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RAS Expanded: Visual and Tactile Cueing for Individuals with Gait Disorders

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Sensory Rhythmic Cueing of the Brain for Rehabilitation

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Introduction

Based on the investigations of cognitive function and the perception and processing of music, a system of techniques for music therapy called Neurologic Music Therapy (NMT) was developed by Dr. Michael Thaut. This project proposed further study of one of these techniques: Rhythmic Auditory Stimulation (RAS), which addresses sensorimotor rehabilitation. RAS is defined as "a technique that facilitates movements that are intrinsically rhythmical in a repetitive pattern, such as gait" (Clair, Pasiali, & Lagasse, 2008, p. 156). RAS is supported by research in laboratory settings, resulting in improved gait and movement coordination with patients who suffered a cerebrovascular accident or who were diagnosed with Parkinson's or a similar motor disorder (Thaut, Mertel, & Leins, 2008). There is a specific protocol for RAS; however, simply, it uses a specific beat as an external auditory cue for timing. This external cue primes the premotor cortex for movement and entrains the brain to activate the lower extremities at the specified beat. Extant literature indicates priming and entrainment result in improved gait parameters, such as cadence, velocity, and stride length (Clair & O'Konski, 2006).

This study aimed to increase the accessibility of RAS by testing the response with senses other than auditory cues. If the brain primes the body for movement with a steady temporal cue through the *auditory* tract, will the same result be found if the steady temporal cue is processed via the *visual* system or the *somatosensory* system?

Methods

Primary research question: Will the steady temporal cue processed through visual or somatosensory systems result in the same or comparable improved gait parameters?

Participants

- Over the age of 18
- Diagnosed with gait impairment due to Parkinson's, Huntington's, TBI, stroke, or similar disorders.
- Must be able to walk without additional support
- Must be able to see visual and to hear auditory trial stimuli

Materials

- iPad
- Applications = Visual (visual metronome) & MetroTimer (auditory metronome)
- Music stand
- 10 meters marked on smooth, unobstructed floor
- Calculator

Design

- Single case, feasibility study

Procedure

The method for testing this protocol was modeled after the RAS protocol, with the addition of visual and somatosensory cues in subsequent trials. The protocol included the following steps on a ten meter walkway:

1. