The Effects of an Eleven-Week Therapeutic Riding Program on Motor Skills as Measured by the Bruininks-Oseretsky Test of Motor Proficiency

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THE EFFECTS OF AN ELEVEN-WEEK THERAPEUTIC RIDING PROGRAM ON MOTOR SKILLS AS MEASURED BY THE BRUININKS-OSERETSKY TEST OF MOTOR PROFICIENCY

By

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THESIS

Submitted to the Department of Physical Therapy at Grand Valley State University at Allendale, Michigan in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN PHYSICAL THERAPY

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THE EFFECTS OF AN ELEVEN-WEEK THERAPEUTIC RIDING PROGRAM
ON MOTOR SKILLS AS MEASURED BY THE BRUININKS-OSERETSKY
TEST OF MOTOR PROFICIENCY

ABSTRACT

The purpose of this single-case experimental design study was to determine whether or not therapeutic horseback riding was effective in improving motor skills. The subject was a 7-year-old girl with diplegic cerebral palsy. She participated in a therapeutic riding program for 11 weeks. The Bruininks-Oseretsky Test of Motor Proficiency- Short Form (BOT-SF) was administered a total of seven times (two pretests, three tests during the riding program, and two posttests). Due to the limited number of testing sessions and only having 1 subject, the results of the study are considered inconclusive. However, based on visual analyses of graphs, some improvements in motor performance were noted. The most improvements appeared to occur with balance, bilateral coordination, upper-limb coordination, response speed, visual-motor control, and upper-limb speed and dexterity.
DEDICATION

This thesis is dedicated to my loving and patient husband who has had to endure so much in order for this project to become a reality. Thank you for all of your support and encouragement. (AAS)

Thank you to my friends and family for giving me the encouragement to succeed in Grand Valley State University’s Physical Therapy program and in this master’s thesis. (AMC)
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CHAPTER 1

INTRODUCTION

I saw a child who couldn't walk
sit on a horse, laugh and talk
then ride it through a field of daisies
and yet he could not walk unaided.

I saw a child, no legs below
sit on a horse, and make it go
through woods of green
and places he had never been
to sit and stare,
except from a chair.

I saw a child who could only crawl
mount a horse and sit up tall.

Put it through degrees of paces
and laugh at the wonder on our faces.

I saw a child born into strife
take up and hold the reins of life
and that same child, I heard him say
Thank God for showing me the way...

- John Anthony Davies (1967)
Historical Perspective

The Greeks used therapeutic horseback riding as early as the fifth century B.C. to improve the spirits of wounded soldiers (Mayberry, 1978). Patients who could not be healed were given a horseback ride to cheer them up (Haskin, Erdman, Bream & MacAvoy, 1974). In the eighteenth century, riding was considered an appropriate treatment for pulmonary tuberculosis (Bain, 1965). Around this same period, it was believed that therapeutic horseback riding improved posture, balance, joint movement and muscle control. Despite this belief, specifically designed programs to benefit the handicapped did not begin until the mid-nineteen hundreds (Heipertz, 1981). Liz Hartzel of Denmark can be considered the forerunner of modern therapeutic horseback riding. After being stricken with poliomyelitis, she won the silver medal for dressage in the 1952 Olympic Games (Tuttle, 1987).

Although therapeutic horseback riding has been introduced fairly recently in the United States, it has been used in Europe more extensively and for a longer period of time. Europe and North America historically have had different philosophies regarding the use of horses as part of a therapeutic regimen. Europe has a medical orientation, and riding is routinely implemented as part of a physical therapy treatment. North America, however, has traditionally regarded therapeutic horseback riding as a recreational, sporting and educational experience (DePauw, 1984).

The researchers chose to do their master's thesis on therapeutic horseback riding because of the general lack of knowledge in the physical therapy community regarding this form of intervention. Although the number of studies are limited, some have shown that this form of therapy can result in significant improvements in a child's level of physical functioning. Much of the reason for the success of a riding program may be due to the fact that children are highly motivated to participate because they do not view the
riding as therapy. The researchers are hopeful that this form of therapy will continue to
grow in popularity and acceptance in the United States. The researchers will attempt to
make a positive contribution by demonstrating the effectiveness of such a therapeutic
riding program.

Definitions

Currently, there continues to be controversy regarding the language used to describe
various forms of using a horse as a therapeutic tool. Part of this confusion may be due to
the novelty of this form of therapy. Many people speak loosely of "horseback riding for
the disabled". According to DePauw (1986), this can be considered a general heading
under which there are various forms including: "developmental vaulting, driving,
hippotherapy, remedial riding, recreational riding, riding as a sport, and so on" (p. 218).
Potter, Evans and Nolt (1994) categorize "therapeutic riding" slightly differently under
the subcategories of hippotherapy, rehabilitation riding, sports riding, and developmental
vaulting.

Therapeutic horseback riding is designed around teaching the rider horsemanship
skills. The rider controls the horse through physical and verbal commands (Potter et al.,
1994). The major emphasis is on social and educational skills, as well as developing
physical benefits (Gentry, 1986). Hippotherapy, on the other hand, is a passive form of
therapy (the rider does not control the horse) in which the rider sits or is placed in
different positions on the horse in the presence of a therapist (Heipertz, 1981). "Hippos"
is Greek for the word "horse". Examples of positions utilized in hippotherapy may
include prone, side sitting, and sidelying to name a few.

It is easy to see why there is so much confusion regarding terminology. One reason
for this ambiguity is the fact that many of the aspects of riding overlap. To avoid further
confusion regarding terminology, the researchers will use the term therapeutic horseback
riding to describe the use of a horse to improve the rider's riding skills without the direct purpose of rehabilitative (physical or occupational) therapy.

According to Potter et al. (1994), the horse's movement stimulates the rider's neuromuscular system. Tuttle (1987) stated that hippotherapy can be used to facilitate normal tone and inhibit abnormal movements and postures. Riding therapy refers to individually prescribed physical exercise on horseback. In addition to being moved passively by the horse, the rider also performs exercises designed to improve strength, range of motion, relaxation, equilibrium reactions, and coordination (Heipertz, 1981). Although a physical therapist often consults with therapeutic riding instructors, it is not necessary that they be there to deliver the treatment, unlike with hippotherapy programs.

Kuprian (1981) reported that the horse's rhythmical movements caused muscle activation and relaxation. The horse's movement allowed the rider to practice balance and coordination simultaneously. The movement of the horse helped to facilitate pelvic mobility and the width of the horse helped to increase hip abduction range of motion. The alternating movement of the horse facilitated muscle contraction of the trunk flexors and extensors (Physical Therapy Forum, 1995). Riders gained improvements in the ability to sustain lumbar lordosis, especially while seated on an English saddle (DePauw, 1986).

Organizations and Centers for Riding

In the field of therapeutic horseback riding, the United States has two major organizations responsible for the growth and development of riding programs for the disabled. The first, the National Foundation for Happy Horsemanship for the Handicapped (HHFTH), was founded in 1967. People involved in this program do not receive any monetary compensation. This organization prefers to avoid research and written information regarding therapeutic horseback riding because they believe that
there is extensive variability between riding participants. Membership into the HHFTH is by invitation only. North American Riding for the Handicapped (NARHA) is the other national organization. It was founded in 1969. NARHA is an excellent source to gain information regarding various programs, insurance issues, the accreditation process, and instructor certification courses. Membership into NARHA is open to the public.

The Cheff Center in Augusta, Michigan works closely with NARHA (Griffith, 1992). The Cheff Center is where this research project will be conducted. Bennett (1990) reported that in the world of therapeutic horseback riding, the Cheff Center is considered a leader in the field. In the United States, the Cheff Center was the first and largest center opened for the specific purpose of therapeutic riding for the disabled. The facility opened in 1970. Today, there are approximately 400 students who ride per year and 100 are on the waiting list. In the video, Small Miracles, it was evident that the Cheff Center continues to be one of the leading centers in the nation, not only for its riding programs, but also for its education of riding instructors.

