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Effects of Hippotherapy on Coordination of Speech in a Person with Traumatic Brain Injury

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Abstract

Hippotherapy occurs when physical therapists, occupational therapists, and speech-language pathologists use the movement of a horse as a treatment strategy. Previous research has documented improvements in gross motor function such as walking, reaching, standing, balance, and trunk control following treatment that incorporates hippotherapy. However, no study to date has investigated the effect of hippotherapy on fine motor control functions such as speech. The purpose of the study was to complete a pilot investigation of the effects of hippotherapy on speech motor control in one person with traumatic brain injury. The treatment records of a 24 year-old woman with TBI who received speech therapy using hippotherapy were reviewed and the speech motor control data from ten sessions was extrapolated. Results indicated immediate improvement in speech motor control with continued improvement through session ten.

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Introduction

It has been established that animals can greatly improve the lives of people with and without disabilities. This can be accomplished by having a pet, or more formally, via Animal-Assisted Therapy and Animal-Assisted Activities. Animal-Assisted Activities can be done by anyone with special training and is not unique to the client. It essentially involves the animal and a handler visiting patients to improve their quality of life. Animal-Assisted Therapy however, is a goal-driven intervention led by a licensed therapist. It is "designed to promote improvement in human physical, social, emotional, and/or cognitive functioning" (Animal-Assisted Activities/Therapy 101, 2012). Pet Partners, the nation's largest nonprofit organization providing animal-assisted interactions, allows the following animals to be eligible for registration: dogs, cats, guinea pigs, rabbits, domesticated rats, horses, donkeys, llamas, alpacas, pot-bellied pigs, and birds. (Animal-Assisted Activities/Therapy 101, 2012). Hippotherapy is a specific type of animal assisted therapy that utilizes horses for therapy. Sessions are conducted by physical and occupational therapists and speech language pathologists. These professionals utilize this treatment strategy to "achieve pre-set functional outcomes for their clients" (Learn about EAAT, 2015).

Hippotherapy is unique because horses are prey animals and are extremely sensitive to the environment (Ohrynowicz, 2007). Hippotherapy (hippos is Latin for horse) can date back to the age of Hippocrates in ancient Greece. He wrote a chapter on "Natural Exercise," mentioning horse riding (Benjamin, 2000). Hippotherapy has grown quite a bit as a field since the time of Hippocrates, to now being practiced in 48 countries, with more than 650 therapeutic riding centers throughout North America alone (Ohrynowicz, 2007). It gained international recognition when Liz Hartel used riding to help her recover from poliomyelitis. She subsequently went on to win a silver medal in the 1952 Helsinki Olympics for dressage (Benjamin, 2000). In the 1970's the US physical therapists began to develop treatment uses for the movement of the horse. However, it wasn't until 1987 when a team of United States and Canadian physical therapists went to Germany to study hippotherapy and develop a standardized curriculum that hippotherapy as a discipline began to be studied in the United States (Benjamin, 2000). A few years later, the American Hippotherapy Association formed in 1992. Today, empirical evidence for hippotherapy is growing rapidly, but more research is needed.

Hippotherapy occurs when licensed physical, occupational, and speech-language pathologists utilize equine movement to improve patient function (Heine & Benjamin, 2000). It is part of an integrated treatment plan based on the therapist's evaluation and the functional goals of the patient. It is a dynamic systems theory, which takes the approach of the whole system of the patient based on the work of Lewis in 2000. The application of the dynamic systems theory to hippotherapy is based on the similarities in gait between horse and human (see Figure 1). The walking horse provides rhythmic, repetitive movements similar to human walking which can give training opportunities to improve posture, balance, and strength (Kim & Lee, 2014) When a patient with motor deficits is placed astride a correctly moving horse, the motor influence of the walking horse affects the patient in a therapeutic way. The horse's center of gravity is displaced in three dimensions, and the repetitive pattern of movement is transmitted to the patient. The walking horse passively moves a patient's pelvis with motions similar to those required for walking, thus producing perturbations to a patient's center of gravity in all directions, while also introducing visual stimuli (Silkwood-Sherer, 2012). The patient reacts to the multidimensional, dynamic input of the horse's movement, including tactile, proprioceptive, and vestibular stimuli. These stimuli address musculoskeletal, motor, and sensory processing factors of the patient's whole system (Macauley, 2007).

