awareness, however, does not occur for Deaf children of hearing parents until they are adults (Stewart, 1987).

Not only parents have an instrumental role to a Deaf child's interest and participation in physical activity, but also the schools he/she attends. Ellis (2001) examined what influence parents and schools have on physical activity level and fitness of Deaf children. The results showed residential students of Deaf parents demonstrated greater cardiorespiratory endurance, lower body fat, and more years of community sports involvement than residential and nonresidential students of hearing parents. Ellis' (2001) results support Stewart's (1991) explanation that Deaf parents are more likely to influence their Deaf children's physical activity, and that residential schools for the Deaf provide more meaningful opportunities, in a structured versus unstructured environment. Many Deaf children who attend hearing schools are unaware of Deaf sport programs due to the fact their teachers are unaware that such programs exist. There is also a strong pressure by the teachers to keep the Deaf students in an inclusive setting with their hearing peers (Stewart, 1987).

Summary

In summary, there is an abundance of research on the motor development of Deaf children, and Deaf children's academic, linguistic, and social skills. More often than not, studies show that Deaf children of Deaf parents perform better in academic, linguistic and social skills compared to Deaf children of hearing parents (e.g. Butterfield et al., 1993 and Harlan et al., 1996). Differences of gross motor development between the two parent groups (hearing and deaf) of Deaf children, however, have not been found conclusive. Researchers have found little or no difference between hearing and Deaf children in motor development. When differences do exist between the Deaf and hearing children in motor development, it is most likely the result of malfunctioning of the semicircular canals (Dummer et al., 1996; Schmidt, 1985; & Winnick, 1979). Recent studies indicate Deaf children should have equivalent motor abilities and physical fitness to their hearing peers unless they exhibit vestibular damage (e.g. Butterfield, 1991; Dummer et al. 1996; and Winnick & Short, 1986).

CHAPTER III

METHOD AND PROCEDURES

Introduction

The methods and procedures used in the study are presented as follows: selection of participants, Test of Gross Motor Development, video equipment, and statistical analysis.

Selection of Participants

A total of 29 participants, 11 females and 18 males volunteered for this study. All participants were four to nine years old, and divided into age groups, 4-6 and 7-9. The mean age was 6. All attended either Rochester School for the Deaf (RSD), in Rochester, New York, or Saint Mary's School for the Deaf, in Buffalo, New York. The physical education teachers from RSD and SMSD selected a total of 14 participants of Deaf parent(s)/guardian(s) and 15 participants of hearing parent(s)/guardian(s), respectively. The teachers selected Deaf students according to their age, cognitive function, availability, and parental permission. To avoid discriminatory analysis of testing, the test administrators did not inquire about the hearing status of the parent(s)/guardian(s) until all participants were tested. All children regularly participated in physical education class three days a week for thirty minutes each session. Approval to use the participants from the two schools was granted by the school's administrator and by the child's parent(s) or legal guardian(s). Informative letters and consent forms were signed by parent(s)/guardian(s) giving clearance for student participation (see Appendix A).

Test of Gross Motor Development

The Test of Gross Motor Development (TGMD, Ulrich, 1985) was administered to measure the Deaf children's locomotor and object control gross motor development (a sample of the TGMD testing information is included in Appendix B). The test measures 12 gross motor skills that are frequently taught to male and female children in preschool, early elementary, and special education classes. The locomotor subtest measures the run, gallop, hop, leap, horizontal jump, skip, and slide; and the object control subtest measures the two-hand strike, stationary bounce, catch, kick, and overhand throw.

For each skill the tester is provided with an illustration, equipment/condition requirements, directions, and performance criteria. Children receive one point for meeting each of the performance criteria given for each of two trials. These criterion-based scores can be added and compared to norm-referenced standards. Age norms are provided in half-year increments for ages three to eight for both subtests (Ulrich, 1985).

Reliability of the TGMD, as evidenced by test-retest coefficients, and inter-scorer coefficients, is quite high. Test-retest reliability coefficients ranged from .84 to .99, and inter-scorer generalizability coefficients ranged from .77 to .99 for the gross motor skills. Validity was documented based upon various criteria. Most notably, content validity is claimed for the selection of the 12 tests as representing skills frequently taught in the preschool and early elementary grades and for the selection of the performance criteria. Construct validity was determined by statistical analysis: (a) the skills all seem to relate to a 'gross motor' construct, (b) the tests are highly related to age, and (c) nonhandicapped children do better on the test than mentally retarded children. Additional construct validation was established by analysis of cross-age performance and comparisons between subjects with and without mental retardation.

The TGMD provides four different scores: raw scores, percentiles, subtest standard scores, and a composite quotient. Locomotor and object control raw scores were the primary analysis utilized in this study.

The four test administrators were the participant's physical education teachers; this provided participants effective communication and understanding of the test items to be performed. The test administrators were familiar with the content and standard procedure for the administration of the TGMD. They completed a short workshop and practiced until they were in agreement with the standard procedures before data collection. When the test was administered, the test administrators communicated according to the participants preferred mode of communication.

Video Equipment

The video equipment used in the study included two Panasonic video cameras, model 150-EL, two standard videocassettes EGT-120 to record all data, two wireless microphones, and two tripods. The video equipment was used to record the student's skills during the administration of the TGMD. Further analysis of the TGMD skills was gained by later viewing the videotapes and transcribing results from the student's performances.