The Cheff Center currently has about 37 horses on a 380-acre complex (Griffith, 1992). Most of the horses are donated by organizations and private citizens. It was reported in the Physical Therapy Forum that only 1 in 20 horses meets all of the criteria necessary to be a therapy horse. At the Cheff Center, before the horses are accepted from donors they must pass a 3-week training period. Lida McCowan, Former Executive Director of the Cheff Center, stated in West Michigan that "It's hard to turn down a gift horse, but our horses must be special because they're working with special children" (p. 24). Pearce (1977) insightfully noted that "the only time a child, who is usually wheelchair bound, actually has 'legs' is when he is horseriding, then for bonus measure he has four" (p. 55).

The Cheff Center, like most riding centers, is maintained with the help of donations of
time and money. The Cheff Center currently utilizes approximately 90 volunteers per
week. In addition, there are two full-time riding instructors and a physical therapist who
works as a consultant. One of the goals of the Cheff Center is to become one of the first
centers in this country to implement an extensive hippotherapy program.

The Cheff Center treats a wide variety of riders. Diagnoses seen include cerebral
palsy, hearing-impaired, visually-impaired, muscular dystrophy, spinal cord injury, spina
bifida, cerebral vascular accident, traumatic brain injury, multiple sclerosis, autism,
Down's syndrome, and other forms of mental impairment. They see both children and
adults. They have had riders from 5 to 70 years of age (B. Brown, personal
communication, March 8, 1995). The majority of the riders are within the pediatric
population, and consequently, this is where the research has focused (Brock, 1987). The
majority of the handicapped riders who participate in riding programs are between the
ages of 6 and 15 (Freeman, 1984). Nationwide, riding sessions vary in frequency and
duration. The Cheff Center typically sees riders for 1 hour sessions each week during the
school year.

Aspects of Therapeutic Riding

A physician's referral is required before a therapeutic riding program can be
implemented (Menelaus, 1977). However, many physicians do not realize that a
seriously handicapped person could benefit from a riding therapy program and often do
not recommend or refer to these types of programs (Lang, 1986). Also, many therapists
are lacking hands-on experience with this form of therapy.

With horseback riding, safety is an important concern. If the rider is severely
disabled, an assistant may ride on the therapy horse as a "back rider" for safety and to
facilitate the desired response. There are certain requirements for the horse that are
necessary for proper safety. The horse should have a good temperament, and depending
on the size of the rider should be between 11 and 14 hands high (Haskin et al., 1974). The horse should also be tolerant of abuse and not be frightened by the presence of adaptive equipment (Freeman, 1984).

The riding seat is important to consider in therapeutic riding because the correct seat can help to decrease tone in the hip adductors and can also facilitate an erect sitting posture (Tuttle, 1987). Ideally, the saddle should be of the Western or English variety. The rider may have to begin on a Western saddle if they require more support. Eventually, the riding instructor or therapist should try to progress them to an English saddle if their disability and skill level permits. The English saddle is less cumbersome and facilitates a better sitting posture; it also requires the rider to make subtle adjustments to maintain their balance. The position of the rider while on the horse may help to inhibit unwanted reflexes. For example, a child is not as likely to experience ankle clonus while putting pressure through the balls of the feet because of the flexed and abducted position of the hips (Freeman, 1984).

When some riders first begin a program, they often must wear a belt that two side walkers hold onto for safety. A third person, the leader, may help to physically steer the horse and control the speed, or may just give verbal directions. All riders, regardless of level of skill, are required to wear protective helmets. Depending on the riders' needs, a variety of adaptive equipment is available such as special reins and stirrups. For additional information on special equipment, the reader is referred to Freeman's article in Clinical Management (1984).

While on horseback, in addition to learning the skills necessary to ride, the rider also participates in an individually designed exercise program. Typical exercises may include touching the horse's ear, touching the stirrup and holding hands out to the side (Freeman, 1984). This is just a small list of typical exercises that may be performed. Developing
an appropriate exercise program that is individualized to the rider is crucial. This is where a knowledgeable therapist may be utilized to give suggestions and feedback to the riding instructors.

Children often tolerate therapy on a horse much better than they do in a structured therapy gym. The children are often eager to get on the horse and do not view their riding experiences as therapy at all; they just look at it as fun. Because the horse offers three-dimensional movements, the rider can work on several components of an exercise at one time (Gentry, 1986). Some benefits claimed include: improved balance, coordination, body awareness, agility, relaxation, strengthening and stretching (Walker, 1978). Those who downplay the physical benefits of therapeutic riding for the handicapped still feel that there is a place for it. Menelaus (1977) reported that "Most of the management of the severely physically disabled should be directed, not at physical improvement, but at expanding the individual's capacity to find value and enjoyment in as many as possible of life's activities" (p. 944).

Need for Study

"One of the fastest growing treatments for the disabled population is therapeutic horseback riding" (Griffith, 1992, p. 2). This type of program has continued to grow in popularity in recent years with an increasing number of new facilities being developed (Biery & Kauffman, 1989). According to the North American Riding for the Handicapped Association, there are currently 450 accredited riding programs in this country today (NARHA brochure, 1992). Often there is eagerness and excitement about starting a new riding program. The centers usually are able to get enough financial support to start a program, however, after a few years many of the supporters demand scientific "proof" that the riders are improving (Brock, 1987). If these programs are to continue, more scientific studies need to be done to substantiate the claims made as to
the benefits of such riding programs (DePauw, 1986).

"Research and scientific studies to support the claim that therapeutic riding is indeed beneficial are almost nonexistent" (Biery, 1985, p. 346). It has been reported that "Research is critically needed in all aspects of therapeutic riding" (Potter et al., 1994). If therapeutic horseback riding is to gain credibility as an effective treatment, especially as an adjunct to traditional physical therapy techniques, then scientific proof of its benefits is necessary. The researchers have found that the majority of articles written about riding programs for the disabled tend to focus on psychological rather than physical improvements, or they are general informative articles written about different programs in existence. Gentry (1986) reported on some of the psycho-social benefits gained following an 8-week therapeutic riding program in Washington, D.C. at the National Center for Therapeutic Riding. Following the program, they reported improvements in self-confidence (increased by 62%), interest in learning (increased by 41%), and listening skills (increased by 80%).

Many of the articles cited in the bibliography of other works contain works, both published and unpublished, written in German. However, due to scarce resources, the researchers were only able to have one German article translated. Joan Griffith (1992), Master of Library Science, reported that "In doing the research for this paper, it became clear that many cited documents would be difficult to obtain. They may be out of print, privately owned by operating centers and individuals, or in untranslated foreign languages, especially German."

**Purpose of Study**

The purpose of this descriptive study was to evaluate how effective a therapeutic riding program was in influencing motor control in a child with a non-progressive neurological disorder. As previously mentioned, most of the literature in this field
focused on the psychological benefits of the horseback riding programs. The researchers of this study wanted to address the physical benefits that may be gained. In an attempt to address a wide variety of physical skills (both fine and gross motor), the researchers administered a test that has been shown to be a valid measurement of motor skills. The test administered was the Bruininks-Oseretsky Test of Motor Proficiency (BOT). More specifically, the short form of the test (BOT-SF) was administered.
CHAPTER 2

LITERATURE REVIEW

Therapeutic Horseback Riding

According to Biery (1985), Chassigne of Paris, was responsible for one of the first studies on the value of therapeutic horseback riding. In 1875, Chassigne suggested that this form of riding was especially beneficial for patients with neurological disorders. Improvements in balance, muscle strength, and joint mobility were reported.

Biery and Kauffman (1989) studied 8 subjects with mental retardation aged 12 to 22. They assessed both standing and quadruped balance. Each of the subjects were timed on four tests for standing balance and six tests for quadruped balance. The items tested in the standing balance assessment included: standing on one leg with (a) arms at sides, (b) arms folded on chest, (c) arms at sides, blindfolded, and (d) arms folded on chest, blindfolded. The quadruped balance tests included: (a) raise right arm, (b) raise right arm and left leg, (c) raise right arm and right leg, (d) raise left arm, (e) raise left arm and right leg, and (f) raise left arm and left leg. Measurements were taken 6 months prior to (evaluation 1), immediately prior to (evaluation 2), and immediately following (evaluation 3) a 6-month riding program. Using the t test and Wilcoxon matched-pairs ranked-signs test, Biery and Kauffman found no significant difference between standing balance between evaluations 1 and 2. However, a significant improvement in standing balance was evident between evaluations 2 and 3. This suggests that the improvement in balance was related to the therapeutic riding program itself. In quadruped, balance decreased between evaluations 1 and 2 (they attributed this unexpected change to the fact
that half of their subjects had otitis media infections during this interim period). There was, however, a significant improvement in quadruped balance between evaluations 2 and 3. Therefore, there were significant improvements in both standing and quadruped balance following a six-month therapeutic horseback riding program.

