A Case Study Concerning the Effects of Hippotherapy on Developmental Dysarthria
A Senior Honors Thesis
Presented in Partial Fulfillment of the Requirements for graduation with research distinction in Speech and Hearing Science in the undergraduate colleges of The Ohio State University

by
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Abstract

Hippotherapy is an approach to equine assisted therapy (EAT) that uses equine movement along with physical, occupational, or speech therapy treatment strategies (Håkanson, Möller, Lindström, & Mattsson, 2009). In speech-language pathology, the few existing studies focusing on hippotherapy have primarily used subjective measurements such as questionnaires (e.g., Borton & Ogburn 2009). These studies suggested that children who participated in hippotherapy were believed (by their parents and others) to experience improved speech and language skills, increased motivation to attend therapy sessions, and improved self-concepts (Macauley & Gutierrez, 2004). Increases in vocalizations have also been noted in non-verbal participants (Lehrman & Ross, 2001). This study is a single participant case study designed to examine the immediate effects of four hippotherapy sessions on objective measures [i.e., respiratory strength, vocal intensity (loudness) and the mean length of utterance (MLU)] of a person with developmental dysarthria, where developmental dysarthria refers to speech abnormalities due to chronic weakness of the speech musculature. Because no appropriate participant was found in time for data collection to be completed, the study goals were changed to piloting of procedures.

Keywords: hippotherapy, therapeutic horseback riding, developmental dysarthria, speech therapy
Effects of Hippotherapy on Developmental Dysarthria

Efforts Toward a Case Study Concerning the Effects of Hippotherapy on Developmental Dysarthria

Equine assisted therapy (EAT) uses horseback riding as a therapeutic activity (Håkanson, Möller, Lindström & Mattsson, 2009). EAT consists of three categories: Vaulting, therapeutic riding, and hippotherapy. Vaulting is generally used for individuals with emotional and behavioral disabilities and involves diverse, gymnastic type movements while on the horse. Therapeutic riding is strictly exercise based, in which the rider works on controlling the horse’s speed and direction (Meregillano, 2004). The North American Riding for the Handicapped Association (NARHA) registers individuals who lead therapeutic riding sessions and the facilities where these sessions occur (Borton & Ogburn, 2009).

Hippotherapy differs from the other two forms of EAT in that its practice is limited to individuals licensed as a physical therapist, physical therapist assistant, occupational therapist, occupational therapist assistant, or speech language pathologist. These professionals must be registered with the American Hippotherapy Association (AHA). If therapy is being conducted at a NARHA registered center, the individual conducting the therapy must also be registered with NARHA or have a NARHA registered individual present (Borton & Ogburn, 2009).

Hippotherapy, the focus of this study, is an approach of EAT that utilizes equine movement along with physical, occupational, or speech therapy treatment strategies (Macauley & Gutierrez, 2004). Individuals certified in hippotherapy are educated on how to manipulate the client in ways to maximize sensory input from the horse’s
movements to help improve sensory processing and neurological function (Hippotherapy vs. Therapeutic Riding, n.d.). Proponents emphasize that hippotherapy is not a leisure activity, but a clinician-based rehabilitative treatment (Debuse, Gibb & Chandler, 2009).

Therapeutic riding, as opposed to hippotherapy, is usually recommended for less severe cases of mental or physical disabilities (Hippotherapy vs. Therapeutic Riding, n.d.). It offers a fun activity that also provides the benefit of social interaction while possibly simultaneously strengthening the participant. One study conducted on therapeutic horseback riding analyzed the quality of life, health status and gross motor function of children with cerebral palsy (Davis, Davies, Wolfe, Raadsveld, Heine, Thomason, Dobson & Graham, 2009) and failed to support that form of EAT. Davis et al. (2009) randomly assigned 99 children with cerebral palsy who were between the ages of four and twelve into control and experimental groups. Quality of life was determined by the Cerebral Palsy Quality of Life--Child Kidscreen. Health status was determined by the Child Health Questionnaire, and gross motor skills were determined by the Gross Motor Function Measure. Each measure was taken before and after the ten-week study. The results from this study suggested that there was not a significant difference between the control and experimental groups when pre and post therapy results were examined (Davis, et. al., 2009).

