

Physical Therapy Treatments Incorporating Equine Movement: Exploring Kinetic Interactions between Children with Cerebral Palsy and the Horse

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Outline

- Cerebral Palsy (CP)
- Hippotherapy (HPOT)
- Research questions
- Method
- Results
- Conclusion

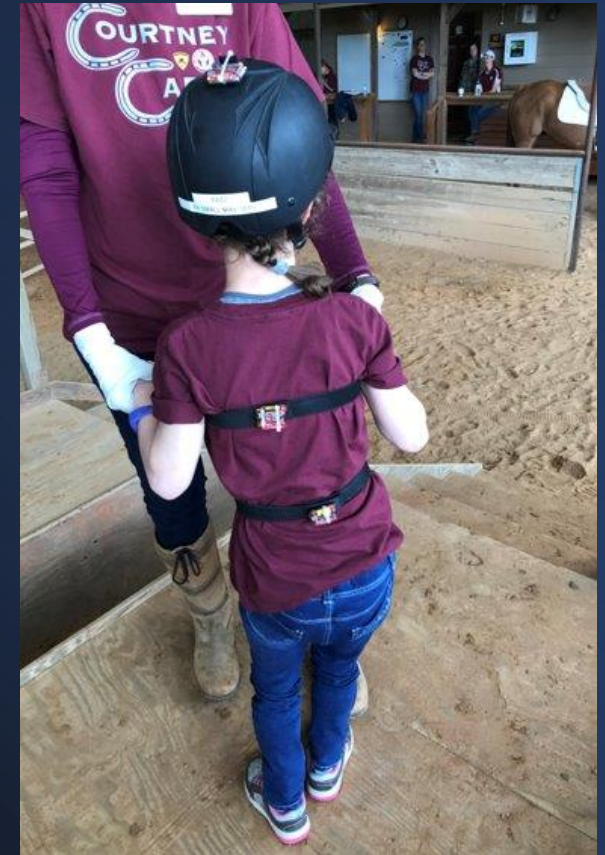
Examining the movement of the horse and the participant during a hippotherapy session

Studies have shown that incorporating equine movement into a physical therapy (PT) session can be a useful tool to treat functional mobility.

What is occurring between the equine and mounted participant? Evidence regarding the underlying mechanism is often overlooked.

Using sensors to examine kinetic variables, we investigated the response of the children with cerebral palsy (CP) to the horse's movement during PT sessions incorporating equine movement.

(Benda, et al. 2003; Bertoti, 1989; Casady & D. Nichols-Larsen, 2004; MacPhail, et al. 1988; McGibbon, et al. 1998; Shurtleff & Engsberg, 2010.)



Cerebral Palsy (CP)

- Non-progressive lesion in developing brain which affects individual's ability to move
- Most common cause of motor disability in children
- 75-81% diagnosed with spastic CP
- One clinical sign: increased tone leads to decreased function

(Graham, et al. 2004; Kirby, et al. 2011; Moreau, et al. 2016; Nasher, et al. 1983.)



What is Hippotherapy?

Hippotherapy (HPOT) per the American Hippotherapy Association:

- Physical, Occupational, or Speech therapy incorporating equine movement into a treatment session.
- American Hippotherapy Association states:
 - Evidence-based practice and clinical reasoning
 - Purposeful manipulation of equine movement as a *therapy tool* to engage sensory, neuromotor and cognitive systems to promote functional outcomes
 - Part of a plan of care for the participant
 - Equine movement is a treatment tool applied by the therapist

(American Hippotherapy Association, 2021)

Hippotherapy (HPOT)

A horse at a walk provides sensory and motor input to rider comparable to human walking.

Part of an integrated treatment plan

Specific PT goals for an HPOT session often include improving function, balance, posture to enhance functional mobility

Research Questions

Does incorporating HPOT into a PT session affect functional mobility of children with spastic CP?

How do children with CP respond to the horse's movement during an HPOT session?

To investigate, kinetic variables were tracked and analyzed.