Wingate (1982) studied 7 children with cerebral palsy who participated in a therapeutic riding program two times per week for 5 weeks. This was considered a pilot project and lacked vigorous scientific controls. However, improvements such as standing and sitting posture, less falls during ambulation, decreased tone, and increased head control were all subjectively reported by the riders' family members.

Haskin, Erdman, Bream and MacAvoy (1974) wrote an informative-type article on therapeutic riding. At the end of the article, they cited two case examples of children who had participated in a six-month riding program. The first case involved a 7-year-old girl with quadriplegia. The girl exhibited improvements in sitting and standing balance as evidenced by the decreased amount of assistance required for ambulation. Additionally, there were reports of improved head control. Initially, she could only ambulate short distances with hand-held assistance. Following the riding program, she was independent in crutch ambulation for short distances. The second case example was a 7-year-old boy who demonstrated notable improvements in endurance. Initially, he could only walk about four steps. Following the riding program, he could walk four blocks. Control of extraneous variables were not addressed in the above two case examples.

Haskin, Bream and Erdman (1982) did not do a scientific study, but rather they presented treatments that they typically use in treating a number of children with cerebral palsy. This was a program of hippotherapy in which they incorporated principles of Rood, Bobath, and Proprioceptive Neuromuscular Facilitation. They claimed benefits in
reducing spasticity, and in maintaining and increasing range of motion in the upper extremities.

Munkacsy-Nastav (1988) studied two subjects using a quasi-experimental design. The researcher found that "therapeutic riding has a positive effect on sitting balance, sitting posture and riding balance of cerebral palsy children aged three to twelve years." The 2 subjects rode for 5 weeks and were assessed before and after the 5-week period. One of the test measurements included a timed balance test in which the researcher timed how long the child could sit independently on a chair with the child's sacrum positioned three inches from the back of the chair. The test ended when the child lost his or her balance or when 4 minutes had elapsed. Another test measurement was the amount of shoulder drop which was tested by counting the number of 1 inch grids on the video taped films. The grid on the videotape was also used to assess the angle of sway (measured using a protractor). Posture was assessed using a modified design of Bertoti's postural assessment scale which rates the child according to aspects of posture in the head and neck, shoulder and scapula, trunk, and spine. Each subcategory was scored from 0 to 3. In Bertoti's original scale, she also addressed the pelvis and the test was done in standing. Munkacsy-Nastav, however, did the test in sitting and the assessment of the pelvis was omitted. The final test measurement was of riding balance which was scored from 0 to 9. The researcher scored the riding during direct observation of the riding sessions. The score was given based on the number of sidewalkers, the presence of a backrider and the hand placement of any physical assistance.

Bertoti (1988) studied 11 children (2 to 9-years-old) with cerebral palsy. The purpose of this study was to assess posture in children with spastic cerebral palsy before and after 10 weeks of therapeutic riding. Two baseline measurements were taken 10 weeks prior to the initiation of riding and just before riding. The researcher found a statistically
significant (according to the Friedman Test) improvement in posture for 8 of the 11 subjects studied as measured by the "Posture Assessment Scale" that this researcher developed. The posture scores were given by three experienced pediatric physical therapists who scored the children simultaneously. Interrater reliability was acceptable at .82. Subjectively, the researcher reported improvements in muscle tone and balance as evidenced by improved functional skills in sitting, standing, and walking. The researcher reported that following the therapeutic riding program, in her clinical experience, improvements were observed in weight shifting during upper extremity reaching, creeping, and transitional movements. She described improvements in the quality of weight bearing in all four extremities during prone prop, quadruped, kneel, and stance. Improvements in sitting balance were evidenced by the increased ability to right the trunk in all directions during minimal to moderate perturbations.

Weburg (1993) used a modified single case (AB) design. She studied a 61-year-old female who was 14 years post left cerebral vascular accident (right hemiplegia). Three baseline measurements were taken (1 week between tests) before the implementation of a hippotherapy program. Measurements included: active range of motion of the shoulder; passive range of motion of the shoulder, elbow, wrist, hip and knee; hand function of the non-involved hand; and balance. Following 10 weeks of riding (an average of one session per week), the researcher reported improvements including quality of gait, active range of motion and self-esteem. Unfortunately, the results of the study were not statistically significant. Balance was assessed by timing the duration of independent stance with arms "down" (eyes open and closed) and arms "in" (eyes open and closed). The terms arms "down" and "in" were not explained. Balance was also measured by having the subject sit on the horse with arms out to the side and with arms crossed while the horse was moving. Balance was also assessed during
ambulation. Because the subject scored maximally on all the balance pretests, no change in balance was reported.

Brock (1987) conducted a study in order to measure the effects of a therapeutic riding program on physically disabled adults (ages 19 to 41). The riding sessions were twice weekly for 8 weeks. The subjects were evaluated on self-concept, coordination, and strength. Two designs were utilized. The first was a Pretest/Posttest design involving 15 subjects. The second was a Posttest Only design with 24 subjects randomly assigned into either the riding or non-riding group. The results of the study showed significant improvements in arm and leg coordination in the first design. The second design, however, showed that there was significantly higher arm coordination for the experimental as compared to the control group. The researcher also found higher scores for strength and self-concept among all of the riders. However, the results were not statistically significant.

Armstrong-Esther, Sandilands, Myco and Miller (1988) began studying 47 mentally and physically disabled adults. The final sample population included 39 subjects. The subjects were divided into two groups. The first group included those who rode three times a week for 6 weeks, had a 2 week rest break and then rode again for another 6 weeks. This pattern was repeated for an unspecified amount of time. The second group rode for 6 weeks only and then stopped. The researchers examined balance, spinal flexion and lateral flexion, shoulder rotation and hip flexion, as well as psychological and cognitive variables. One statistically significant physical improvement was an increase in left shoulder range of motion. Additional improvements in the lower extremities included an increase in bilateral ankle, knee and hip flexion.

Exner, Engelmann, Lange and Wenck (1994) studied 67 patients with paraplegia and quadriplegia secondary to spinal cord injuries. During the course of the riding program,
18 patients were able to functionally walk again. The study was conducted over a period of 18 months but it was not specified how long each of the individual riders were involved in the program. Exner et al. reported that hippotherapy has a long lasting effect on decreasing spasticity, especially compared to other forms of treatment. In this study, 37 patients experienced a substantial decrease in spasticity. Of these 37, 11 patients experienced decreased spasticity for 12 hours, 6 patients for 24 hours and 7 patients for 36 hours. Twenty-six of the 67 patients experienced pain in either the hip or back prior to horseback riding. Of these, 4 patients had decreased pain for 1 day, 13 patients had decreased pain for 2 days and 8 patients had decreased pain for up to 1 week following riding. Seventeen patients had a significant increase in flexibility. The flexibility gains lasted for 1 day in 2 patients, 2 days in 4 patients, and 1 week in 11 patients. All 67 patients were reported to experience improvements in trunk control, trunk position, posture, and improved body awareness.

History of the Bruininks-Oseretsky Test of Motor Proficiency

"The Bruininks-Oseretsky Test of Motor Proficiency (BOT) is an individually administered test that assesses the motor functioning of children from four and a half to fourteen and a half years of age" (Bruininks, 1978, p. 11). Dr. Bruininks based this motor test on the Oseretsky Test of Motor Proficiency from the 1940's. After conducting standardization tests, each of the subjects' raw scores were converted to point scores. These point scores were then used to calculate standard scores for the individual subtests, standard scores for the composite tests, percentile ranks, age equivalents, and stanines.

Two forms of the BOT are commonly administered; they are the complete battery and the short form. The complete battery thoroughly assesses fine and gross motor skills. The complete battery (BOT) is categorized under eight subtests composed of 46 items. The Short Form of the BOT (BOT-SF) also assesses the same eight subtests, but
does so with only 14 of the 46 items. The 14 items were selected from the complete battery based on ease of scoring and decreased time to administer. (See Appendix A for a list of the test items in the BOT-SF.)