Differences in practitioner requirements between therapeutic riding and hippotherapy may be the reason why no significant improvement was found. As mentioned before, a clinician certified in hippotherapy must have a degree in physical therapy, occupational therapy, or speech therapy, where as a therapeutic riding instructor can come from any educational background as long as they are certified by NARHA.
The clinician’s knowledge of the physiology of the human body and of how the horse’s movements affect different systems may be an underlying reason that the limited research on hippotherapy suggests its greater promise as an adjunctive therapy.

Before a horse can be considered for any form of EAT, it must usually be screened using a tool, such as the Equine Movement Performance Instrument (Spink, 1993), then undergo desensitization training. Therapy horses are selected based on their size and conformation, where conformation refers to the anatomical structure of the horse. The size and conformation of a horse will influence its gait, which should be “forward, relaxed, straight and pure… (Spink, 1993).” Temperament is also an extremely important factor because calm and relaxed horses are usually best.

A key to hippotherapy is the horse’s movement and the position of the client on the horse. By sitting astride the horse, an individual’s pelvis and trunk are passively influenced by the horse’s rhythmic movements (Lechner, Kakebeeke, Hegemann & Baumberger, 2007). These movements affect multiple systems including, “sensory, muscular, skeletal, limbic vestibular, and ocular.” Hippotherapy has a direct influence on posture, because the client must continually adjust to the horse’s movements, using feedback, feed-forward postural control. It is believed that postural control is the base from which gross motor skills develop (Casady & Nichols-Larsen, 2004). Hippotherapy is also believed to affect people who suffer from psychiatric disabilities by promoting better self-esteem and self-efficacy (Håkanson, et. al, 2009).

Past research involving hippotherapy is primarily focused in the discipline of physical therapy. To date, hippotherapy research concerning the field of speech pathology is extremely limited. The majority of studies conducted thus far involve
gathering results via questionnaire or observation. Consequently, there are very little objective data from which to draw conclusions about hippotherapy’s effects on speech and language disorders. This project is one of the first to focus on objective measurements, and will therefore provide a more credible information base from which further research can be built.

One study in the field of speech pathology that did consider objective measurements was conducted in Brazil in 2006 by Nobrega de Melo and Cruz de Lucerna. This study examined outcomes related to eight weeks of hippotherapy in seven children between the ages of four and eight years old with spastic tetraparesis cerebral palsy. This study set out to measure the effects of hippotherapy on the respiratory system and oral motor skills of children within this population. Procedures employed by this study included measuring the diadochokinesis task of repeating /pataka/. The vital capacity of speech was measured by determining average durations for the vowels /a/, /i/, and /u/, and the consonants /s/ and /z/. The researchers also used sentence imitation to determine the participants’ phonation coordination.

Results from this study (Nobrega de Melo & Cruz de Lucerna, 2007) suggest that hippotherapy improved the oral motor function in the participants, who noted respiratory benefits as well. It is believed that these improvements occurred due to the three-dimensional movements impacted on the individual by the horse’s gait. The rider’s position on the horse while it is moving aligns the hyoid muscle, shoulder girdle, and pelvic girdle. Control over the hyoid muscle can promote breath, head and neck control. Maintaining control over the shoulder girdle can improve oral control and strengthening
the pelvic girdle increases balance of the thoracic muscles which in turn promotes better breath control (Nobrega de Melo & Cruz de Lucerna, 2007).