Testing Procedures

All testing by test administrators was conducted during regular scheduled physical education classes. Prior to the actual testing and videotaping, the video camera and tripod were set up in two testing sites. The testing site for each school was in the gymnasium. Skill stations for object control and locomotor test items were set up prior to the student's arrival. Children were individually assessed on all test items within their natural setting by one of the test administrators. All skill test items were administered to each child in one or two physical education classes. Each child was given a demonstration and allowed to practice to ensure understanding his/her performance was recorded. The skills were grouped into two substeps assessing locomotion and object control (Ulrich, 1985). The locomotor test items measured run, gallop, hop, leap, horizontal jump, skip, and slide. The object control test items measured the two hand strike, stationary bounce, catch, kick and overhand throw (refer to Appendix B).

Data Analysis

The objective of the study was to compare the motor development of Deaf children of Deaf parents and Deaf children of hearing parents. Videotaping of the participants allowed the investigator to view the tapes after all participants were tested and to then record scores for participants. Each participant's performance on the two TGMD subtests was scored. Participants received a 1 or a 0 for each performance criteria within the 12 subtest skills. Once all participants were scored, the data were then prepared for analysis.

The first step in the data analysis was to compare raw scores of the two groups on the locomotor and object control subtests of motor development using an independent t-test. The independent t-test is used to determine whether two sample means differ significantly ($p<.05$) from each other.

The second step of the statistical analysis was to perform a 2x2 univariate factorial analysis of variance on the raw scores of each of the two subtests. One factor included two variations of age: four to six and seven to nine, and the second factor included two variations of parent: Deaf and hearing. This analysis was used to investigate the main interaction effects related to the two variables and their variation.

A third analysis involved a 2x2 univariate factorial analysis of the variables with age serving as a covariate. Finally, data were analyzed to determine whether the participants of this study performed at or above average levels of performance of youngsters from the standardize sample associated with the TGMD.

An informal letter addressed to the parent(s)/guardian(s) of the Deaf children collected additional data. Questions related to hearing status, weekly activity level, Deaf sport, and etiology. Responses were encouraged on a volunteer basis only.

CHAPTER IV

RESULTS

Presented in this chapter are the results of data analysis associated with this study.

Results

The data were statistically analyzed to compare the motor development between Deaf children of Deaf parents and Deaf children of hearing parents. Results on the two subtests of the Test of Gross Motor Development served as a basis for the results of the study.

Locomotor and object control raw scores, standard scores, ages, and identification of parents are listed in Appendix D. The analysis of data included all subjects (n=29) who participated in the study as identified in Chapter three. Raw score means for locomotor skill scores and object control skill scores for the children of Deaf parents and the children of hearing parents are presented in Table 3.1.

The first analysis involved performing independent t-tests to determine if a significant difference occurred between the two subtests of motor development on the TGMD: locomotor and object control. The "t" statistic performed on the locomotor subtest was not significant ($t(27) = .287$, $p>.05$). The "t" statistic performed on the object control subtest was also not significant ($t(27) = -.36$, $p > .05$).

TABLE 3.1 MEAN RAW SCORES FOR CHILDREN OF DEAF PARENTS AND CHILDREN OF HEARING PARENTS ON LOCOMOTOR AND OBJECT CONTROL SKILLS.

	x	n	age
Locomotor			
Deaf Children of Deaf Parents	20.8	14	6.4
Deaf Children of Hearing Parents	21.2	15	6.3
Object Control			
Deaf Children of Deaf Parents	14.6	14	6.4
Deaf Children of Hearing Parents	13.5	15	6.3

The second step of the statistical analysis was to perform a 2x2 univariate factorial analysis of variance of each subtest (locomotor and object control) using the SPSSX computer software program to determine if age (4-6 and 7-9) or parent's hearing status (deaf vs hearing) were significant factors on participant test performance.

The results of these analysis appear in Tables 3.2 and 3.3. The results indicated that the main effect of age was significant ($p<.05$) on both the locomotor and object control subtests and that the main effect of hearing status of parent or interaction effects were not significant ($p>.05$).

In view of the finding that age was significant, i.e. older participants exhibited significantly higher raw scores than younger participants, a 2x2 univariate factorial analysis was conducted to determine the results of the influence of type of parent with age serving as a the co-variate. The results indicated no significant difference ($p<.05$) between the parental groups on either the locomotor or object control subtests.

As a matter of interest, data were reviewed to determine and assess the performance level of participants on motor development. An analysis of the data indicated that, in regard to the locomotor area, 78.5% (11 of 14) of the children of Deaf parents scored at or above average performance levels and 73% (11 of 15) children of hearing parents scored at or above average performance levels. In regard to object control, 93% (13 of 14) of children of Deaf parents and 93% (6 of 7) of children of hearing parents scored at or above average performance levels.

TABLE 3.2

2x2 UNIVARIATE ANOVA OF LOCOMOTOR SUBTEST BY PARENT AND AGE GROUP.

Source of Variation	SS	DF	MS	F	Sig.
Main Effects					
Parent	.60	1	.60	.05	.83
Age	82.13	1	82.13	6.27	.019*
Interaction					
Parent x Age	5.98	1	5.98	.46	.506
Error	327.49	25	13.10		
Total	414.0	28			

$*p<.05$

TABLE 3.3

2x2 UNIVARIATE ANOVA OF OBJECT CONTROL SUBTEST BY PARENT AND AGE GROUP.

Source of Variation	SS	DF	MS	F	Sig.
Main Effects					
Parent	23.98	1	23.98	1.95	.175
Age	156.91	1	156.91	12.78	.001*
Interaction					
Parent x Age	4.23	1	4.23	.35	.560
Error	306.95	25	12.28		
Total	481.86	28			

*p<.05

Summary of Findings

Although the older participants in the study generally exceeded the performance of younger participants and most participants exhibited average or above motor development, their performance was not significantly affected by whether they were or were not children of Deaf or hearing parents.