Reliability and Validity of the BOT

In the original study, the complete battery of the BOT was assessed for test-retest reliability by using 126 students (5 of these students were enrolled in special education) who were tested twice within a 7 to 12 day period. The students were chosen from second and sixth grade classes at three schools. For the second graders, the reliability coefficients were .77 for Gross Motor and .88 for Fine Motor. The reliability coefficients for the sixth graders were .85 and .68 for Gross and Fine Motor, respectively. The Battery Composite scores were .89 for the second graders and .86 for the sixth graders. This demonstrates that the BOT can be considered as a reliable test instrument (Bruininks, 1978).

The BOT-SF is also considered to be a reliable measurement tool. In the test-retest reliability study that was mentioned above (using 126 students), the reliability coefficient for the second graders was .87 and it was .84 for the sixth graders. Although the BOT and the BOT-SF (in their entirety) can be used as a reliable measure, the individual subtests of the two versions have not been proven to be reliable (Bruininks, 1978).

To establish construct validity for the BOT, the following aspects were addressed: 1) the relationship of test content to specific aspects of motor development as published in clinical literature, 2) the relevant statistical properties of the test, and 3) how the test compared for assessing children with and without handicaps. As hypothesized, there is a direct correlation (.78) between age and the subtest scores. The correlation between the individual item and the total test score is lower than an individual item and a total subtest score (Bruininks, 1978).
Broadhead and Bruininks (1982) did a retrospective study of the original 765 children from the national normative study (ages 5 to 14). They wanted to see if there was a gender difference in motor performance. For this study, only the results of the BOT-SF were considered. The BOT-SF is much less time consuming and has been proven to be an acceptable alternative to the complete BOT. "Over the span of chronological age covered, five through fourteen years, the mean performance curves for both boys and girls are markedly linear for all the fourteen test items which comprise the eight subtests of motor proficiency represented in the test" (Broadhead and Bruininks, 1982, p. 153). Gender differences in mean performance were noted for 11 of the 14 items. Boys performed better on Strength, Running Speed and Agility, and Response Speed. The girls excelled in Balance, Bilateral Coordination, and Upper-Limb Speed and Dexterity.

Broadhead and Bruininks (1983) examined the factor consistency in the BOT-SF. They looked at the data of the original 765 subjects and divided them into four categories based on age and gender. They found that Bilateral Coordination, Balance, Running Speed and Agility, and Strength were the most consistent factors across age and gender. The researchers concluded that "Although the shortened form of the BOT battery cannot realistically be expected to be as precise as its longer counterpart in describing a detailed factor structure of motor abilities, this version retains several elements for both old and young non-disabled boys and girls" (Broadhead and Bruininks, 1983, p. 17).

Beitel and Mead (1980) evaluated 24 children (ages 3 to 5) using the Bruininks-Oseretsky Test of Motor Proficiency (BOT). In this age group, they found no significant difference in test scores between the two sexes. They found that "The short form [of the BOT] accounted for 96.3% of the variability of the complete battery, so the short form can be substituted for the complete battery whenever appropriate" (Beitel and Mead, 1980, p. 919).
As a follow-up to their previous study, Beitel and Mead (1982) evaluated the BOT to determine its test-retest reliability. They examined 25 children aged 3 to 5 years who were divided into two groups based on age and gender. They found that there was no significant carryover or "sensitization" effects between repeated testing of the short form. The children in this study were tested and retested within 2 to 2 1/2 weeks. They concluded that if the time between tests were even longer than two and a half weeks, that the effect of the first test on the second test would be virtually nonexistent. There was a high correlation (.96) at the p=.001 level between the test and retest which indicates that there are not significant testing effects.

Spiegel, Steffens, Rynders, and Bruininks (1990) compared the Early Motor Profile (EMP) to the BOT and the BOT-SF with 109 kindergarten children. At the p<.001 level, the correlation between the BOT and the EMP was .659 and between the BOT-SF and the EMP was .615. Therefore, the BOT and BOT-SF are considered to be reliable measures of motor performance.

Beer and Fleming (1989) used the BOT-SF on 28 students. They found two important differences between male and female students. The boys scored better on subtest 4 (Strength [Standing Broad Jump]). The girls performed better on subtests 2 and 7 (Balance [Standing on Preferred Leg on Balance Beam] and Visual-Motor Control [Drawing a Line Through a Straight Path with Preferred Hand]).

Butterfield and Ersing (1986) examined the effects of age, sex, etiology, and degree of hearing loss on balance. One hundred thirty-two subjects ages 3 to 14 were tested on subtest 2 of the BOT-SF. Scores increased with age. Contrary to Broadhead and Bruininks (1982) and Beer and Fleming (1989), this study found that gender did not cause differences in test scores.

Siegel, Marchetti and Tecklin (1991) also studied hearing-impaired children. They
wanted to determine if the balance deficits found in this population were age-related. Twenty-eight subjects were tested using the Balance subtest of the BOT. They compared the normative values with the subjects' scores. They determined that performance on the Balance subtest was neither age nor gender-related.
The researchers chose to do a single-case experimental design because of the variability of the riders and potential riders in our target population. Because of this variability, it was difficult to control for extraneous variables. The researchers had initially planned to study a small number of children. However, the Cheff Center was only able to locate one child that fit all of the established criteria. This research study was a single-case experimental design. Single-case designs are characterized by repeated measurements and two design phases—baseline and intervention (Portney & Watkins, 1993). Griffith (1992) stated, "Some individuals minimize the validity of research and support the therapy based on their personal experience with the therapy's effect on improving a patient's condition. They believe, furthermore, that disabilities are different and individualized, so that it is difficult to generalize meaningfully, and that the best assessment is that because the patient improved, the therapy works" (p. 5). Griffith believes that single subject designs will continue to be utilized as a research method.

Inclusion criteria established for the selection of the subject included a non-progressive neurological diagnosis, no horseback riding within the past 6 months, 4½ to 14½ years of age, responsible attendance (80%), availability and willingness to participate in gross and fine motor testing before, during and after the riding program. If the child participated in physical therapy, she must have had consistent therapy throughout the testing period. According to the researchers, consistent therapy was defined as a therapy program that has neither just begun nor just ceased within 1 month.
prior to or extending beyond the riding program. The researchers felt that if the rider began (or resumed) a therapy program near the same time that they began their riding program, then it would be difficult to differentiate the cause of any gains achieved.

Congruent with the Cheff Center's policies, the exclusion criteria consisted of the child not having any medical or orthopedic problems that would prohibit riding (for example, congenital hip dysplasia). Other contraindications included seizures, severe mental retardation, excessively fragile skin, emotional distress that would interfere with safety, progressive neuromuscular disease that would prohibit any postural control, and osteoporosis imperfecta (Mayberry, 1978). If the child was unable to wear a helmet (for example, due to an abnormally enlarged skull), then the child would not be able to participate. Additional contraindications included riders with tethered cords, worsening of neurological symptoms during a riding session and symptoms of Chiari II Malformation or hydromyelia when a cause had not yet been identified. Furthermore, riders with spinal cord lesions above the upper thoracic region could not participate in therapeutic riding secondary to inadequate trunk control. Subjects having certain bone tumors, that would increase the likelihood of sustaining a fracture, or status-post tendon lengthening surgeries were also precluded from riding. Uncontrolled diabetes or hypertension and severe varicose veins were also contraindications (NARHA Guide, 1992). It is a physician's responsibility to screen for the above contraindications during a thorough physical exam that must be completed before allowing anyone to participate in a therapeutic riding program.

The subject was tested: 1) 2 weeks prior to initiation of the therapeutic riding program, 2) immediately preceding the first riding session, 3) immediately preceding the fifth riding session, 4) immediately preceding the eleventh (final) riding session, 5) immediately following the eleventh (final) riding session, 6) 2 weeks following
the cessation of riding, and 7) 5 weeks following the cessation of riding. The short form of the Bruininks-Oseretsky Test of Motor Proficiency was administered during these seven testing periods. The average length of each testing session was 20 to 30 minutes.