Preliminary studies using questionnaires have indirectly suggested the value of the current project by supporting the use of hippotherapy for individuals with speech-language difficulties. For example, one study involving children with language-learning disabilities investigated the effects of hippotherapy via questionnaire (Macauley & Gutierrez, 2004). In this study, three boys participated in two one-hour long sessions of traditional speech therapy every week for six weeks. One participant was nine years old, another ten, and the other twelve. Each of the boys was diagnosed with a language learning disability and had participated in traditional speech therapy since the age of five. At the conclusion of this six-week session, the children and their guardians completed separate questionnaires relating to speech and language abilities, motivation to attend sessions, and self concept. After a break for winter, the same children participated in six weeks of hippotherapy, also consisting of hour-long sessions twice a week. The same questionnaires were completed at the conclusion of the hippotherapy. Results suggested that hippotherapy improved the children’s speech and language skills, increased their motivation to attend therapy sessions, and improved their self concepts. Based on their responses to the questionnaires, it appeared that the guardians believed that hippotherapy was more effective than traditional therapy for these children. The children indicated in their responses that they felt hippotherapy and traditional therapy were of equal benefit. (Macauley & Gutierrez, 2004). The participant in this research will complete a questionnaire utilized in Macauley and Gutierrez’s study, to see if the results obtained coincide with the results gathered by this previous study.
The results from this study may have occurred due to the fact that traditional speech therapy took place before the hippotherapy, or because hippotherapy was the last method to be tested, and thus more memorable. An alternative for improving this study would be to have a control group receiving traditional speech therapy and an experimental group receiving hippotherapy at the same time. After so long, these groups could be switched, and any changes in progress could be documented.

Previous studies have also considered the effects of hippotherapy on physical and psychosocial benefits. These studies discovered hippotherapy improved muscle symmetry, postural alignment, facilitated normal movement and walking, and improved respiratory and motor control of speech. Psychosocial benefits included improved self-concept, locus of control, emotional state, and mood along with better behavior (Macauley & Gutierrez, 2004).

In 2004, Renee Casady, (personal communication, October 2009) completed a Masters thesis in physical therapy on hippotherapy. In that study she set out to determine the effect of hippotherapy on the general functional development of children with cerebral palsy. Ten children between the ages of 2.3 to 6.8 years participated in this study. Casady used the Pediatric Evaluation of Disability Inventory (PEDI) test as part of her study to measure functional and social skills as well as mobility in the ten participants. This study involved measurements with the PEDI before, during and after a ten week course of hippotherapy. Hippotherapy was conducted for each participant once a week for the ten weeks. During and after hippotherapy sessions, Casady reported higher social scores on the PEDI. One of her participants in this project also learned how to use
an augmentative device to cue the horse to begin walking from a stopped position (Casady & Nichols-Larsen, 2004).

A case study conducted by Lehrman and Ross (2001) involving a nine year old student with multiple disabilities and visual impairments also yielded results suggesting improvements in speech and language in association with hippotherapy. Prior to a ten week hippotherapy session, the participant, “seldom made verbal sounds, used a few functional signs, had moderate mental retardation, and had spatiality of the legs with limited coordination in the trunk and neck” (Lehrman & Ross, p. 108). This background information was gathered through an interview with the participant’s mother and observation. After hippotherapy treatment, this individual showed an increase in verbal communication and had acquired new functional signs, although the study does not state how many. Other positive outcomes for this participant included gaining the ability to walk short distances unassisted and an increase in visual attention span (Lehrman & Ross, 2001).

Developmental dysarthria (DD), the focus of this study, is a disorder commonly found in individuals with cerebral palsy (Hodge, in press), where dysarthria refers to the impaired speech movements resulting from damaged neuromuscular pathways. These neurological impairments can lead to delayed acquisition of speech as well as reduced coordination of muscles and lack of muscular support for proper phonation and articulation. Individuals suffering from DD may exhibit a lack of gross and fine motor skills due to impaired neuromuscular control (Hodge, in press). Because of developmental dysarthria’s effects on respiratory and motor control and hippotherapy’s effects on postural alignment as well as respiratory and motor control of speech, it is
believed that hippotherapy will increase the participant’s respiratory strength, ability to achieve stronger phonation levels thus promoting better control over pitch, and will consequently extend the length of utterances the participant is able to produce, an outcome with linguistic implications. The results from this study will determine if hippotherapy is an effective treatment strategy in improving physiological and linguistic outcomes associated with this type of communication disorder. In addition, a questionnaire will be administered to the participant before beginning hippotherapy and after the four week sessions. The questionnaire will be taken from a previous study conducted by Macauley and Gutierrez in 2004.