Hippotherapy is used within the fields of Physical Therapy, Occupational Therapy and Speech Language Pathology for the treatment of persons with movement disorders stemming from a variety of conditions, including cerebral palsy, Down syndrome, stroke, and traumatic brain injury. Previous research has found evidence of improvements in factors related to balance, which include posture while standing, the symmetry of the trunk and upper-leg muscles during standing and walking, dynamic head and trunk stability, and reaching skills. Hippotherapy also causes decreased energy expenditure during walking and improved function (Silkwood-Sherer, 2012). It has also been shown to normalize muscle tone; increased strength and coordination; and improve spatial orientation, corrective reflexes, and equilibrium (Macauley, 2007). Hippotherapy has also been shown to improve posture, range of motion, hip adduction, gait, muscle tone, and motor coordination (Macauley, 2007). Hippotherapy increases step length and decreases step time, both of which are associated with decreased risk of falls and improved balance (Kim & Lee, 2014). All of these effects of Hippotherapy (equine movement in treatment) are on the gross motor system. Less research has been conducted on the effects of Hippotherapy on fine motor systems, such as speech articulation. However, the same neurological system is used in both. Therefore, more research is needed into how Hippotherapy affects patients with both fine and gross motor impairments, such as what occurs with Traumatic

Brain Injuries. Persons with Traumatic Brain Injuries are one population of patients with both gross and fine motor coordination problems.

Traumatic Brain Injuries (TBI) are a form of injury in which there is mild to severe damage to the brain following a sudden injury (Traumatic Brain Injury, 2015). Normal functioning of the brain is disrupted with a TBI (Traumatic brain injury: fact sheet, 2014). The consequences of these brain injuries could possibly include “physical, sensory, cognitive-communication, swallowing, and behavioral issues”. Each year in the United States, 1.7 million people sustain a TBI. (Traumatic Brain Injury, 2015). In general, males are more likely to suffer from a TBI than females. The most likely age groups to suffer are 0 to 4, 15 to 19, and adults over the age of 65 (Traumatic brain injury: fact sheet, 2014). Traumatic Brain Injury is the leading cause of worldwide disability, and as researcher McNamee,Walker, Cifu, and Wehman said, they “have a predilection to disrupt young people on the verge of their most productive years” (2009). Previous research has also stated that TBI can have “devastating effects on the speech system” (Kuruvilla, Murdoch, & Goozee, 2007) and that deficits in fine motor skills, such as speech, are likely to persist after the injury (McNamee, Walker, Cifu, & Wehman, 2009).

Communication issues that may persist following a TBI could include apraxia, aphasia, and dysarthria (Dysarthria, 2015). The focus of our research project will be dysarthria, as this condition is “one of the most unrelenting consequences of traumatic brain injury, occurring in approximately one-third of individuals with TBI five years post-injury” (Guo & Togher, 2008). Dysarthria is a motor speech disorder in which there are difficulties fine motor coordination of speech. The patient may have “trouble controlling his or her mouth and throat in order to form clear speech." A person with dysarthria may present with various symptoms, such as slurred or mumbled speech, an unusual rate or loudness, or may sound breathy or horse. (Dysarthria (the basics), 2015).

Living with dysarthria post-TBI can have detrimental effects on a patient's life. Everything from personal relationships to job opportunities can be affected. Considering the most common ages that people sustain TBIs, a child may lose the chance to ever communicate normally, or an older adult may lose an ability they have always had. The benefits of improving dysarthria in patients with TBI are invaluable. Through hippotherapy, this may be possible. It is has been shown by other disciplines that hippotherapy improves gross motor function, yet as previously discussed, no research has been published on equine movements' effect on fine motor function, such as speech. The purpose of the present study is to examine the effects of Hippotherapy on the fine motor coordination of speech in persons with TBI.

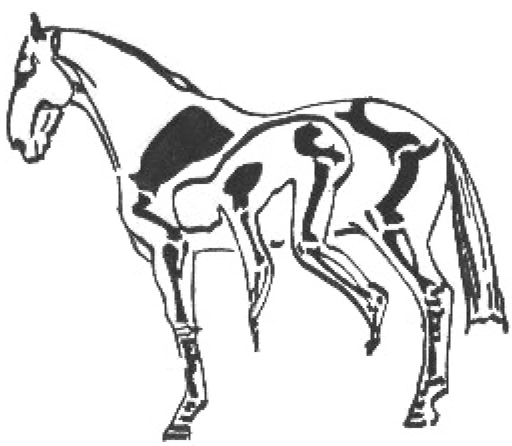

Figure 1. Similarities in anatomy and gait between horse and human.

Methods

The speech coordination measures were extracted from the de-identified speech therapy treatment notes of a 24 year old woman who had sustained a traumatic brain injury and was receiving speech therapy/hippotherapy under a speech-language pathologist who had board certification in hippotherapy. Specifically, the speech coordination measures consisted of diadokokinetic rates (alternating movement rates) for the syllables /pa/, /ta/, /ka/, and /pataka/ which had been documented at the beginning and end of each session as a measure of progress toward the speech therapy goal of increased intelligibility. Additional data from the files consisted of documentation of length of sustained /ah/. This data was analyzed and revealed an increase in respiratory support for speech following the treatment sessions as well.