Prior to data collection, anticipated problems included attrition, low attendance, anxiety about riding, testing effects, medical complications, motivation, and participation level/behavior of the child. Although some anticipated problems were outside of the researchers' control, others were addressed to a limited extent. The Cheff Center, as well as the researchers, stressed to the rider and her parents the importance of good attendance and consistency of behavior. The researchers attempted to decrease the child's anxiety by having the Cheff Center do an orientation session with the child. At the orientation, the child was allowed to get used to the horses (grooming and feeding) and was provided with education about horses.

Because of the subject's age, maturation was a variable considered during the testing period. A true experimental design could not be carried out, therefore, there was ambiguity regarding causal relationships. It was suggested that there was a relationship between therapeutic horseback riding and motor skills, but it could not be stated with certainty that there was a definite cause and effect relationship. Because there was only one subject, tests of significance could not be performed. However, this does not mean that the results were not meaningful. Another potential limitation was that there may have been a tendency for the Hawthorne effect to skew the results of the study. There may have been a desire for the child to try to improve in order to please the researchers or riding instructors because of the individualized attention. This study was narrow-focused due to the strict inclusion and exclusion criteria that the researchers developed. Another limitation to the study was the lack of generalization due to the single-case design. Griffith (1992) sees primarily two problems in doing research for the
disabled. First, longitudinal research is expensive. Second, precise scientific instruments are rare in this field of study. Another limitation is that the subject selection was not a random sample, the selection process is outlined in the paragraph which follows.

Bliss Brown, Program Director of the Cheff Center for the handicapped, in Augusta, Michigan, helped the researchers locate a suitable subject for the researchers’ study. The instructors at the Cheff Center agreed to provide the riding instructions for the student. The researchers were responsible for the tests and measurements. The Cheff Center usually has a waiting list for prospective riders. The typical waiting period is 2 years. Because we needed a subject who has not participated in riding within the past 6 months, the first child on the waiting list that met the selection criteria was asked to participate. If that child was not able or willing to participate, the selection process was continued down the list. As previously mentioned, the researchers had hoped to have several subjects. However, after the selection process was completed, only 1 subject qualified for this study.

The Cheff Center contacted the parents of the prospective rider to see if they would be interested in participating in this research study. After the parents expressed interest, the researchers were notified that an appropriate child had potentially been located. Next, the researchers contacted the parents of the potential subject to further explain the purpose of the study, to answer any questions, and to obtain informed consent. In addition to a consent form that was signed by the child and her parents, a physician's referral was obtained prior to initiation of the riding program. The researchers clarified time frame requirements (that the child needed to be available 2 weeks prior to and 1 month following the 11-week riding program). The researchers stressed the need for good attendance, nutrition, and proper sleep for accurate results. The parents were informed that the child should wear tennis shoes and comfortable clothing for all of the
BOT-SF testing sessions.

The BOT is specifically designed to avoid any differences in testing conditions. The instructions were read word-for-word to the subject to avoid misinterpretation. When necessary, the researcher repeated or rephrased the instructions for further clarification. The BOT has specific testing equipment that is crucial for accurate results. The guidelines for test administration in the Examiner's Manual (Part 4) were followed closely including scheduling, equipment, and guidelines (Bruininks, 1978).

To avoid problems with interrater reliability, one researcher (AAS) was responsible for performing and collecting the measurement data. The researcher who administered the test has had limited clinical experience with the BOT. According to Bruininks (1978), "Examiners need not have special training but must become thoroughly familiar with the directions for administering the test and practice giving it in simulated situations before actual administration" (p. 11). The researcher responsible for the testing conducted an intrarater reliability study on 6 young adults (ages 23-30). The reliability coefficient was determined to be .93. To avoid potential researcher bias in the single-case experimental design, each testing session's scores were filed away. The scores were not tallied until all measurements were completed. Therefore, the researcher was unaware of previous scores. Data collection began on September 12, 1995, and concluded on January 9, 1996. During the 11-week riding program the subject was absent on two occasions (October 31 and November 14, 1995). However, the attendance rate was acceptable at 81.8%.

The horses at the Cheff Center are well-trained and are screened before acceptance into the program. Riding instructors are knowledgeable and have also been trained to address safety issues. The Cheff Center was responsible for all of the riding sessions. The researcher observed five of the nine riding sessions in which the subject was present.
The Cheff Center has a standard consent form and physician referral form that was signed before the child began riding. The researcher's primary responsibility was for the administration of the Bruininks-Oseretsky Test of Motor Proficiency. The limited potential hazards of the testing was addressed in the Human Subjects Review Committee; written permission was obtained to proceed with our study on September 11, 1995. An additional consent form specifically related to participation in this study was signed by the subject and her mother prior to data collection.

The researchers had hoped to demonstrate that an 11-week riding program improves strength, coordination and balance in the upper and lower extremities of the disabled rider with basic descriptive and visual analysis. However, the researchers did not anticipate establishing statistically significant results regarding the therapeutic riding program due to the single-case design and lack of control over extraneous variables.
CHAPTER 4

RESULTS

Using the A-B-A design, the subject was tested seven times on each of the 14 test items on the Bruininks-Oseretsky Test of Motor Proficiency- Short Form. The first two baseline scores were taken before the subject began riding. The first two of the three treatment scores were taken before the fifth and eleventh (final) riding session. The third treatment score was taken following the eleventh (final) riding session. The final two baseline scores were taken at 2 and 5 weeks following the cessation of the riding program. The results were analyzed two different ways. As shown in the graphs (Figures A-N), the left side contains all seven of the data points collected. On the right side of the graphs, the third treatment points are omitted. These points were omitted because, unlike the other treatment scores, these tests were administered immediately following the riding session. The initial plan was to gather only the six tests that are illustrated on the right side of the graphs. However, the researchers also wanted to compare whether there was an immediate effect from the horseback riding that was not being shown in the subsequent tests. On some of the graphs, it appears that there is indeed a significant difference between the two graphs (with and without the third treatment test).

The total point scores possible, as well as the raw scores, for each of the 14 test items are listed in Appendix A. The first test item administered was Running Speed and Agility. The subject scored a 3 and a 4 during the baseline phase. During the intervention phase, the subject scored a 2, 3 and 4, respectively. In the final baseline phase, she scored a 3 and a 2. These results do not demonstrate a clear pattern.
However, the subject's score improved from a 3 to a 4 immediately following the eleventh riding session, this may indicate that riding has a short term effect on running speed and agility. (See Figure A.)

The second test item was Standing on Preferred Leg on Balance Beam. During the initial baseline, the subject exhibited sporadic activity with point scores of 2 and 0. However, during the treatment and second baseline phase, the subject’s performance remained constant with a point score of 1 on the remaining five tests. These results may indicate that the treatment effected the subject’s balance with residual effects maintained throughout the second baseline phase. (See Figure B.)

The third test item was Walking Forward Heel-to-Toe on Balance Beam. The subject had a point score of 1 on each of the seven testing periods. These scores do not indicate any treatment effectiveness. (See Figure C.)

The fourth test item was Tapping Feet Alternately While Making Circles with Fingers. During the initial baseline, the subject scored a 0 (fail) on each of the tests. During the intervention phase, the subject scored a 1 (pass) on three consecutive trials. During the final baseline, the subject scored a 1 and 0, respectively. These results indicate that the subject's bilateral coordination significantly improved during the treatment phase. Residual effects of treatment are visible within the first data point of the second baseline period. However, the residual effects of treatment did not continue beyond that point. (See Figure D.)

The fifth test item was Jumping Up and Clapping Hands. The subject scored a 2 on each of the initial baseline trials. During treatment, the subject scored a 2, 3 and 2, respectively. During the post-treatment baseline, the subject scored a 2 during both tests. These results show slight improvement midway through the intervention phase. However, there are no lasting effects of the treatment. Intervention may have improved
the subject’s bilateral coordination as evidenced by the improvement noted in this skill. However, when analyzing the pre- and post- test riding scores, there was a decrease from a 3 to a 2 immediately following riding. (See Figure E.)

The sixth test item is the Broad Jump. During the initial baseline and intervention phase, the subject scored a 3 on each trial. During the final baseline, she scored a 5 and a 2. These results are inconclusive. (See Figure F.)