**Method**

**Design**

This study was initially designed as a single case experiment concerned with pre and post experimental measures (Barlow, Nock, & Hersen, 2009). Because it has not yet been conducted using this design, this method section will use the future tense predominantly. Physiologic and linguistic measurements will be collected both before and after each of the four individual therapy sessions. Data will also be gathered via questionnaire before the four sessions of hippotherapy begin. The same questionnaire will be administered after the four sessions of hippotherapy have been completed.

**Participant Recruitment and Characteristics**

This study is designed to involve one participant between the ages of six and seventeen who is suffering from developmental dysarthria. This was a single case study because time constraints on this project prohibited the recruitment, assessment and administration of hippotherapy for multiple participants. This participant will never have
participated in hippotherapy or therapeutic riding before. Recruitment for individuals interested in this study was conducted by personnel associated with Nationwide Children’s Hospital in Columbus, Ohio, as well as a local speech language pathologist in Galena, Ohio.

**Procedures**

Renee Casady, a licensed physical therapist board certified in hippotherapy with the American Hippotherapy Association will be conducting the therapy sessions at White Pine Stables Therapeutic Riding Center. This facility is located in Galena, Ohio and is registered with the North American Riding for the Handicapped Association. Christy Richmond, a NARHA certified instructor, is the director of this facility. Consequently, the conditions required for sanctioned hippotherapy could be met by this team.

The plan entails four weeks of hippotherapy to occur in an indoor arena between the months of April and May, with one session taking place a week. Each session requires twenty minutes (plus or minus five minutes) of the client on the horse’s back. Measures of respiratory strength, phonation, and the linguistic outcomes of mean utterance length will be made for both pre and post therapy sessions in a room adjacent to the arena. Although the twenty minute therapy session will be conducted by Ms. Casady, Ms. Richmond will determine the horse best suited for the participant, as determined by its gait and girth size.

For the therapy sessions, the horse will be led by a “leader,” while Ms. Casady conducts the therapy. The techniques used within the therapy will depend on the individual participating. The participant will have two “sidewalkers,” which are individuals on both sides of the horse to ensure safety if he or she would become off
balance or if the horse would shy. The participant will also be required to wear a riding helmet as a safety measure.

**Measurement and Instrumentation**

Dependent measures to be examined in this study are respiratory strength, phonation levels as well as the linguistic outcomes of mean utterance length of one participant with developmental dysarthria. Respiratory strength will be determined through the use of a peak-flow meter. Peak flow meters are often used by asthmatics to help determine environments that may trigger an asthma attack or to simply see if their medication is working. These are hand-held, tube shaped devices that measure the peak expiratory flow, or PEF, in liters per minute. To use a peak flow meter, an individual inhales deeply and then forcefully exhales into the tube while sitting in an upright position. This exercise is repeated three times, with the highest measurement noting the individual’s PEF (Asthma and the Peak Flow Meter, n.d.). This process will be utilized in this study, and measurements from this appliance will determine the strength of the participant’s exhalation.

To determine intensity levels of phonation and linguistic outcomes, the computer program Praat (Boersma & Weenink, 2007) will be utilized. To obtain a speech-language sample for analysis immediately before and after treatment sessions, the participant will wear a headset with an attached microphone that is connected to a portable laptop computer via a cord. This measurement, along with all other measurements in this study, will be conducted off of horseback in a room adjacent to the indoor arena where the therapy is set to occur. The headset microphone attached to the laptop will allow the participant’s speech to be directly recorded into the Praat program.
Praat will convert the child’s recorded speech into spectrograms, which are images of acoustic intensity. An example of a spectrogram has been included in Figure 1, titled *Spectrogram including intensity measure*. This example shows the display associated with the student researcher saying the phrase “I love hippotherapy.” The top of the image is a waveform, whereas the bottom represents the spectrogram. The yellow line running through the bottom image traces the intensity of speech throughout this phrase.