CHAPTER V

DISCUSSION AND CONCLUSION

Discussion

The purpose of this investigation was to determine if the motor development between Deaf children of Deaf parents and hearing parents is significantly different.

Unlike studies where the hearing status of parents (Deaf and hearing) does have an impact on the Deaf child's linguistic, academic, and social development, analysis in this study showed no significant difference in the motor development of children of Deaf or hearing parents. The main effect of age was significant on both the locomotor and object control subtests. The older group (7-9), as expected, performed better than the younger group (4-6) on both subtests. The significant difference between the 2 age groups is consistent with expected changes in the motor development of children (Ozum, 1995). Motor development is progressive change in movement behavior throughout life. A predictable pattern of development is expected with age in the initial, elementary, and mature stage cycle (Gallahue, 2000).

Previous studies reviewed in Chapter II concluded that Deaf children of Deaf parents perform better in academic (e.g. Brill, 1969; Meadow, 1968; Ritter-Brinton & Stewart, 1992), linguistic (e.g. Vacarri & Marschark, 1997), and social areas (e.g. Butterfield et al., 1993), than do Deaf children of hearing parents. Interestingly, this study did not find that the motor development of Deaf children differs significantly if raised by Deaf or hearing parents. There may be several contributing factors as to why there was no significant difference in this study.

The need for parental support may differ between Deaf children's motor development and development of linguistic, academic and social skills. Since visual observation is important when learning motor skills, and other modes of communication may be more important when learning linguistic, academic and social skills, parent influence may be more important when learning linguistic, academic and social skills, than when developing motorically.

Parental involvement in physical activity increases the child's likelihood to participate and experiment in play movement activities; this may be reason to speculate differences in motor development. Gallahue (1995) addressed how opportunities for practice, instruction, encouragement, and the conditions of the environment contribute significantly to movement skill development. Since experience and exposure is crucial to a child's motor development, parents have a terrific impact upon the amount of exposure and experience that they provide to their child. Responses from the informal letter to parent(s)/guardian(s) collected with this study indicated that all parents (Deaf and hearing) were physically active on a weekly basis and that all Deaf children in this study were active as well. This may suggest that if parents are physically active, their Deaf child is more likely to be physically active, and motor development is nurtured.

The type of school Deaf children attend may affect motor development (Stewart, 1991, & Ellis 2001). All participants in this study attended a Deaf school rather than an inclusive school. Even if some participants may not have been exposed to a high level of physical activity at home, all participants attended a similar school environment where physical activity and sport-related experiences were provided. Both schools provided a structured physical education program designed to meet the needs and challenges for all participants in this study; both schools also provide early intervention programs, which include physical education. These factors may have contributed to the relatively high performance levels of participants and may have contributed to the finding that significant differences were not found in this study.

The low number of subjects participating in this study was an important factor in the statistical analysis. Twenty-nine participants in two groups of 15 and 14 participants, respectively, is a relatively low number of participants and contribute to statistically low power. A larger number of participants increases the odds of rejecting the null hypothesis.

Conclusion

Based on the procedures and limitations of this study it is concluded that there are no significant differences between the motor development of Deaf children with parents who are hearing or Deaf.

Recommendations

The following recommendations for further research are suggested:

1. Compare participants in integrated and segregated school environment.
2. Compare subjects who participate and who do not participate regularly in a physical education program at their school.
2. Increase the number of participants in future studies.

REFERENCES

Anderssen, N., & Wold, B. (1992). Parental and peer influences on leisure time activity in young adolescents. *Research Quarterly for Exercise and Sport, 63*(4), 341-348.

Biddle, S., & Goudas, M. (1996). Analysis of children's physical activity and its association with adult encouragement and social cognitive variables. *Journal of School Health, 66*(2), 75-78.

Birch, J. W., (1975). *Hearing impaired pupils in the mainstream*. Minneapolis, Minnesota: Leadership Training Institute/Special Education, University of Minnesota, p. 50.

Boyd, J. (1967). Comparison of motor behavior in deaf and hearing boys. *American Annals of the Deaf, 112*, 598-605.

Brace, D. K., (1927). Measuring motor ability and scale of motor ability test. New York, New York: A.S. Barnes, p. 138.

Brace, C., (1936). *A comparison of the ability of deaf boys with normal boys in balance control.* Unpublished Master's thesis, University of Texas, Austin.

Braden, J., (1987). An explanation of the superior performance IQs of deaf children of deaf parents. *American Annals of the Deaf, 132*(4), 263-266.

Branta, C., Haubenstricker, J., & Seefeldt, V. (1984). Age changes in motor skill during childhood and adolescence. *Exercise and Sport Science Reviews, 12*, 467-520.

Brill, R. G. (1969). The superior IQ's of deaf children of deaf parents. *California Psalms, 15*(2), 1-4.

Brown, W. J., & Brown, P. R. (1996). Children, physical activity, and better health. *ACHPER Healthy Life Journal, 43*(4), 19-24.

Bruinicks, R.H. (1978). Bruinicks-Oseretsky test of motor proficiency. Circle Pines, MN: American Guidance Service.

Brunt, D., & Broadhead, D. B. (1982). Motor proficiency traits of deaf children. *Research Quarterly for Exercise and Sport, 53*, 236-238.

Butterfield, S. A. (1983). *A comparison of fundamental motor and balance skills of deaf and hard of hearing children ages three through fourteen.* Unpublished doctoral dissertation. The Ohio State University.