The seventh test item was Catching a Tossed Ball with Both Hands. She scored a 3 on both trials during the initial baseline. During the treatment phases, she scored a 2, 2 and 3. During the final baseline, the subject scored a 2 on each trial. These findings do not demonstrate any conclusive results. However, the scores for pre- and post-riding on the eleventh week (test numbers 4 and 5) appear to have had an immediate improvement in upper-limb coordination as her scores returned from a 2 to the baseline measurement of 3. (See Figure G.)

The eighth test item was Throwing a Ball at a Target with Preferred Hand. The initial baseline scores were 2 and 1. The treatment scores were 2, 3 and 2. The final baseline scores were 3 and 2. These results suggest that there may have been a mild treatment effect as the subject’s score never went below 2 (which was the highest score during the initial baseline). When the third treatment score (post-riding) is eliminated, the graph shows less variation in the trend. Following the final riding session, the subject’s score decreased from a 3 to a 2. This may indicate that upper-limb coordination decreases immediately following horseback riding. (See Figure H.)

The ninth test item is Response Speed. Initially, the point scores were 0 and 2. During treatment, her scores were 3 on the first two tests, and 5 on the final treatment test. The final baseline scores remained stable at 3. Considering these results, an upward trend of improvement is apparent during the initial baseline period and at the beginning
of the intervention phase. Although there was gradual improvement prior to the intervention phase, the point scores during the final baseline did not return to the point of the initial baseline. Scores dropped to a constant during the final baseline period. These findings suggest that treatment had a positive effect on the subject’s performance. Furthermore, the subject’s score improved from a 3 to a 5 between testing periods 4 and 5 (pre- and post-riding). This suggests that response speed improves substantially immediately following therapeutic horseback riding. (See Figure 1.)

The tenth test item was Drawing a Line Through a Straight Path with Preferred Hand. The subject scored the maximum point score during all seven of the testing periods. It cannot be determined whether or not there was any effect of riding on this skill. (See Figure J.)

The eleventh test item was Copying a Circle with Preferred Hand. The subject scored maximally (a point score of 2) during all of the baseline and treatment tests. Again, these results are inconclusive regarding the effect of riding on this visual-motor task. (See Figure K.)

The twelfth test item was Copying Overlapping Pencils with Preferred Hand. The initial baseline scores were 1 and 2. The treatment scores were a 1, 2 and 2, respectively. The post-riding baseline scores were both 2. The scores are sporadic prior to and during treatment. However, during and after the treatment phase, the subject improved her visual-motor control as evidenced by constant point scores of 2. This may show that riding has a positive and lasting effect on this skill. (See Figure L.)

The thirteenth test item was Sorting Shape Cards with Preferred Hand. The first baseline scores were 2 and 3. The treatment scores were 4, 4 and 5. The final baseline scores were 5 and 3. There was an upward trend of improvement exhibited during the first baseline phase and the intervention phase. Residual effects are evident during the
initial phase of the second baseline period with a decline in improvement thereafter. These results suggest that there was a treatment effect in reference to sorting cards (Upper-Limb Speed and Dexterity). Also, the subject’s score improved from a 4 to a 5 immediately following horseback riding. (See Figure M.)

The fourteenth test item was Making Dots in Circles with Preferred Hand. The initial baseline scores were 4 and 5. Treatment scores were 5, 5 and 4. The final baseline scores were 5 and 4. These scores do not demonstrate a clear pattern. However, when the fifth testing session (post-riding) is omitted, the graph suggests a slight treatment effect as the scores increased during the baseline and treatment phases and then decreased during the final baseline phase. The upward trend in the first baseline phase may indicate that the above assumption is not accurate because the skill was already improving. Additionally, there is a decrease in the subject’s performance immediately following riding as her score decreased from a 5 to a 4. (See Figure N.)

The researchers divided the scores on the BOT-SF into gross and fine motor skills. Subtests that include gross motor skills are Running Speed and Agility, Balance, Bilateral Coordination, Strength, Upper-Limb Coordination and Response Speed (Subtests 1-6). The overall gross motor scores were 16 on each of the initial baseline tests. The intervention scores were 17, 20, and 22, respectively. The final baseline scores were 21 and 15. These results indicate that therapeutic riding had a positive effect on gross motor skills. (See Figure O.)

Subtests that are part of fine motor skills are Visual-Motor Control and Upper-Limb Speed and Dexterity (Subtests 7-8). The overall fine motor scores were 13 and 16 during the initial baseline tests. During intervention, the scores were 16, 17, and 17. The final baseline scores were 18 and 15. These results indicate that therapeutic riding may have improved this subject’s fine motor skills. (See Figure P.)
The subject’s overall point scores were also analyzed. The following point scores are based on a total possible score of 98. During the initial baseline, the subject scored 29 and 32. The treatment scores were 33, 37 and 39. In the final baseline phase, the subject scored 39 and 29. These results indicate that there may have been some improvement in overall motor skills during the course of the eleven-week therapeutic horseback riding program. (See Figure Q.)

The null research hypothesis is as follows: An 11-week therapeutic riding program (1 hour/week) will not have any effect on motor performance as measured by the BOT-SF. The alternative hypothesis states: An 11-week therapeutic riding program will improve gross and/or fine motor skills as measured by the BOT-SF.

In general, the results of this research study proved to be inconclusive. The single-case design, with a limited number of testing sessions, did not allow for a stable baseline. Additionally, there were not enough data points to determine whether or not the therapeutic riding program caused the changes seen throughout the testing period. Despite the fact that statistical significance was not established, some improvements in motor performance were suggested by visually analyzing the graphs. It appears as if most improvements occurred with Balance (Standing on Preferred Leg on Balance Beam), Bilateral Coordination (Tapping Feet Alternately While Making Circles with Fingers; Jumping Up and Clapping Hands), Upper-Limb Coordination (Throwing a Ball at a Target with Preferred Hand), Response Speed, Visual-Motor Control (Copying Overlapping Pencils with Preferred Hand), and Upper-Limb Speed and Dexterity (Sorting Shape Cards with Preferred Hand; Making Dots in Circles with Preferred Hand).

Some improvements were noted during the final riding session in which the subject was tested pre- and post-riding. Improvements were noted in Running Speed and Agility (3 to a 4), Upper-Limb Coordination (Catching a Tossed Ball [3 to a 4]), Response Speed
(3 to 5) and Upper-Limb Speed and Dexterity (Sorting Shape Cards with Preferred Hand [4 to 5]). In a few of the test items, there was a decrease in performance noted immediately following riding. The subject’s score decreased on Bilateral Coordination (Jumping Up and Clapping Hands [3 to 2]), Upper-Limb Coordination (Throwing a Ball at a Target with Preferred Hand [3 to 2]), and Upper-Limb Speed and Dexterity (Making Dots in Circles with Preferred Hand [3 to 2]) immediately following horseback riding.
CHAPTER 5

DISCUSSION

According to the literature that was cited in Chapter 2, other researchers have found improvements in balance, coordination, muscle strength, range of motion, flexibility, posture, decreased spasticity, and improved ambulation skills following therapeutic horseback riding. However, many of these studies lacked scientific controls or had a small sample size.

The single-case experimental design presented in this study suggests improvements in several areas of motor skills. Over the course of an 11-week therapeutic horseback riding program, the subject's scores on the BOT-SF suggest improvements in Balance (Standing on Preferred Leg on Balance Beam), Bilateral Coordination (Tapping Feet Alternately While Making Circles with Fingers; Jumping Up and Clapping Hands), Upper-Limb Coordination (Throwing a Ball at a Target with Preferred Hand), Response Speed, Visual-Motor Control (Copying Overlapping Pencils with Preferred Hand), and Upper-Limb Speed and Dexterity (Sorting Shape Cards with Preferred Hand; Making Dots in Circles with Preferred Hand).

When analyzing the gross and fine motor graphs (Figures O and P), it appears as if both of these skills improved throughout the riding sessions. With the gross motor testing, there was a baseline established before the scores improved during the intervention phase. The scores continued to improve during the first of the final baseline measurements. The final baseline measurement showed a decrease that was even lower.
than the initial baseline measurements. This may indicate that there were residual effects from the riding program. Although a clear baseline was not established with the fine motor scores, there was an upward trend of improvement noted throughout the initial baseline, intervention, and first of the final baseline scores. However, there was a significant decrease in fine motor scores in the last testing session (final baseline). These results indicate that there may have been some treatment effect as the scores did decrease with the withdrawal of treatment.