The speech coordination measures were then plotted on a graph and statistically analyzed using Pearson correlation coefficients.

Results

Day	Pa Pre	Pa Post	Ta Pre	Ta Post	Ka Pre	Ka Post	PaTaKa Pre	PaTaKa Post	Ahh Pre	Ahh Post
1	3.8	2.4	3.3	2.8	3.5	3.4	5.8	4.9	5.7	10.3
2	3.4	2.7	3.5	2.6	3.5	3.5	5.4	4.3	14.8	15.1
3	2.6	2.4	3.0	2.4	4.5	3.9	5.4	4.9	16.1	13.9
4	3.3	2.9	2.8	2.5	3.2	3.0	5.3	4.4	10.1	11.3
5	2.3	2.2	2.6	2.4	3.7	3.4	5.7	4.5	15.4	13.5
6	2.1	2.0	2.1	2.3	2.9	3.0	5.9	4.4	16.1	12.3
7	2.0	1.5	2.0	1.5	2.2	2.1	4.9	3.1	14.6	20.1
8	2.1	1.5	2.1	1.7	2.4	2.0	4.5	3.8	25.0	19.5
9	2.2	1.5	2.2	1.9	2.9	2.4	4.5	3.5	15.8	16.5
10	1.9	1.6	1.8	1.6	2.4	2.1	3.9	3.5	23.1	21.0

Table 1. Diadochokinetic rate in seconds as well as time of sustained /ah/ in seconds.