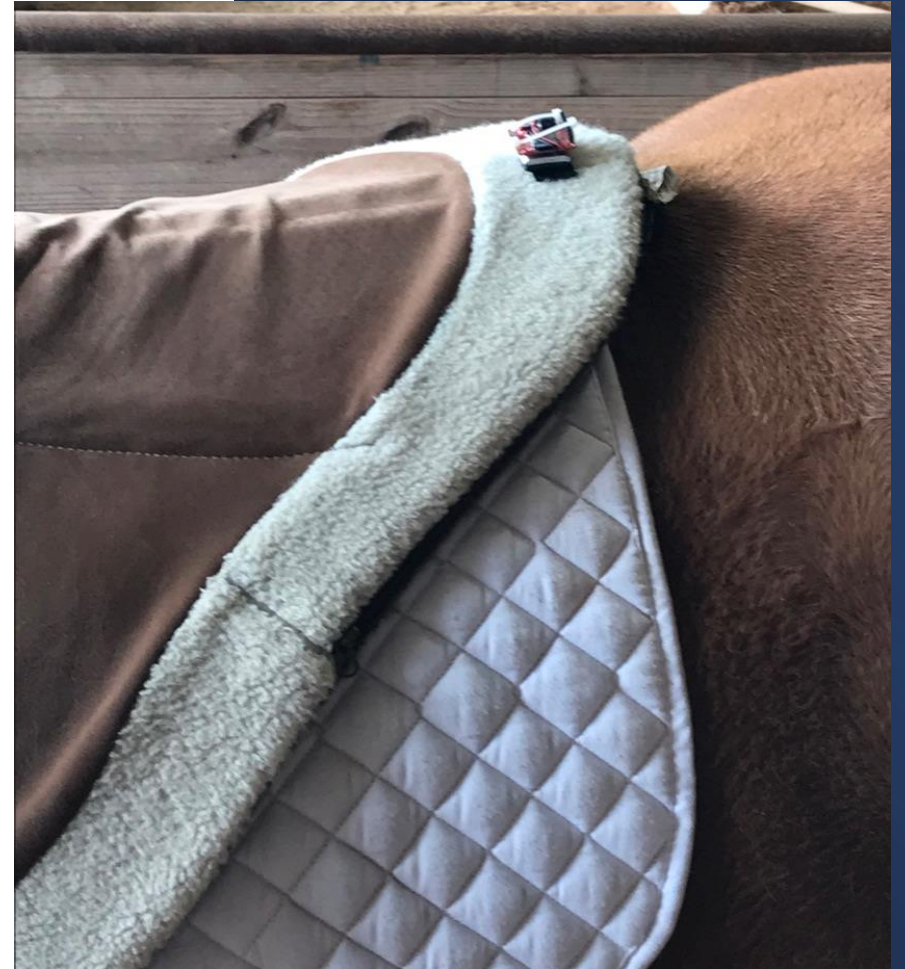
Method

- Participants
 - Children with spastic CP, aged 3-14
 - Three with hemiplegia, one with quadriplegia
- Eight 20-minute HPOT sessions
 - Steady pace, 10 minutes series of figure-of-eight
 - 2ND 10 minutes, same pattern
 - Walk-halt-walk at 1-minute intervals
- Conducted
 - PATH (Professional Association of Therapeutic Horsemanship) International Premier Accredited Centers, Texas A&M Mechanical Engineering Department and Texas A&M Parsons Mounted Cavalry
 - Horse Handler, 2 Side-Walkers, Timer, PT