In addition to the gross and fine motor skills improving, the overall point scores also improved during the therapeutic riding program. A clear initial baseline was not established in reference to the overall point scores. The scores improved during the initial baseline phase, the intervention phase, and the first of the final baseline tests. The last measurement (the final baseline score) returned to a point score similar to the first of the baseline scores. These results indicate that riding appears to improve overall motor skills. (See Figure Q.)

When initially designing the study, it was determined that the subject would be tested a total of six times, with the testing to be done prior to the riding sessions during the intervention phase. However, it appeared as if the subject was making some gains during riding that could not be seen during the next testing session. Therefore, it was decided that the researchers would do an extra testing session immediately following (as well as preceding) the final riding session. This was done to determine if there were immediate effects of the riding that were not long lasting. It appears as if short-term improvements occurred in Running Speed and Agility, Upper-Limb Coordination (Catching a Tossed Ball), Response Speed, and Upper-Limb Speed and Dexterity (Sorting Shape Cards with Preferred Hand).

In a few of the test items, there were decreases in performance noted immediately
following riding. Areas in which the subject’s scores decreased immediately following the riding session included: Bilateral Coordination (Jumping Up and Clapping Hands), Upper-Limb Coordination (Throwing a Ball at a Target with Preferred Hand), and Upper-Limb Speed and Dexterity (Making Dots in Circles with Preferred Hand). In addition to random fluctuations, perhaps one possible explanation for this decline in performance was due to the subject’s fatigue.

Two of the three items under the subtest of Visual-Motor Control did not show any change. These items included 1) Drawing a Line Through a Straight Path with Preferred Hand and 2) Copying a Circle with Preferred Hand. No change was observed as the subject scored maximum point scores on all trials. The results of the Strength subtest were inconclusive. As seen on the graph, the subject scored the same point score on every trial with the exception of the final baseline phase. The subject’s score improved by 2 points during the first final baseline test and then dropped by 3 points. These results may suggest that there were strength gains, but that they were not demonstrated until 2 months after the riding began. This is consistent with the fact that it often takes up to 6-8 weeks for substantial strength gains to appear (Staron, Karapondo, Kraemer, Fry, Gordon, Falkel, Hagerman & Hikida, 1994). Finally, balance scores did not change. Part of this problem may have been attributed to the fact that an initial baseline was not established.

A problem with the validity of a subtest of the BOT-SF was specific to this handicapped child with a diagnosis of spastic diplegic cerebral palsy. For example, a child with a condition that results in excessive adduction and internal rotation tone in the lower extremities, cannot be expected to perform well on a task involving walking heel-to-toe on a 2 inch wide balance beam. This subtest is appropriate to test in normal children, but it did not appear to be an accurate measurement of balance for this particular child.
Another problem with the study was that it did not take into account the fact that a young child is expected to improve in motor skills as a result of maturation. The testing occurred over a 4-month period of time. Using the data from the original norm-referenced sample of children, a 7-year-old girl (over a 2-month period of time throughout the intervention phase) is expected to improve in the following areas: 1) Running Speed and Agility (0.2), 2) Balance (0.0), 3) Bilateral Coordination (0.3), 4) Strength (0.4), 5) Upper-Limb Coordination (0.5), 6) Response Speed (0.3), 7) Visual-Motor Control (0.5), and 8) Upper-Limb Speed and Dexterity (1.1) (Bruininks, 1978). The subject in this study had improvements greater than that expected due to maturation alone, in the following subtests: Bilateral Coordination (1.0), Response Speed (1.5), and Upper-Limb Speed and Dexterity (1.5). Balance and Upper-Limb Coordination improved but did not improve greater than that expected due to maturation. However, when assessing the effects of maturation on performance, the ABA design can be effective in differentiating treatment effect versus maturation. If the improvements were due solely to maturation, you would not expect to see a decline in performance during the final baseline phase. It is more important to look for a decline in performance after the withdrawal of treatment than to look purely at how much of the child’s improvement in skills was due to maturation.

According to various authors, the BOT has been shown to be a valid and reliable measurement tool to assess motor skills in children. Although further testing is needed, the BOT is considered to be an appropriate test for children with and without disabilities (Bruininks, 1978). In this research project, the BOT-SF was used as a criterion-referenced test rather than a norm-referenced test. The handicapped subject was compared against herself, and not with other children. Although the complete battery of the BOT is considered to be the best indicator of a child’s present level of
motor skills, the BOT-SF is considered an acceptable alternative (Broadhead and Bruininks, 1983).

To the best of the researchers’ knowledge, no other studies have been done using the BOT-SF to test the effectiveness of therapeutic horseback riding. To encompass many of the aspects of previous studies, the researchers wanted to look at balance, coordination and strength. The BOT-SF was chosen because it assesses a multitude of motor skills and the test is specifically designed for children.

In retrospect, the BOT-SF may or may not have been the best test to use in this study. In many aspects, the test was effective in that it was all-encompassing, fun for the child, standardized, portable, a reliable and valid measurement tool, easy to administer, and conservative regarding time requirements. One thing less desirable about the BOT-SF was that there may have been a learning effect during the course of seven testing periods (especially in reference to Response Speed and Visual-Motor Control). Typically, the BOT is considered to be free from a significant learning effect. However, it is not known if there is a stronger learning effect when the test is used repeatedly (seven times in 4 months) as was done in this study. Additionally, activities that were performed by the subject could not be accounted for while outside of the riding and testing sessions. For example, this subject was in the second grade where she practiced visual-motor control activities routinely. If improvements had been noted in Visual-Motor Control during the testing sessions, her scores may have been attributed to outside practice (extraneous variable).

One thing that may have had an adverse effect on the testing results was the lack of environmental controls. The test was administered in the same location each time, but the temperature was not well-controlled. The subject complained about being cold during some testing sessions. Although the subject was requested to wear the same pair
of tennis shoes for each testing session, she did not always have on the same footwear. At times, she would wear cowboy boots, which were particularly relevant when performing the running, jumping, and balance beam activities.

The subject attended 9 of the 11 riding sessions; this fulfilled the 80% attendance requirement that was established in the inclusion criteria. She participated fully and seemed to put forth her best effort in all subtests. She stated that she liked therapeutic riding better than physical therapy in a traditional setting.

In this study, internal validity is controlled by the fact that it would be highly unlikely that extraneous variables would coincidentally occur at both the onset and the cessation of treatment. As with all single-case designs, (and many group designs) external validity is difficult to establish. With a single-case design, it is difficult to generalize because there is so much variability within and between subjects. The best method of establishing generality of research findings involves a systematic replication of research designs (Gonnella, 1989). It is the researchers’ hope that this study will serve as a foundation upon which other studies may develop. This study should be viewed as a pilot study. Suggestions for future research include: 1) using more subjects in order to establish generalizability, 2) doing a longitudinal study to determine the long term effects of therapeutic horseback riding, 3) establishing a control group and comparing the results from traditional physical therapy and therapeutic horseback riding, and 4) obtaining more data points in order to establish a clear baseline.
REFERENCES


FIGURES A-Q

GRAPHS OF BOT-SF TESTING
RUNNING SPEED AND AGILITY
WITH POST-RIDING TEST

RUNNING SPEED AND AGILITY
WITHOUT POST-RIDING TEST

A = Baseline  B = Treatment

FIGURE A
BALANCE WITH POST-RIDING TEST

STANDING ON PREFERRED LEG ON BALANCE BEAM
A = Baseline  B = Treatment

BALANCE WITHOUT POST-RIDING TEST

STANDING ON PREFERRED LEG ON BALANCE BEAM
A = Baseline  B = Treatment

FIGURE B
BALANCE WITH POST-RIDING TEST

WALKING FORWARD HEEL-TO-TOE ON BALANCE BEAM
A = Baseline  B = Treatment

BALANCE WITHOUT POST-RIDING TEST

WALKING FORWARD HEEL-TO-TOE ON BALANCE BEAM
A = Baseline  B = Treatment

FIGURE C
BILATERAL COORDINATION WITH POST-RIDING TEST

- TAPPING FEET ALTERNATELY WHILE MAKING CIRCLES WITH FINGERS
A = Baseline  B = Treatment