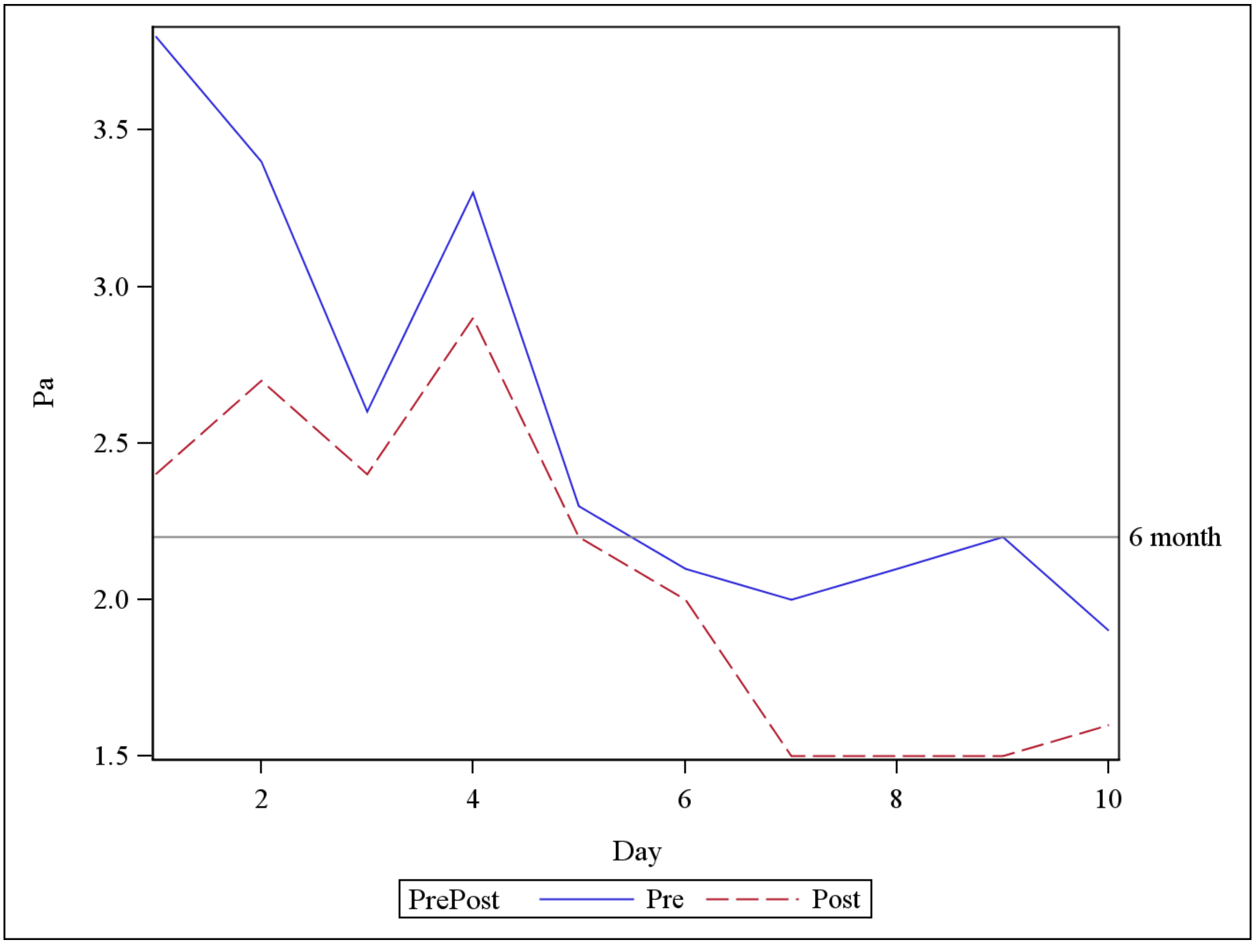

Figure 2. /Pa/ pre and post-hippotherapy measures.

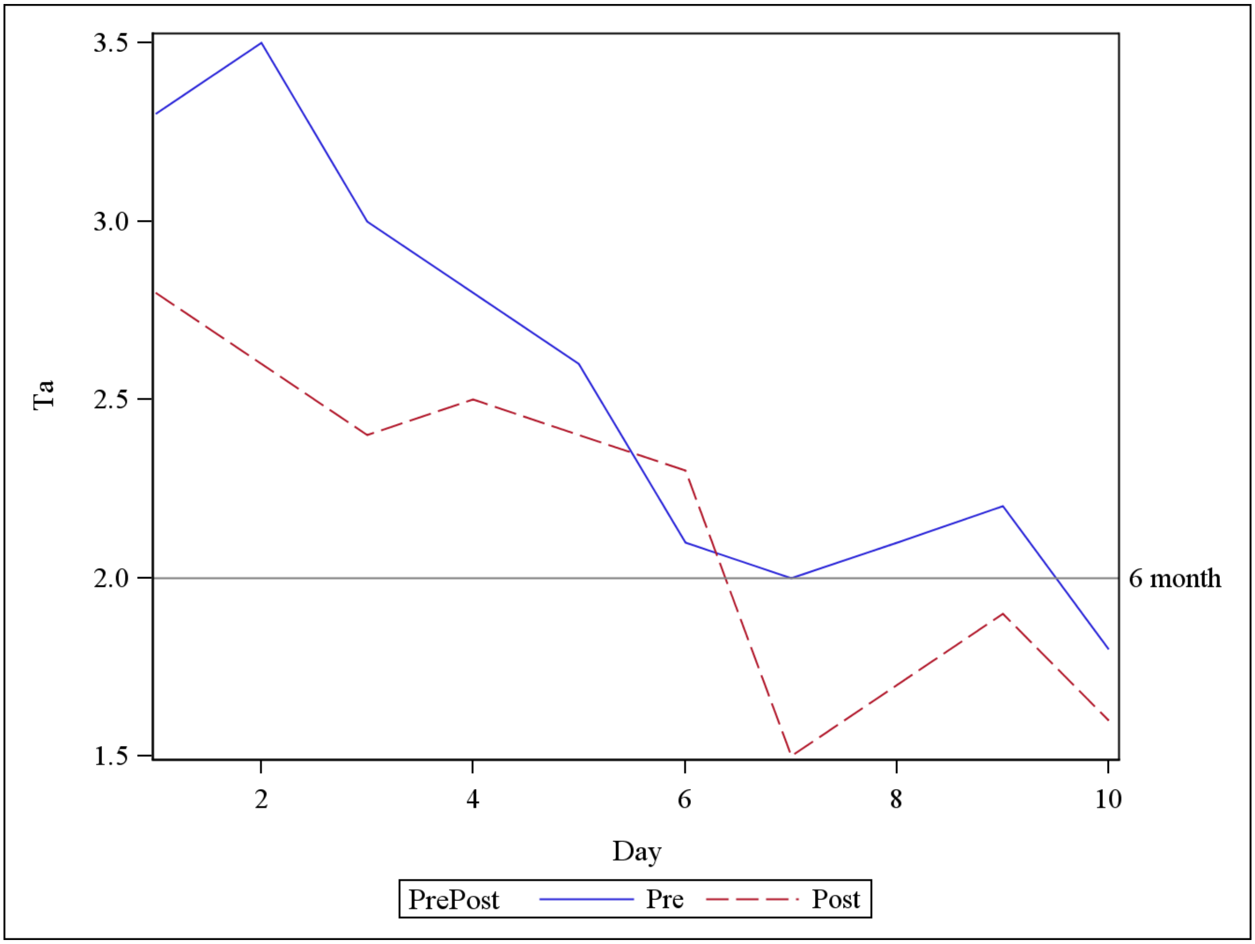

Figure 3. /Ta/ pre and post-hippotherapy measures.