Butterfield, S. A., (1991). Physical education and sport for the deaf: rethinking the least restrictive environment. *Adapted Physical Activity Quarterly, 8*, 95-102.

Butterfield, S. A., van der Mars, H., & Chase, J. (1993). Fundamental motor skill performance of deaf and hearing children ages 3-8. *Clinical Kinesiology,* Spring, 2-6.

Carlson, B.R. (1978). Assessment of motor ability of selected deaf children in Kansas. *Perceptual and Motor Skills*, 34, 303-305.

Conrad, R., & Weiskrantz, B.C. (1981). On the cognitive ability of deaf children with deaf children with deaf parents. *American Annals of the Deaf, 126*, 995-1003.

Craft, D.(1995). Visual impairments and hearing losses. In J. P. Winnick (Ed.), *Adapted Physical Education and Sport* (pp.143-166). Champaign, IL: Human Kinetics.

Craft, D., & Lieberman, L. (2000). Visual impairments and deafness. In J. P. Winnick (Ed.), *Adapted Physical Education and Sport* (pp.159-180). Champaign, IL: Human Kinetics.

Dempsey, J., Kimiecik, K., & Horn, T. (1993). Parental influence on children's moderate-to-vigorous physical activity: An expectancy-value approach. *Pediatric Exercise Science, 5*, 151-167.

Department of Health, Education, & Sport Welfare, 1977a, p.42480, (1995). In J.P. Winnick (Eds.), *Adapted Physical Education and Sport* (p.9). Champaign, IL: Human Kinetics.

DePauw, K. P., & Gavron, S.J. (1995). Disability and Sport. Champaign, IL: Human Kinetics.

Desselle, D. D. (1994). Self-esteem, family climate, and communication patterns in relation to deafness. *American Annals of the Deaf, 139*, 322-328.

Dolnick, E. (1993). Deafness as culture. *The Atlantic*, 272(3) 37-53.

Dummer, G. M., Haubenstricker, J.L., & Stewart, D. A. (1996). Motor skill performances of children who are deaf. *Adapted Physical Activity Quarterly, 13*, 400-414.

Eichstaedt, C. B., & Kalakian, L. H., (1993). Developmental/Adapted Physical Education. (3rd ed.), New York: Mackmillan Publishing Company.

Eichstaedt, C. & Seiler, P. (1978). Signing: communicating with hearing impaired individuals in physical education. *Journal of Physical Education, Recreation & Health, 49*,(5), 19-21.

Ellis, K. (2001). Influences of parents and school on sports participation and fitness levels of deaf children. *Palaestra, 17,*(1), 44-49.

Ellis, K., Butterfield, S., & Lehnhard, R. (2000). Grip-strength performances by 6 to 19 yr. old children with and without hearing impairments. *Perceptual and Motor Skills, 90*, 279-282.

Freedson, P. S., & Evenson, S. (1991). Familial aggregation in physical activity. *Research Quarterly for Exercise and Sport, 62*(4), 384-389.

Gallahue, D. L. (1989). Understanding motor development: Infants, children, adolescents (2nd ed.), Indianapolis, IN: Benchmark Press, Inc.

Gallahue, D. L. (1995). Motor development. In J. P. Winnick (Ed.), *Adapted Physical Education and Sport* (pp.253-268). Champaign, IL: Human Kinetics. Dubuque, IA: Brown & Benchmark.

Gallahue, D.L., (2000). Motor development. In J. P. Winnick (Ed.), *Adapted Physical Education and Sport* (pp.265-279). Champaign, IL: Human Kinetics.

Gallahue, D. L., (1982). *Understanding motor development in children.* New York: Wiley.

Gallahue, D. L., & Ozmun, J. (1998). *Understanding motor development: Infants, children, adolescents, adults.* Boston: McGraw-Hill.

Gallaudet Research Institute. (January, 2001). *Regional and National Summary Report of Data from the 1999-2000 Annual Survey of Deaf and Hard of Hearing Children and Youth.* Washington, DC: GRI, Gallaudet University.

Galvan, D. (1999). Differences in the use of american sign language morphology by deaf children: Implications for parents and teachers. *American Annals of the Deaf, 144*(4) 320-324.

Geddes, D.(1977). Adapted physical activity: Individualized approach. Boston: Allyn & Bacon.

Geddes, D.(1978). Motor development profiles of preschool deaf and hard-of-hearing children. *Perceptual and Motor Skills, 46*, 291-294.

Goodman, J., & Hopper, C. (1992). Hearing impaired children and youth: A review of psychomotor behavior. *Adapted Physical Activity Quarterly, 9*, 214-236.

Graziadei, A. (1998). *Learning outcomes of deaf and hard of hearing students in mainstreamed physical education classes.* Unpublished doctoral dissertation, University of Maryland, College Park.

Hadadian, A. & Rose, S. (1991). An investigation of parents' attitudes and the communication skills of their deaf children. *American Annals of the Deaf, 136*(3), 273-277.

Harris, A. E. (1978). The development of the deaf individual and the deaf community. In L. Liben (Ed.) *Deaf children: Developmental perspectives* (pp. 217-234). New York: Academic Press.

Hintermair, M. (2000). Hearing impairment, social networks, and coping: the need for families with hearing-impaired children to relate to other parents and to hearing-impaired adults. *American Annals of the Deaf, 145*(1), 41-50.

Horvat, 1990. In Eichstaedt, C.B., & Kalakian, L.H., (1993). Developmental/Adapted Physical Education. (3rd ed.), p.14 New York: Macmillan Publishing Company.

Individuals with Disabilities Education Act (IDEA) Ammendments of 1997 (PL 105-17), 20 U.S.C. 1400 (1997).