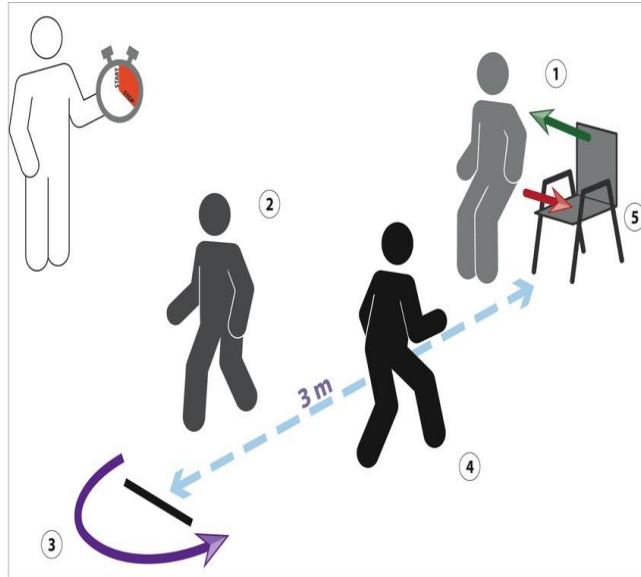


Method

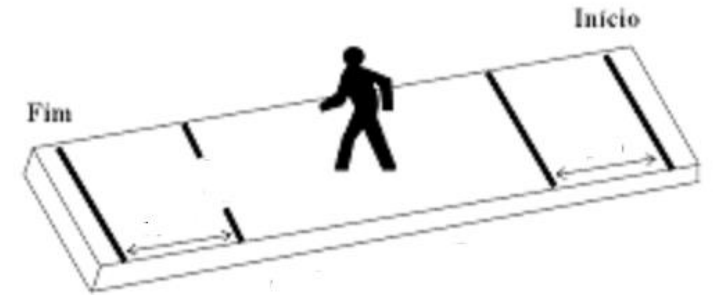
- Data Collection
 - Days 1, 4, 8
 - Functional mobility tests
 - Timed Up and Go (TUG)
 - 10 Meter Walk Test (10mWT)
 - SparkFun 9DoF Razor
 - Microprocessor, IMU (inertial measurement unit) and microSD card
 - Attached to horse and child
 - Recorded movements
 - Tracked acceleration, angular velocity, body orientation