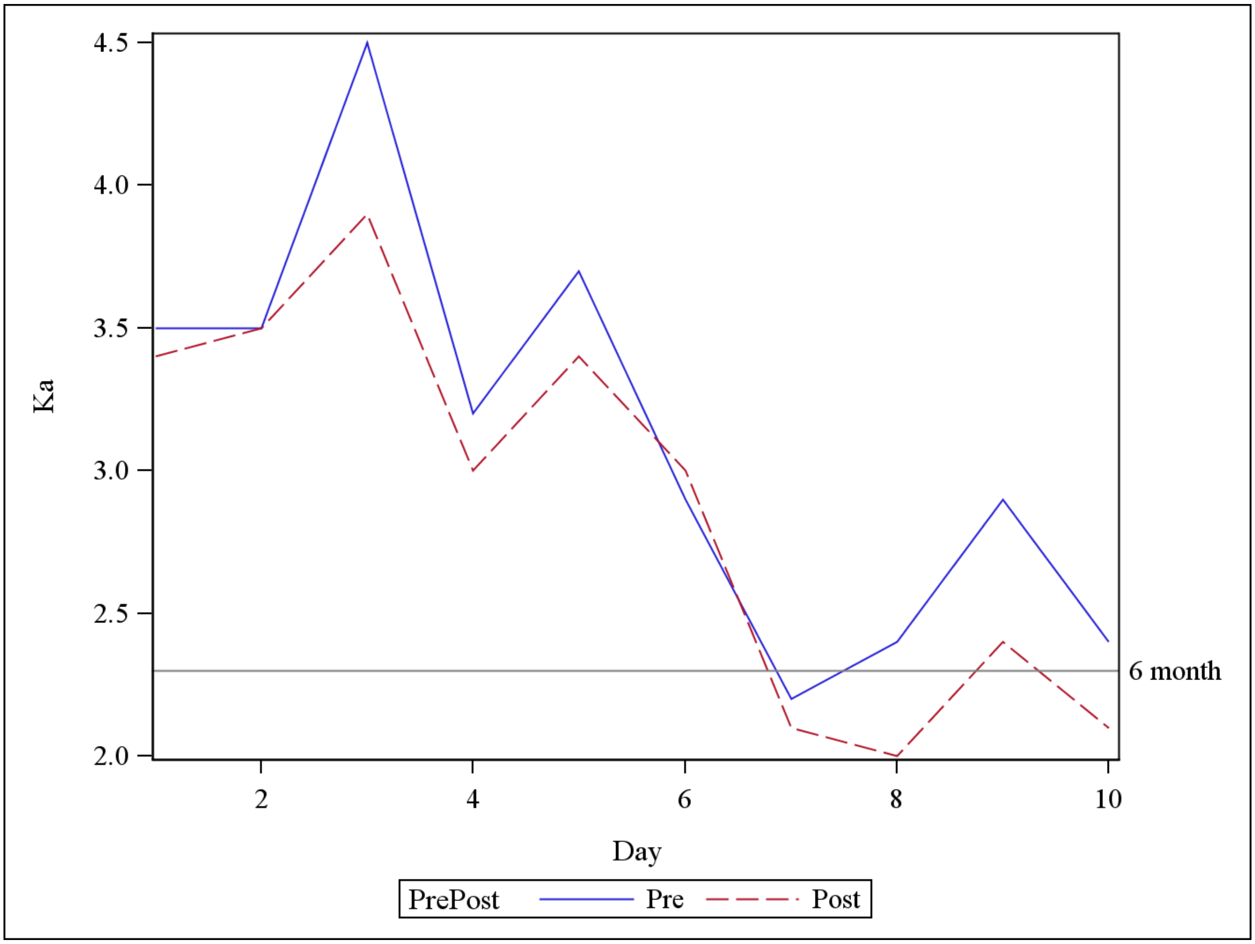

Figure 4. /Ka/ pre and post-hippotherapy measures.