Jansma, P., & French, R. (1992). Special Physical Education. Englewood Cliffs: Prentice Hall.

Karwas, M. R., & Depauw, K. P. (1990). Parallels between the women's and disabled sport movements. *Abstracts of Research Papers, 1990 AAHPERD Convention*. Reston, VA: American Alliance for Health, Physical Education, Recreation and Dance.

Kottke, F., & Lehmann, J. (1990). Krusen's handbook of physical medicine and rehabilitation (4th ed.). Philadelphia: W. B. Saunders.

Kusche, C. A., & Greenberg, M.T. (1983). Evaluative understanding and role-taking ability: A comparison of deaf and hearing children. *Child Development, 54*, 141-147.

Leigh, G. K. Language, thought, and the enhancement of self-esteem. *Family Perspective*, 1977.

Lieberman, L. J., Dunn, J.M., van der Mars, H., & McCubbin, J. A. (2000). Peer tutor's effects on activity levels of deaf students in inclusive elementary physical education. *Adapted Physical Activity Quarterly, 17*(1), 20-39.

Loovis, E. M. & Ersing, W. F. (1979). Assessing and programming gross motor development for children. Cleveland Heights, OH: Ohio Motor Assessment Association.

Malina, R. M., & Bouchard, C. (1991). Growth, maturation, and physical activity. Champaign, IL: Human Kinetics.

McCullagh, P., Matzkanin, K.T., Shaw, S.D., & Maldonado, M. (1993). Motivation for participation in physical activity: A comparison of parent-child perceived competencies and participation motives. *Pediatric Exercise Science, 5*, 224-233.

McMurray, R. G., Badley, C. B., Harrell, J. S., Bernthal, P. R., Frauman, A. D., & Bangdiwala, S. I. (1993). Parental influences on childhood fitness and activity patterns. *Research Quarterly for Exercise and Sport, 64*(3), 249-255.

Meadow, K. P. (1968). Early manual communication in relation to the deaf child's intellectual, social, and communicative functioning. *American Annals of the Deaf, 113*, 29-41.

Mindel, E., & Vernon, M.C. They grow in silence. Silver Spring, Md.: National Association of the Deaf, 1971.

Mitchell, R. E., & Karchmer, M.A. (2002). Chasing the mythical ten percent: parental hearing status of deaf and hard of hearing students in the united states. *Gallaudet Research Institute, Gallaudet University.*

Moore, L. L., Lombardi, D. A., White, M. J., Campbell, J. L., Oiveria, S. A., & Ellison, R. C. (1991). Influence of parents' physical activity levels on activity levels of young children. *Journal of Pediatrics, 118*, 215-219.

Moores, D. F. (1996). Educating the Deaf: Psychology, principles, and practices (4th ed.). Boston: Houghton Mifflin.

Myklebust, H. R. (1964). The psychology of deafness. New York: Grune & Stratton.

Newport, E. (1988). Constraints on learning and their role in language acquisition of American Sign Language. *Language Sciences, 10*(1), 147-172.

Office of Special Education and Rehabilitative Services (OSE/RS), 34 CFR 300 (1998).

Piaget, J. (1952). The origins of intelligence in children. New York: International Universities Press.

Rarick, G. L. (1981). The emergence of the study of human motor development. In G.A. Brooks (Ed.), Perspectives on the academic discipline of physical education (pp. 163-189). Champaign, IL: Human Kinetics.

Ray, S. (1982). Adapting the WISC-R for deaf children. *Diagnostique, 7*, 147-157.

Reid, G. (1987). Motor behavior and psychosocial correlates in young handicapped performers. In D. Gould & M. Weiss (Eds.), Advances in pediatric sport sciences (Vol. 2, pp. 235-258). Champaign, IL: Human Kinetics.

Ritter-Brinton, K. & Stewart, D. (1992). Hearing parents and deaf children: some perspectives on sign communication and service delivery. *American Annals of the Deaf, 137*(2), 85-92.

Schlesinger, H. S., & Meadow, K. P. Sound and sign: Childhood deafness and mental health. Berkeley: University of California Press, 1972.

Schmidt, S., (1985). Hearing impaired students in physical education. *Adapted Physical Activity Quarterly, 2*, 300-306.

Singleton, J. (1989). *Restructuring of language from impoverished unput: Evidence for linguistic compensation.* Unpublished doctoral dissertation, University of Illinois at Urbana-Champaign.

Sisco, F. H., & Anderson, R. J. (1980). Deaf children's performance on the WISC-R relative to hearing status of parents and child-rearing experiences. *American Annals of the Deaf, 125*(7), 923-930.

Stewart, D. A. (1986). Deaf sport in the community. *Journal of Community Psychology, 14*, 196-205.

Stewart, D. A. (1991). Deaf sport: The impact of sports within the deaf community. Washington, DC: Gallaudet University.

Stewart, D. (1987). Social factors influencing participation in sport for the deaf. *Palaestra, 4*(3), 22-28, 50.

Stewart, D., & Ellis, K. (1999). Physical Education for Deaf Students. *American Annals of the Deaf 144*, 315-319.

Stewart, D. A., McCarthy, D., & Robinson, J. (1988). Participation in deaf sport: characteristics of deaf sport directors. *Adapted Physical Activity Quarterly, 5*, 233-244.

Stewart, D. A., & Stinson, M. S. (1992). The role of sport and extracurricular activities in shaping socialization patterns. In T. N. Kluwin, D. F. Moores, & M. G. Gaustad (Eds.), Toward effetive public school programs for deaf students (pp. 129-148). New York: Teachers College.