BILATERAL COORDINATION WITHOUT POST-RIDING TEST

- TAPPING FEET ALTERNATELY WHILE MAKING CIRCLES WITH FINGERS
A = Baseline  B = Treatment

FIGURE D
BILATERAL COORDINATION
WITH POST-RIDING TEST

- JUMPING UP AND
- CLAPPING HANDS
A = Baseline  B = Treatment

BILATERAL COORDINATION
WITHOUT POST-RIDING TEST

- JUMPING UP AND
- CLAPPING HANDS
A = Baseline  B = Treatment

FIGURE E
STRENGTH WITH POST-RIDING TEST

STRENGTH WITHOUT POST-RIDING TEST

STANDING BROAD JUMP
A = Baseline  B = Treatment

FIGURE F
UPPER-LIMB COORDINATION WITH POST-RIDING TEST

UPPER-LIMB COORDINATION WITHOUT POST-RIDING TEST

- CATCHING A TOSSED BALL WITH BOTH HANDS
  A = Baseline  B = Treatment

FIGURE G
FIGURE H

UPPER-LIMB COORDINATION WITH POST-RIDING TEST

UPPER-LIMB COORDINATION WITHOUT POST-RIDING TEST

THROWING A BALL AT A TARGET WITH PREFERRED HAND
A = Baseline  B = Treatment

THROWING A BALL AT A TARGET WITH PREFERRED HAND
A = Baseline  B = Treatment

POINTS

0  1  2  3

0  1  2  3

A  A  B  B  B  A  A

A  A  B  B  B  A  A
RESPONSE SPEED WITH POST-RIDING TEST

RESPONSE SPEED WITHOUT POST-RIDING TEST

FIGURE I
UPPER-LIMB SPEED AND DEXTERITY
WITH POST-RIDING TEST

SORTING SHAPE CARDS
WITH PREFERRED HAND
A = Baseline  B = Treatment

UPPER-LIMB SPEED AND DEXTERITY
WITHOUT POST-RIDING TEST

SORTING SHAPE CARDS
WITH PREFERRED HAND
A = Baseline  B = Treatment

FIGURE M
UPPER-LIMB SPEED AND DEXTERITY
WITH POST-RIDING TEST

MAKING DOTS IN CIRCLES
WITH PREFERRED HAND
A = Baseline  B = Treatment

UPPER-LIMB SPEED AND DEXTERITY
WITHOUT POST-RIDING TEST

MAKING DOTS IN CIRCLES
WITH PREFERRED HAND
A = Baseline  B = Treatment

FIGURE N
GROSS MOTOR POINT SCORES
SUBTESTS 1 - 6

FIGURE 0
FINE MOTOR POINT SCORES
SUBTESTS 7 & 8

FIGURE P
OVERALL POINT SCORES USING B.O.T.-SF

FIGURE Q
APPENDIX A

BOT-SF TEST ITEMS
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APPENDIX B

PERMISSION TO USE BOT FOR TESTING
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APPENDIX C

LETTER TO PARENTS DESCRIBING BOT
This letter is to inform the parents or guardians more about the testing that will take
place at the Cheff Center. The test that will be administered repeatedly is the
Bruininks-Oseretsky Test of Motor Proficiency. This test has been widely used for
children with and without disabilities for several decades.

The first time the test is given, the researcher will be determining arm and leg
preference. This is done by looking to see which hand they throw with and which foot
they kick with most frequently. In the next test, your child will run or walk as quickly as
possible approximately 50 feet, will pick up a plastic block, and will run back to the
starting line.

In the next test, your child will stand on one leg on the balance beam for up to 10
seconds. Next, he or she will walk heel-to-toe down the length of the balance beam.
Your child will be closely guarded during these tests.

Next, your child will sit in a chair and tap his or her feet while making circles with
their fingers. On the next test, your child will jump up in the air and clap his or her hands
as many times as possible before landing.

Your child will perform a standing broad jump, jumping forward as far as possible.
Next, your child will catch a tennis ball thrown gently from 10 feet away. Then, he or
she will throw this tennis ball at a target.

While sitting down, your child’s reaction time will be tested using their dominant
hand. Then, your child will draw a straight line, a circle, and a strangely shaped object.
Then, your child will sort playing cards into two groups based on colors. Finally, they
will make dots with a pencil in circles that have already been drawn.

This seems like a lot, but it really shouldn’t take longer than 20-30 minutes. Most
children find this test to be fun activity.
APPENDIX D

CONSENT FORM
CONSENT FORM

I understand that this is a study of the effects of horseback riding on physical motor skills. The researchers are students in the Master of Science program in Physical Therapy at Grand Valley State University. The results of the study will be used in their Master's thesis and will be strictly confidential. The research may also be published at some point. In addition to participating in the riding program, I consent that my child may also participate in the Bruininks-Oseretsky Test of Motor Proficiency. This is a test that is commonly administered to children, especially those with disabilities, to determine their physical skill level. The test will be performed six times between September of 1995 and January of 1996. Each test is expected to take about twenty to thirty minutes to administer. The areas that this test is designed to measure include: running speed and agility; balance; bilateral coordination; strength; upper-limb coordination; response speed; visual motor control; and upper-limb speed and dexterity.

I understand that these tests possess minimal physical risks such as falling during running or while standing on the balance beam. The test will be discontinued at any time if I or my child so desires. Although I have agreed to allow my child to participate in this study voluntarily, this does not obligate him/her to continue with the study. My child may withdraw from the study at any time. I have been given the phone number and address of one of the researchers conducting the study and have been informed that I may contact her at any time with questions or concerns. In addition, I have been given the phone number (616-895-2472) of Professor Huizenga of the Human Subjects Review Committee.

I have read and understand the above information and I would like for my minor child to participate in this study.

_________________________________________  ________________
Legal Guardian                                    Date

____________________________________________  ________________
Minor Child                                      Date

____________________________________________  ________________
Witness                                          Date
APPENDIX E

HORSEBACK RIDING/ RESEARCH SATISFACTION SURVEY
Horseback Riding/ Research Satisfaction Survey

1. Q: What did you like best about riding?
   A: I liked the horses. Horses are my favorite animals

2. Q: What did you like least about riding?
   A: I don’t know

3. Q: Since the fall, have you noticed any changes in the way that you are able to move your body (for example, running, throwing, standing on one foot?)
   A: I don’t know

4. Q: How would you compare physical therapy and horseback riding? Which do you think was more fun? Which do you think helped the most?
   A: I like it here better [than outpatient P.T.].

5. Q: Would you like to ride horses again?
   A: Yes

6. Q: What did you like most about the testing (running, balance beam, etc.)?
   A: Catching the stick [Response Speed] and catching the ball

7. Q: What did you like least about the testing?
   A: Standing on one foot
APPENDIX F

THERAPEUTIC HORSEBACK RIDING
PARENTS SATISFACTION SURVEY
THERAPEUTIC HORSEBACK RIDING

PARENT SATISFACTION SURVEY

1. Q: What did you like best about the therapeutic riding program that your child was involved in?
   A: Therapy was fun and interesting for her

2. Q: What suggestions or recommendations do you have to improve upon the riding program?
   A: None, it was great

3. Q: Did you notice any physical, social or psychological changes in your child during the course of the riding program? If so, can you please list what they were and to what you attribute these changes?
   A: [Not answered]

4. Q: Would you be interested in having your child participate in a therapeutic riding program again?
   A: Yes

5. Q: Would you please comment on the duration (number of sessions) and length (of each session).
   A: Adequate amount of time

6. Q: Could you please compare and contrast therapeutic horseback riding and physical therapy at the hospital or school settings?
A: Horseback riding was more enjoyable and easier to stay motivated for

7. Q: What are your feelings on the test (Bruininks-Oseretsky Test of Motor Proficiency-Short Form) that was repeatedly administered to your child? While the test was administered, did you notice any improvements over the course of the study?

A: Better balance and coordination

8. Q: While your child was riding the horse, did you notice any changes from the first few riding sessions compared to the last few sessions? If so, please comment on what these were?

A: More confident and posture on the horse improved

9. Q: Would you recommend this type of therapy to other children with a disability similar to your child’s?

A: Yes, definitely

10. Q: Do you have any other comments or concerns regarding the riding or the research project?

A: No! Thanks for helping [my child] get into the horseback therapy!