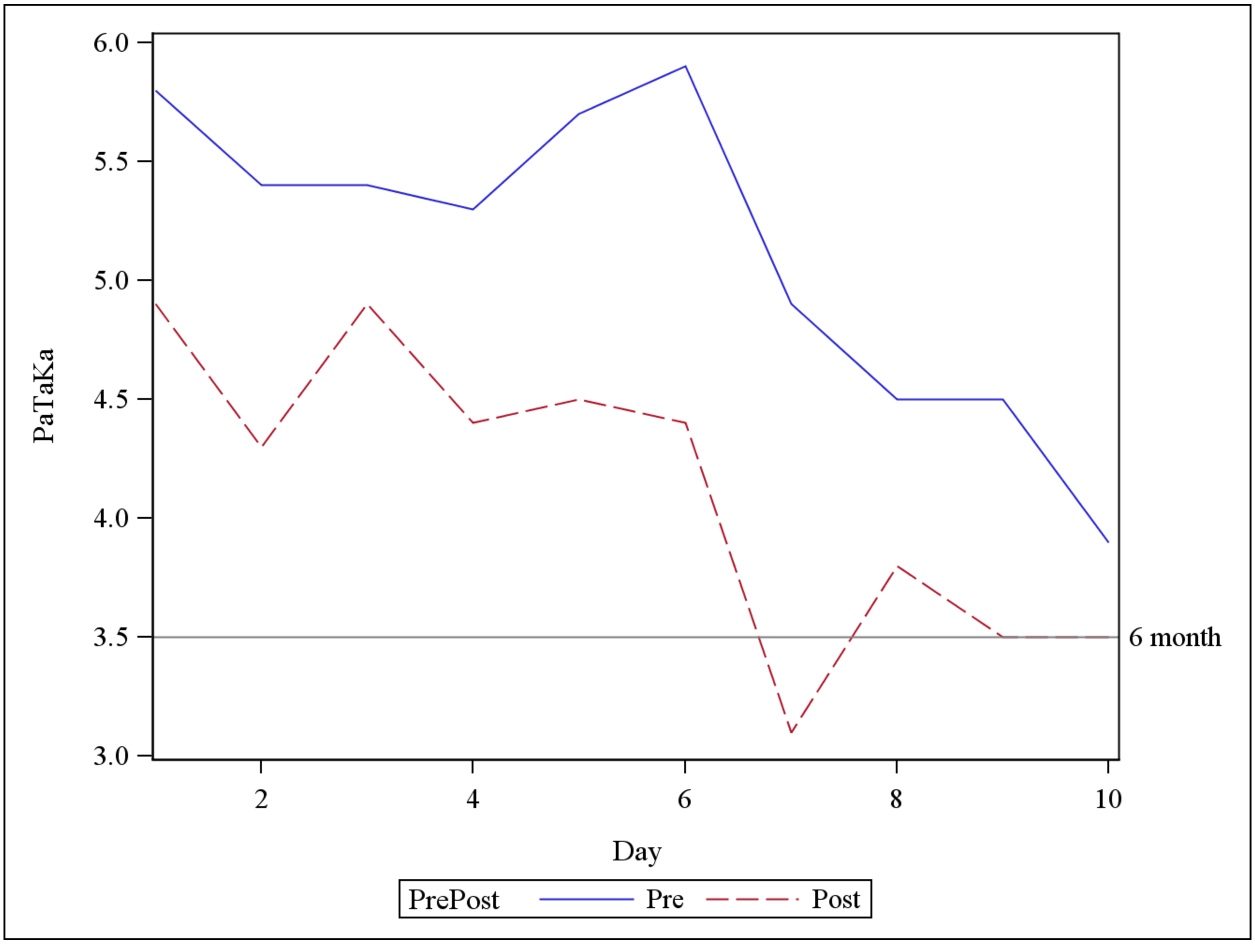

Figure 5. /Pataka/ pre and post-hippotherapy measures.