Experimental Protocol: Functional Mobility Tests

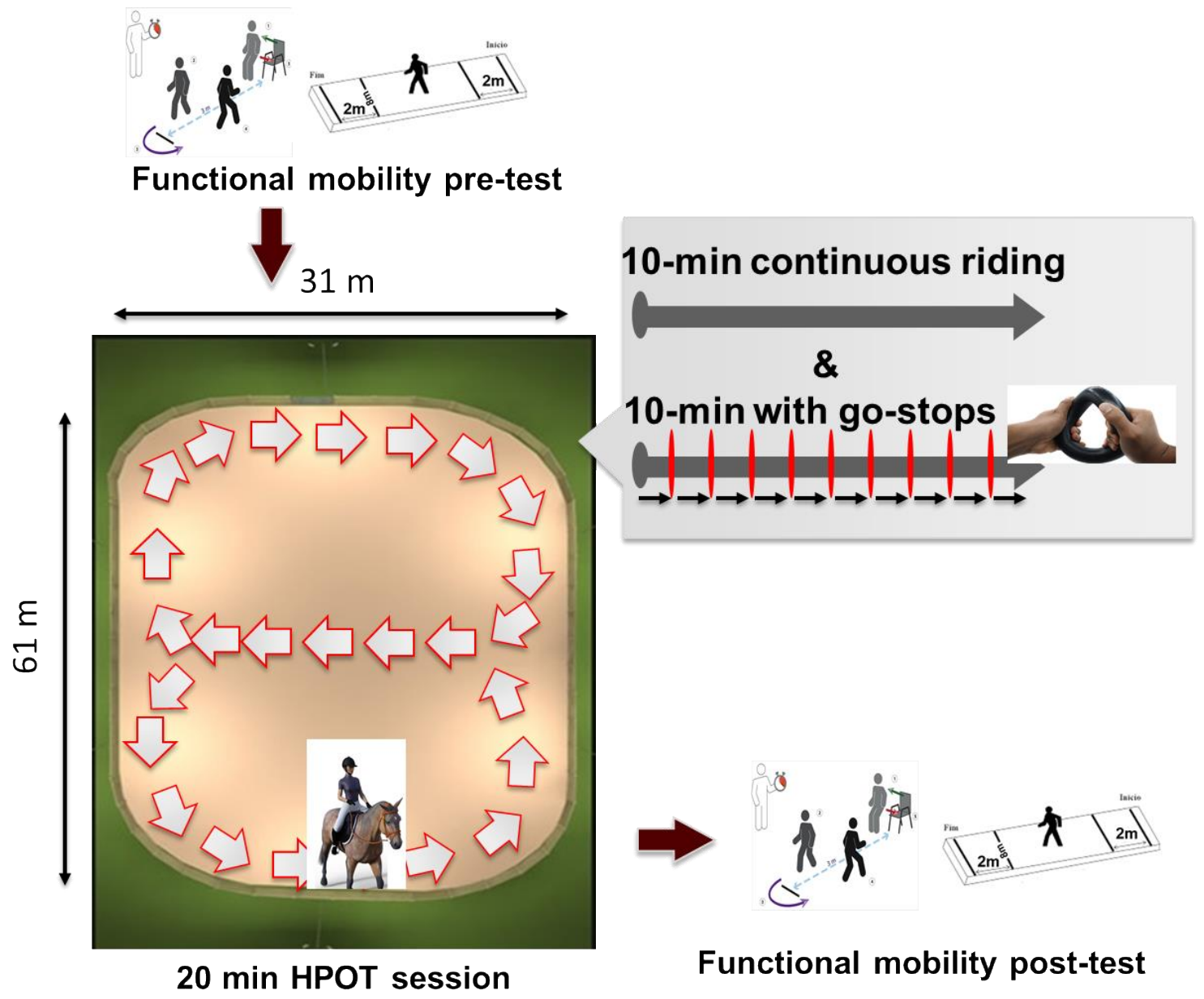


Timed Up and Go
Subject 1, 2, 3



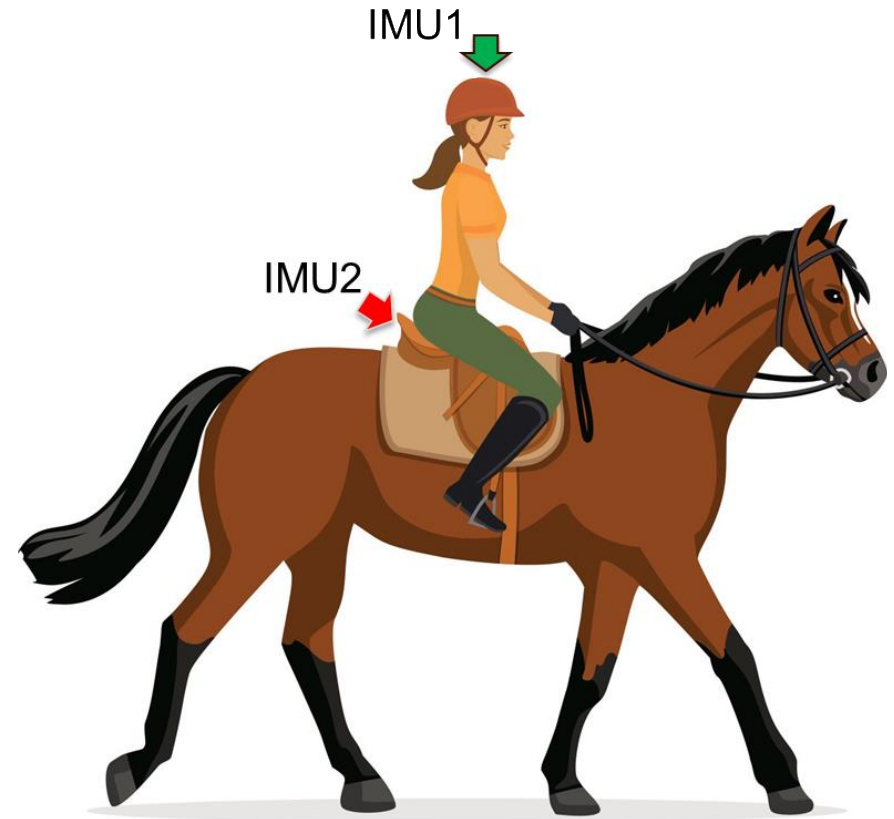
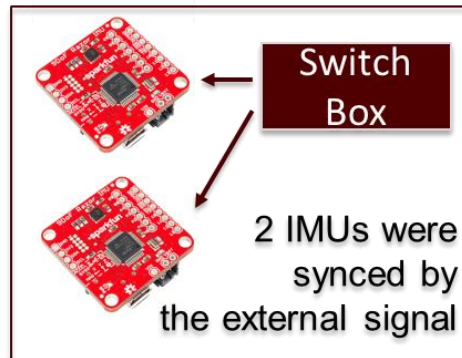
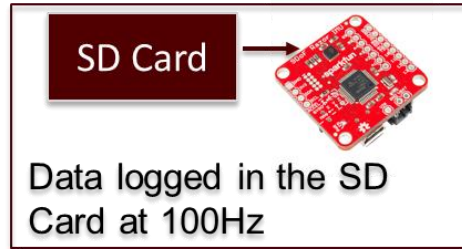
10 Meter Walk Test
Subject 4