Stinson, M. (1994). Affective and social development. In R. C. Nowell & L. E. Marschark (Eds.), Understanding deafness and the rehabilitation process. Boston, MA: Allyn & Bacon.

Ulrich, D. A. (1985). Test of gross motor development. Austin, TX: Pro-Ed.

Ulrich, D. A. (2000). Test of gross motor development. Austin, TX: Pro-Ed.

Vaccari, C., & Marschark, M. (1997). Communication between parents and deaf children: Implications for social-emotional development. *Journal of Child Psychology & Psychiatry, 38*(7), 793-801.

Wiegersma, P. H., & Velde, A. v.d. (1983). Motor development of deaf children. *Journal of Child Psychology and Psychiatry, 24*, 103-111.

Williams, H. G. (1983). Perceptual and motor development. Englewood Cliffs, NJ: Prentice-Hall.

Winnick, J. P. (1995). Adapted physical education and sport. (2nd ed.), Champaign, IL: Human Kinetics.

Winnick, J. P. (2000). Adapted physical education and sport. (3rd ed.), Champaign, IL: Human Kinetics.

Winnick, J. P. (1979). Early movement experiences and development: Habilitation and Remediation. Philadelphia: PA: W.B. Saunders Company.

Winnick, J. P., & Short, F. X. (1986). Physical fitness of adolescents with auditory impairments. *Adapted Physical Activity Quarterly, 3*, 58-66.

Woods, D., (1991). Communication and cognition: How the communication styles of the hearing adults may hinder rather than help - deaf learners. *American Annals of the Deaf, 136*, 247-251.

APPENDICES

APPENDIX A

Letter and Consent Form

Dr. Lauren Lieberman
SUNY Brockport
Department of Physical Education and Sport
Brockport, New York 14420

Lori Volding
SUNY Brockport
Department of Physical Education and Sport
Brockport, New York 14420

Date:

Dear Parent(s)/Guardian(s),

My name is Lori Volding and I am currently pursuing a Masters in Education, Physical Education with an emphasis in Adapted Physical Education and Early Childhood Education at SUNY College at Brockport.

I am writing to tell you about a study that I would like to do with the physical education staff members at St. Mary's School for the Deaf. The purpose of the study is to determine if there is a difference of motor skills between Deaf children of Deaf parent(s)/guardian(s) and Deaf children of hearing parent(s)/guardian(s).

In order to determine the motor skill levels, we will be testing your child on locomotor skills and object control skills. The skill items on the test measure running, galloping, hopping, leaping, horizontal jumping, skipping, sliding, kicking, catching, overhand throwing, stationary bouncing, and two-hand striking. The testing will occur in your child's regularly scheduled physical education class with your child's physical education teacher(s), Lori Volding and Dr. Lauren Lieberman. Videotaping will be used for testing purposes only. Your child's name will not be used beyond this project.

The results of (child/participant's name) performance level will be shared with you. Confidentiality will be maintained throughout the study. Neither (child/participant's name) first or last name will be used in the research project. The students will receive a number which will identify the individual for the purpose of the investigation, yet they will still be addressed by name in class. You will be receiving a short multiple choice questionnaire that we would like for you to complete and return. The questions relate to mode of communication, degree of hearing impairment or Deafness, motor/leisure activity, and etiology.

Participation in this study is voluntary. Refusal to participate will not result in penalty or loss of participation in physical education. You may withdraw (child/participant's name) from the study at any time. There are no risks or discomfort involved in this study. In the event of an injury during the course of the study, SUNY Brockport will not be responsible to provide the student with compensation or medical treatment.

Thank you for your interest in furthering our understanding and knowledge of Deaf culture and Deaf education. We appreciate your participation. The study will be coordinated and supervised by Dr. Lauren Lieberman. Dr. Lieberman has extended experience working and doing research with Deaf children. If you have any questions or concerns please contact Dr. Lauren Lieberman at   or Lori Volding at   , or 964-7459.

If you wish (child/participant's name) to be involved in this study, please sign the enclosed informed consent form, and return before February 14, 1997 to SUNY College at Brockport. Thank you for your interest and cooperation. I look forward to working with you and (child/participant's name).

Sincerely,

Lori Volding

Skill Testing and Videotaping
Consent Form

Certification

This is to certify that I agree to allow my child to be videotaped while participating in the testing of locomotor skills and object control skills during movement education class at St. Mary's School for the Deaf. I understand that if I have any questions, they will be answered by testing personnel or the researchers of the study. I hereby give my consent for:

____

(Participant's Name Printed)

to participate in the study. I reserve the right to withdraw my consent and discontinue participation at any time. My signature indicates that I have received a copy of this form.

____

Parent/Guardian's Name Printed

____

Parent/Guardian's Signature

____

Date: (Month) (Day) (Year)

Thanks again for you support!

APPENDIX B

Test of Gross Motor Development (TGMD) Test Items

Ulrich, (1985). Test of gross motor development. Austin, TX: Pro-Ed.