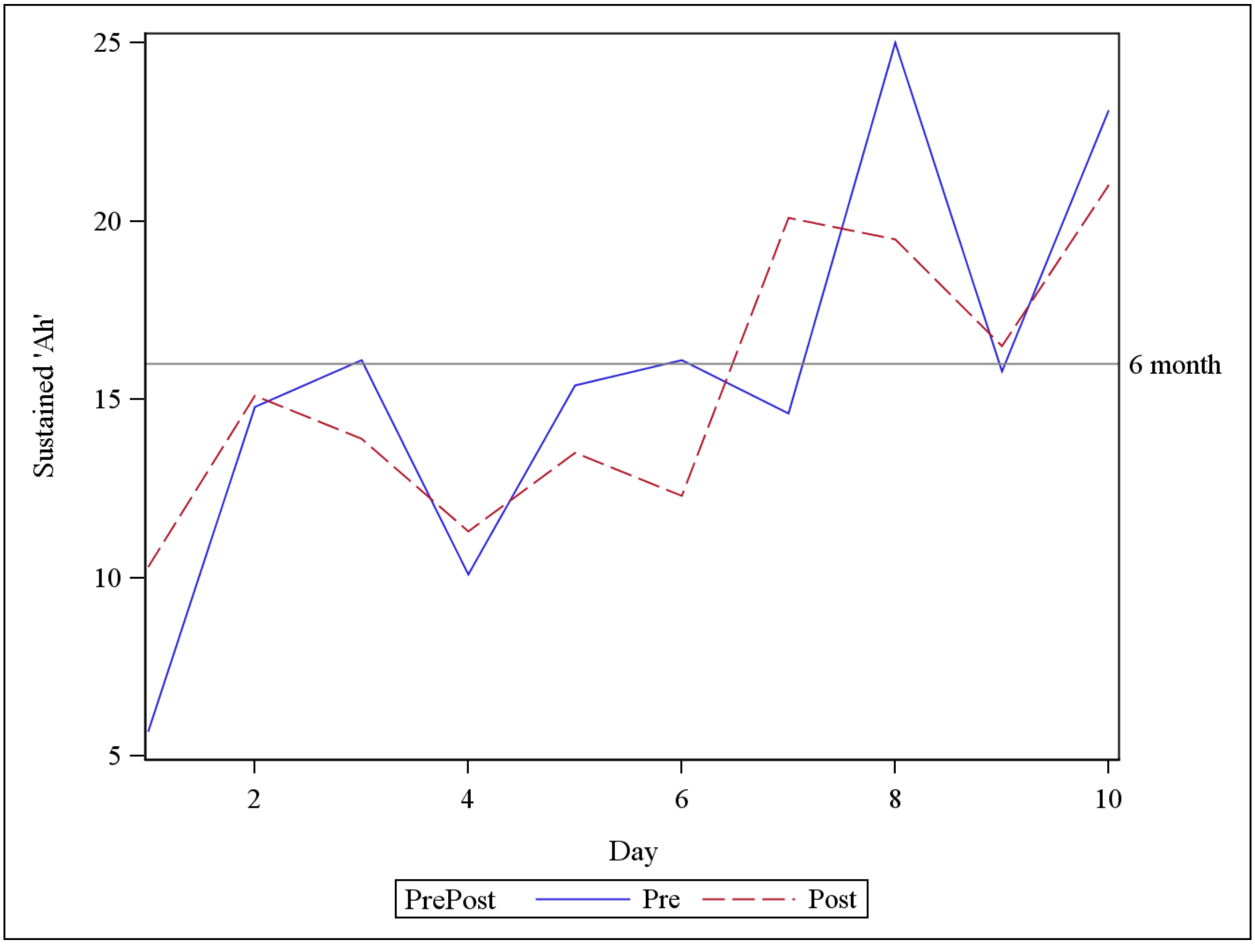

Figure 6. Sustained /Ah/ pre and post-hippotherapy measures.

Pearson Correlation Coefficients, N = 10 Prob > |r| under H0: Rho=0										
	Pa Pre	Pa Post	Ta Pre	Ta Post	Ka Pre	Ka Post	PaTaKa Pre	PaTaKa Post	Ah Pre	Ah Post
Day	-0.86626 0.0012	-0.84942 0.0019	-0.93435 <.0001	-0.89506 0.0005	-0.73567 0.0153	-0.85791 0.0015	-0.80548 0.0049	-0.81964 0.0037	0.73788 0.0148	0.76963 0.0092

Table 2. Correlation coefficients for figures 2 through 6.

Statistical analyses were conducted using SAS. The correlation coefficients for each objective measure of articulation, /pa/, /ta/, /ka/, /pataka/, and sustained /ah/ were obtained. The result for /pa/ pre-hippotherapy was -0.87 which indicated a strong negative correlation. The result for /ta/ pre-hippotherapy was -0.93 which indicated a strong negative correlation. The result for /ka/ pre-hippotherapy was -0.74 which indicated a negative correlation. The result for /pataka/ pre-hippotherapy was -0.80 which indicated a strong negative correlation. The result for sustained /ah/ pre-hippotherapy was 0.74 which indicated a positive correlation. Overall, each pre objective measure displayed a negative correlation with the expected exception of the sustained ahh showing a positive correlation.

The result for /pa/ post-hippotherapy was -0.85 which indicated a strong negative correlation. The result for /ta/ post-hippotherapy was -0.90 which indicated a strong negative correlation. The result for /ka/ post-hippotherapy was -0.86 which indicated a strong negative correlation.The result for /pataka/ post-hippotherapy was -0.82 which indicated a strong negative correlation. The result for sustained ah post hippotherapy was 0.78 which indicated a positive correlation. Overall, each post-objective measure displayed a strong negative correlation with the expected exception of the sustained /ah/ showing a positive correlation. The measurements that were taken six months after the completion of hippotherapy display that the measurements taken at that time were lower than when treatment first began.