Praat can then be used to measure the different intensity levels of the words spoken. For the linguistic outcomes, the child will be encouraged to engage in a conversation with the student researcher, and Praat will be used to measure the length of each phrase as well as count the number of morphemes included in each utterance. A list of common questions will be used to encourage the child to talk during this time of ten or so minutes. An example of a list of these questions has been included at the conclusion of this document in *Appendix*, under the title *Examples of conversational questions*. By recording measures in this type of environment, the child’s mean utterance length in normal conversation can better be determined.

Efforts will be made to minimize bias in the collection of measurements. The information collected within the computer program will be coded so that pre-versus post-session status of the sample will be hidden to prevent interpretations of the data from being affected by preconceived notions.

**Internal Validity**

Efforts to increase the consistency and accuracy of measurements can be used to help promote internal validity. Each measurement will be taken using the same equipment every time. Because only one individual will participate, the headset with the
microphone used for collecting intensity of phonation levels and linguistic outcomes will be set in a fixed position best for that child, and not adjusted throughout the duration of this study. Also, all measurements will occur in the same room adjacent to the arena to prevent the distraction of a new environment during administration.

The effects of maturation, testing, history and selection bias are a few of many concerns in treatment studies (Campbell & Stanley, 1963). However, this study is not primarily concerned with effects over the entire course of the four week treatment. Its primary focus is to see if the measures taken immediately after the therapy session have changed or improved from those taken immediately before. Also, the four week span of this study does not allow much time for the physical and mental maturation of the participant.

Although history and selection bias represent unavoidable threats to internal validity in case studies, the careful description of the participant’s current characteristics and previous intervention experiences are designed to minimize the impact of such threats on conclusions advanced from the study data. Prior to beginning hippotherapy, a “trial-run” of the data collection techniques will be administered to help familiarize the participant with the procedures. It is expected that this will minimize any risk of unsound data collected.

**Results**

A qualified participant, as determined by criteria set forth by this study, was unable to be recruited within the time constraints for the student researcher. Recruitment began on April 13, 2010 when IRB approval was obtained. Four interested parties contacted the student researcher, and interviews were conducted via phone and/or e-mail.
Information on each interested participant and reasons for exclusion from this study can be noted in Table 1, titled *Interested Participants*.

The methods for testing respiratory strength through the use of a peak flow meter have been tested on a child who was participating in therapeutic horseback riding. No data were collected because of the very informal nature of this pilot, and because this study’s focus is hippotherapy rather than therapeutic riding. However, it is believed that respiratory strength will decrease from the pre to post therapy session measurements as a result of muscle fatigue. It is also hypothesized that gradually over several weeks of hippotherapy, these numbers should increase due to the strengthening of the muscles responsible for respiration. Hypothesized data for respiratory strength has been included in Figure 2, titled *Hypothesized measures of respiratory strength*. The total amount of time necessary to inform the participant of how to properly use the peak flow meter and to try three attempts at measurement took no more than 7-10 minutes.

**Discussion**

Although this study was not completed as planned due to the inability to recruit a participant in time for completion, some of the methods of collecting the data have been tested and found to work well on an individual participating in therapeutic riding. It is with hope that this study can be pursued and possibly expanded in the future. Studies of hippotherapy have suggested its promise, yet substantial evidence is needed to support its validity. Using studies similar to the one described in this document, especially because of its focus on the use of objective measures, future research will help determine the benefits of hippotherapy as an adjunctive therapy to traditional speech pathology methods.
Figure 1: **Spectrogram including intensity measure.**
Figure 2: Hypothesized measures of respiratory strength
**Table 1**

*Interested Participants*

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<th>Interested Party</th>
<th>Date of Contact</th>
<th>Background Information</th>
<th>Reason for Exclusion</th>
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<td>Speaks in 2-3 word phrases</td>
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Appendix

Examples of conversational questions

Tell me about your day at school today.

What did you learn?

What is your favorite subject?

What kinds of activities do you do in that class?

Do you have a favorite color?

What kinds of things are that color?

What is your favorite game to play?

Why do you like to play that game?

Can you tell me about your family?

Do you have a favorite sport?

Why is that your favorite sport?

What kind of pets do you have?

How do you feel about riding a horse?
References


Poster session presented at the annual meeting of the American Hippotherapy Association, Atlanta, GA.