Experimental Protocol:
Data Collection Days included TUG & 10mWT

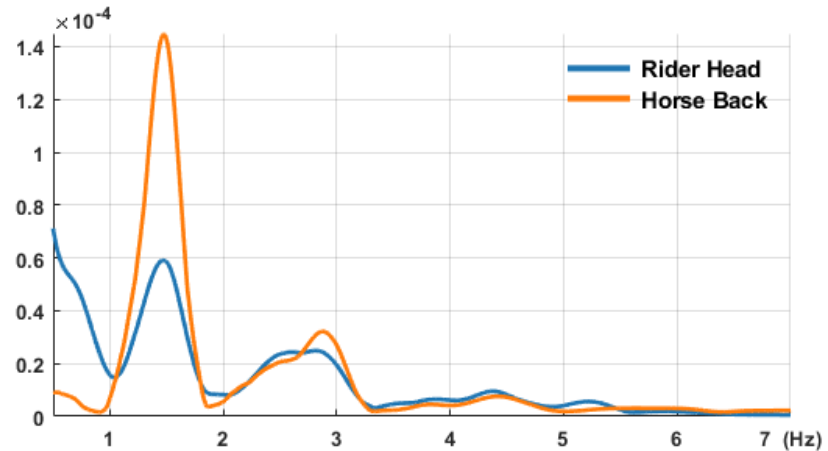


Experimental Protocol: Sensors

IMU sensors

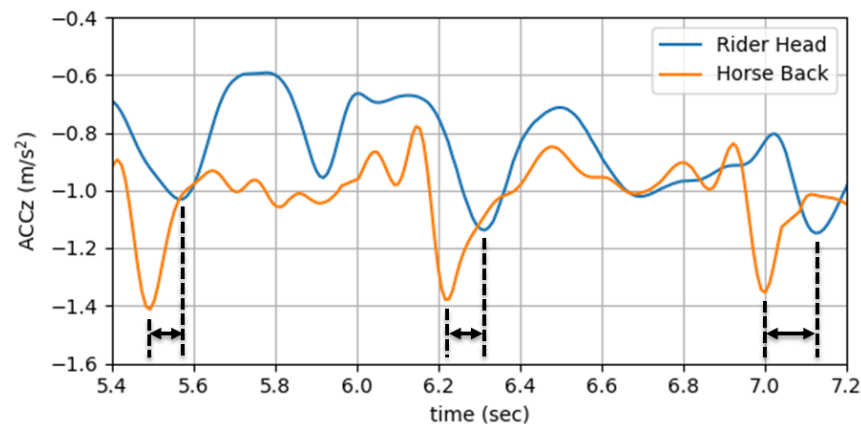


Data Analysis: Sensors



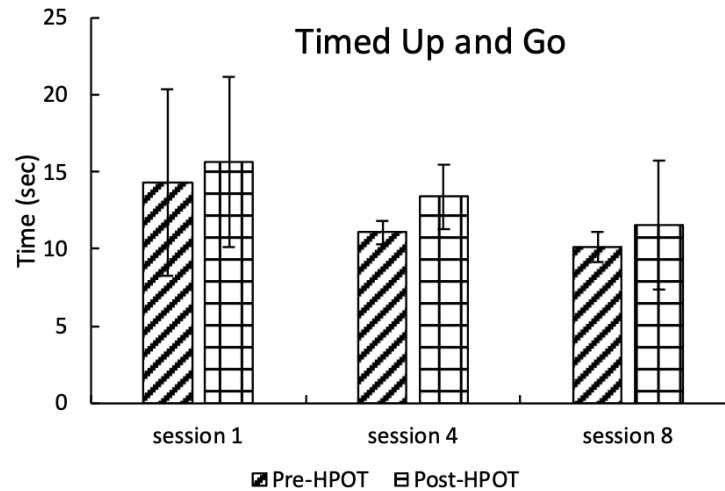
- We examined the vertical acceleration data of both the rider and the horse

- “Frequency error” at the peaks were compared

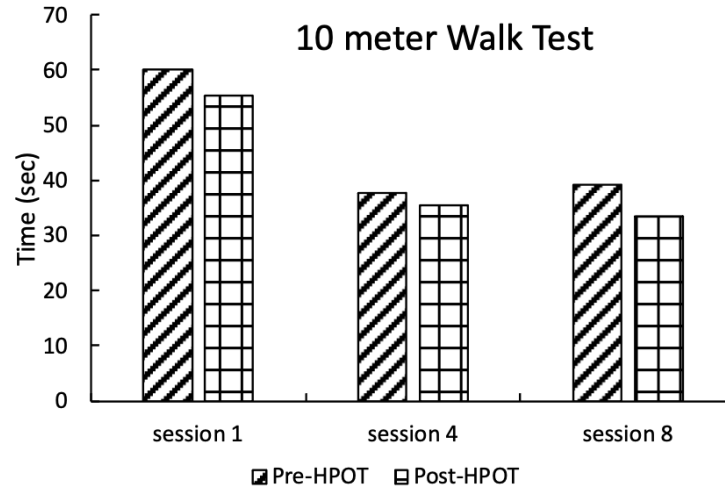


- Correlation analysis were performed to understand how the time series data resemble each other.