Name ______________________________

School/Agency ______________________________

Sex: Male ________ Female ________ Grade ________

TGMD

TEST OF GROSS MOTOR DEVELOPMENT

Dale A. Ulrich

TESTING INFORMATION

1ST TESTING	Year	Month	Day	2ND TESTING	Year	Month	Day
Date Tested	____	____	____	Date Tested	____	____	____
Date of Birth	____	____	____	Date of Birth	____	____	____
Chronological Age	____	____	____	Chronological Age	____	____	____

1st Testing:

____
Examiner's Name

____
Examiner's Title

____
Purpose of Testing

2nd Testing:

____
Examiner's Name

____
Examiner's Title

____
Purpose of Testing

RECORD OF SCORES

1ST TESTING Subtests	Raw Scores	%iles	Std. Scores	2ND TESTING Subtests	Raw Scores	%iles	Std. Scores
Locomotor Skills	____	____	____	Locomotor Skills	____	____	____
Object Control Skills	____	____	____	Object Control Skills	____	____	____
Sum of Standard Scores		=	____	Sum of Standard Scores		=	____
Gross Motor Development Quotient (GMDQ)		=	____	Gross Motor Development Quotient (GMDQ)		=	____

COMMENTS/RECOMMENDATIONS

____

____

____

____

____

____

____

Additional copies of this form (#0552) may be purchased from
PRO-ED, 8700 Shoal Creek Blvd., Austin, Texas 78757, 512/451-3246

LOCOMOTOR SKILLS

Skill	Equipment	Directions	Performance Criteria	1st	2nd
RUN	50 feet of clear space, colored tape, chalk or other marking device	Mark off two lines 50 feet apart Instruct student to "run fast" from one line to the other	1. Brief period where both feet are off the ground		
			2. Arms in opposition to legs, elbows bent		
			3. Foot placement near or on a line (not flat footed)		
			4. Nonsupport leg bent approximately 90 degrees (close to buttocks)		
GALLOP	A minimum of 30 feet of clear space	Mark off two lines 30 feet apart Tell student to gallop from one line to the other three times Tell student to gallop leading with one foot and then the other	1. A step forward with the lead foot followed by a step with the trailing foot to a position adjacent to or behind the lead foot		
			2. Brief period where both feet are off the ground		
			3. Arms bent and lifted to waist level		
			4. Able to lead with the right and left foot		
HOP	A minimum of 15 feet of clear space	Ask student to hop 3 times, first on one foot and then on the other	1. Foot of nonsupport leg is bent and carried in back of the body		
			2. Nonsupport leg swings in pendular fashion to produce force		
			3. Arms bent at elbows and swing forward on take off		
			4. Able to hop on the right and left foot		
LEAP	A minimum of 30 feet of clear space	Ask student to leap Tell him/her to take large steps leaping from one foot to the other	1. Take off on one foot and land on the opposite foot		
			2. A period where both feet are off the ground (longer than running)		
			3. Forward reach with arm opposite the lead foot		
HORIZONTAL JUMP	10 feet of clear space, tape or other marking devices	Mark off a starting line on the floor, mat, or carpet Have the student start behind the line Tell the student to "jump far"	1. Preparatory movement includes flexion of both knees with arms extended behind the body		
			2. Arms extend forcefully forward and upward, reaching full extension above head		
			3. Take off and land on both feet simultaneously		
			4. Arms are brought downward during landing		

LOCOMOTOR SKILLS

Skill	Equipment	Directions	Performance Criteria	1st	2nd
SKIP	A minimum of 30 feet of clear space, marking device	Mark off two lines 30 feet apart Tell the student to skip from one line to the other three times	1. A rhythmical repetition of the step-hop on alternate feet		
			2. Foot of nonsupport leg carried near surface during hop		
			3. Arms alternately moving in opposition to legs at about waist level		
SLIDE	A minimum of 30 feet of clear space, colored tape or other marking device	Mark off two lines 30 feet apart Tell the student to slide from one line to the other three times facing the same direction	1. Body turned sideways to desired direction of travel		
			2. A step sideways followed by a slide of the trailing foot to a point next to the lead foot		
			3. A short period where both feet are off the floor		
			4. Able to slide to the right and to the left side		
			LOCOMOTOR SKILLS SUBTEST SCORE		

OBJECT CONTROL SKILLS

Skill	Equipment	Directions	Performance Criteria	1st	2nd
TWO-HAND STRIKE	4-6 inch light-weight ball, plastic bat	Toss the ball softly to the student at about waist level Tell the student to hit the ball hard Only count those tosses that are between the student's waist and shoulders	1. Dominate hand grips bat above nondominant hand		
			2. Nondominant side of body faces the tosser (feet parallel)		
			3. Hip and spine rotation		
			4. Weight is transferred by stepping with front foot		
STATIONARY BOUNCE	8-10 inch playground ball, hard, flat surface (floor, pavement)	Tell the student to bounce the ball three times using one hand Make sure the ball is not underinflated Repeat 3 separate trials	1. Contact ball with one hand at about hip height		
			2. Pushes ball with fingers (not a slap)		
			3. Ball contacts floor in front of (or to the outside of) foot on the side of the hand being used		

OBJECT CONTROL SKILLS

Skill	Equipment	Directions	Performance Criteria	1st	2nd
CATCH	6-8 inch sponge ball, 15 feet of clear space, tape or other marking device	Mark off 2 lines 15 feet apart. Student stands on one line and the tosser on the other. Toss the ball underhand directly to student with a slight arc and tell him/her to "catch it with your hands." Only count those tosses that are between student's shoulders and waist.	1. Preparation phase where elbows are flexed and hands are in front of body		
			2. Arms extend in preparation for ball contact		
			3. Ball is caught and controlled by hands only		
			4. Elbows bend to absorb force		
KICK	8-10 inch plastic or slightly deflated playground ball, 30 feet of clear space, tape or other marking device	Mark off one line 30 feet away from a wall and one that is 20 feet from the wall. Place the ball on the line nearest the wall and tell the student to stand on the other line. Tell the student to kick the ball "hard" toward the wall.	1. Rapid continuous approach to the ball		
			2. The truck is inclined backward during ball contact		
			3. Forward swing of the arm opposite kicking leg		
			4. Following-through by hopping on nonkicking foot		
OVERHAND THROW	3 tennis balls, a wall, 25 feet of clear space	Tell student to throw the ball "hard" at the wall	1. A downward arc of the throwing arm initiates the windup		
			2. Rotation of hip and shoulder to a point where the nondominant side faces an imaginary target		
			3. Weight is transferred by stepping with the foot opposite the throwing hand		
			4. Following-through beyond ball release diagonally across body toward side opposite throwing arm		
			OBJECT CONTROL SKILLS SUBTEST SCORE		

pro·ed

8700 Shoal Creek Boulevard
Austin, Texas 78757

APPENDIX C

Test of Gross Motor Development (TGMD)

Standard Scores and Percentiles

Ulrich, (1985). Test of gross motor development. Austin, TX: Pro-Ed.