Discussion and Conclusion

Previous research by Shurtliff showed that Hippotherapy impacts trunk control and core muscles which are required as a foundation for speech. Conclusions from his research form the foundation for our results because a person must stabilize the trunk before using speech. Trunk stability allows the nervous system to be effective in fine motor speech.

Decreased times for speech articulation indicates a more normal sounding speech rate for persons with TBI. The subject displayed an increase in fine motor coordination. The increased time for the sustained /ah/ indicates an increase in lung capacity as indicated by statistical analysis. Hippotherapy appears to be similar to motor integration therapy in that it results in an increase in whole body neurological function (Shurtleff, Standeven, & Engsberg, 2009). Hippotherapy was an effective treatment strategy for improving the fine motor coordination required for speech. One limitation of our study was the case study design that included only one participant. Because of this, the results may not be generalizable to other persons with TBI.

References

Animal-Assisted Activities/Therapy 101. (2012, January 1). Retrieved April 16, 2015, from http://www.petpartners.org/AAA-Tinformation

Benjamin, J. (2000, January 1). Introduction to Hippotherapy. Retrieved January 11, 2015. http://www.americanhippotherapyassociation.com

Chang, H., Kwon, J., Lee, J., & Kim, Y. (2012). The Effects of Hippotherapy on Motor Function of Children with Spastic Bilateral Cerebral Palsy. *Journal of Physical Therapy Science, 24*(12), 1277-1280.

Dysarthria. (2015). In *American Speech-Language-Hearing Association*.

Dysarthria (the basics). (2015). In *UpToDate*.

Equine facilitated movement therapy strategies explained. (n.d.). In *Windy Hollow Therapeutic Riding Center*. Retrieved from http://www.windyhollow.org.za/Equine_Therapy.aspx

Guo, Y., & Togher, L. (2008). The impact of dysarthria on everyday communication after traumatic brain injury: A pilot study. *Brain Injury, 22*(1), 83-97.

Heine, B. & Benjamin, J. (2000) Therapy on horseback. Advance for Speech-Language Pathologists and Audiologists, June 26, p. 20-21

History of Hippotherapy. (n.d.). Retrieved January 11, 2015. http://www.americanhippotherapyassociation.com

Kim, S., & Lee, C. (2014). The Effects of Hippotherapy on Elderly Persons' Static Balance and Gait. *Journal of Physical Therapy Science, 26*(1), 25-27.

Kuruvilla, M., Murdoch, B., & Goozee, J. (2007). Electromagnetic articulography assessment of articulatory function in adults with dysarthria following a traumatic brain injury. *Brain Injury, 21*(6), 601-613.

Learn about EAAT (2015). In *The Professional Association of Therapeutic Horsemanship International*.

Lee, C., Kim, S., & Yong, M. (2014). Effects of Hippotherapy on Recovery of Gait and Balance Ability with Stroke. *Journal of Physical Therapy Science, 26*(2), 309-311.

Lewis MD. The promise of dynamic systems approaches for an integrated account of human development. Child Dev 2000; 71:36-43

Macauley, B. (2007). Hippotherapy Improves Respiration and Motor Speech Function. *Scientific and Educational Journal of Therapeutic Riding,* 12-30.

McNamee, S., Walker, W., Cifu, D., & Wehman, P. (2009). Minimizing the effect of TBI-related physical sequelae on vocational return. *Journal of Rehabilitation Research & Development, 46*(6), 893-908.

Ohrynowicz, E. (2007). Hippotherapy as a Treatment Strategy for Children with Communication Disorders.

Silkwood-Sherer, D., Killian, C., Long, T., & Martin, K. (2012). Hippotherapy-An Intervention to Habilitate Balance Deficits in Children with Movement Disorders: A Clinical Trial. *Physical Therapy, 92*(5), 707-717.

Shurtleff, T., Standeven, J., & Engsberg, J. (2009). Changes in Dynamic Trunk/Head Stability and Functional Reach After Hippotherapy. *Physical Medicine and Rehabilitation, 90*(7), 1185–1195-1185–1195.

Sung, Y., Kim, C., Yu, B., & Kim, K. (2013). A hippo therapy simulator is effective to shift weight bearing toward the affected side during gait in patients with stroke. *NeuroRehabilitation, 33*, 407-412.

Traumatic brain injury (TBI). (2015). In *American Speech-Language-Hearing Association*.

Traumatic brain injury in the United States: fact sheet. (2014, June 2). In *Centers for Disease Control and Prevention*.

U.S. Department of Health and Human Services. (n.d.). Get the stats on traumatic brain injury in the United States. In *Centers for Disease Control and Prevention*.