Results: Functional Tests

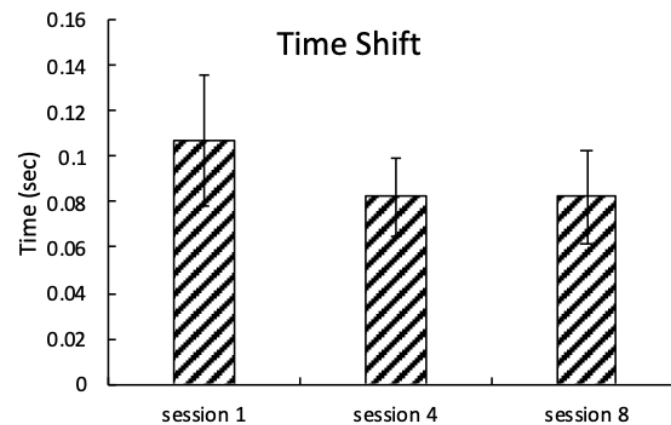
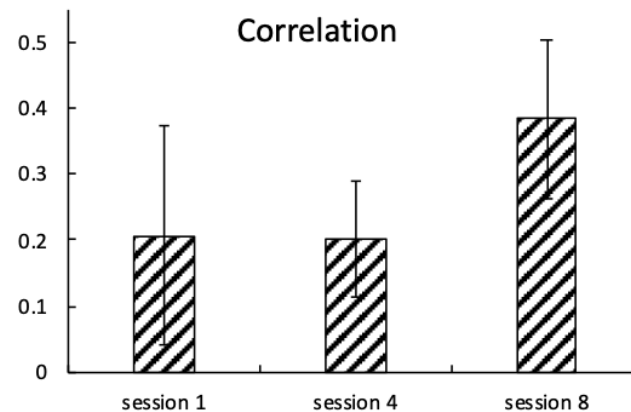
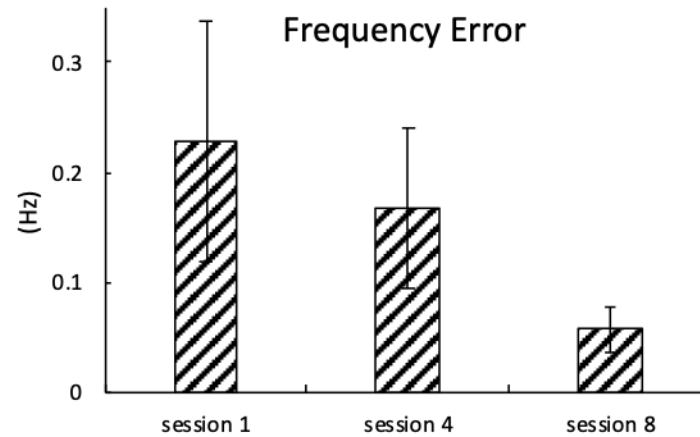


- Compared to session 1, on average, times taken to complete TUG decreased over the sessions.



- Compared to session 1, on average, times taken to finish 10mWT decreased over the sessions

Results: Sensors



- Children's movements increasingly synchronized with movements of the horse (quantified in frequency and temporal domains)
- Reduced frequency errors
- Increased correlation
- Dominant frequencies notable at 1.5, 3.0, 4.5 Hz

Discussion

- As sessions progressed, participants appeared to become more familiar with horse's movement.
- Horse's gait at a walk:
 - Mimics human gait thus this treatment may provide individuals with CP and abnormal gait patterns, opportunity for neuromuscular system to experience a typical gait pattern.
 - Are consistent, rhythmical, cyclical, reciprocal, and multi-dimensional which can facilitate motor learning.
- The increasing synchronization suggests that PT utilizing equine movement is a viable treatment strategy to facilitate functional mobility.

(Moreau, et al. 2016; Nasher, et al. 1983; Garner & B. R. Rigby, 2015; Uchiyama, et al. 2011)



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<https://www.horsesandhumans.org/>

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