Table A

Standard Scores and Percentiles for Locomotor Subtest for Different Ages

Standard Score	Ages 3	4	5	6	7	8	9	10	Percentile Rank
1	0	0-3	0-3	0-4	0-5	0-8	0-9	0-13	
2	1	4	4-6	5-6	6-7	9-12	10-12	14-16	<1
3	2	5	7	7	8-10	13-15	13-16	17	1
4	3	–	8-9	8-10	11	16-17	17-18	18	2
5	–	6	10	11-12	12-15	18	19	19	5
6	4	7	11-12	13	16	19-20	20	20-21	9
7	5	8	13	14-15	17	21	21	22	16
8	6	9	14	16	18-19	22	22	23	25
9	7	10-11	15	17	20	23	23	24	37
10	8-9	12	16	18-19	21	24	24	25	50
11	–	13	17	20	22	–	–	–	63
12	10	14-15	18-19	21	23	25	25	26	75
13	11	16	20-21	22-23	24	–	–		84
14	12	17	22-23	–	25	26	26		91
15	13	18	24	24	26				95
16	14	19	25-26	25-26					98
17	–	20-26							99
18	15								>99
19	16-26								
20									

Table B
Standard Scores and Percentiles for Object Control Subtest for Different Ages

Standard Score	Ages 3	4	5	6	7	8	9	10	Percentile Rank
1				0-1	0-3	0-4	0-5	0-6	
2			0	2	4	5	6-7	7	<1
3		0	1	3	5	6-9	8-9	8-12	1
4		1	–	–	–	10	10-11	13-14	2
5	0	2	2	4	6	11	–	15	5
6	–	–	3	5	7-8	12	12	16	9
7	1	3	4	6	9-10	13	13	–	16
8	–	–	5	7-8	11	14	14-15	17	25
9	2	4	6	9	12-13	15	16	–	37
10	–	–	7	10	14	16	17	18	50
11	3	5	8	11	15	17	–	–	63
12	–	6	9-11	12-13	16	–	18	–	75
13	4	7	12-13	14	17	18	–	19	84
14	5	–	14-15	15	18	–	19		91
15	6-8	8	16-17	16-17	–	19			95
16	9-10	9	18	18-19	19				98
17	11-12	10-12	19						99
18	13	13-15							>99
19	14-19	16-19							
20									

Table C
Converting Sums of Standard Scores to GMDQ

Sum of Std. Scores	Quotient	Sum of Std. Scores	Quotient
38	154	20	100
37	151	19	97
36	148	18	94
35	145	17	91
34	142	16	88
33	139	15	85
32	136	14	82
31	133	13	79
30	130	12	76
29	127	11	73
28	124	10	70
27	121	9	67
26	118	8	64
25	115	7	61
24	112	6	58
23	109	5	55
22	106	4	52
21	103	3	49
		2	46

APPENDIX D

Raw Scores

Rochester School for the Deaf Raw Scores

I.D.#	Age	Deaf or Hearing Parent	Locomotor	Object Control	Standard Score
1	4	H	20	3	17/7
2	6	H	22	18	13/16
3	6	H	15	14	7/13
4	8	H	23	18	9/13
5	5	H	20	8	13/11
6	5	H	18	8	12/11
7	5	H	19	11	12/`12
8	7	H	23	16	12/12
9	7	H	17	15	7/11
10	9	D	21	18	7/12
11	5	D	8	11	4/12
12	5	D	21	12	13/13
13	8	D	25	18	12/13
14	7	D	23	18	12/14
15	9	D	26	18	14/12
16	6	D	20	17	11/15
17	5	D	19	11	12/12
18	6	D	23	18	13/16
19	5	D	20	6	13/9

Standard Raw Scores

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Object Control	-	-	-	-	-	-	1	-	1	-	3	6	4	1	1	2	0
Locomotor	-	-	-	1	-	-	3	-	1	-	1	6	5	1	-	-	1
Total	-	-	-	1	-	-	4	-	2	-	4	12	9	2	1	2	1

Saint Mary's School for the Deaf Raw Scores

I.D.#	Age	Deaf or Hearing Parent	Locomotor	Object Control	Standard Score
20	6	H	25	12	16/12
21	7	H	25	17	14/13
22	7	H	24	16	13/12
23	7	H	24	16	13/12
24	7	H	18	15	8/11
25	8	H	25	16	12/10
26	5	D	16	10	10/12
27	6	D	24	19	15/16
28	8	D	23	14	9/8
29	6	D	22	15	13/14

Standard Raw Scores

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Object Control	-	-	-	-	-	-	-	1	-	1	1	4	1	1	-	1	-
Locomotor	-	-	-	-	-	-	-	1	1	1	0	1	3	1	1	1	-
Total	-	-	-	-	-	-	-	2	1	2	1	5	4	2	1	2	-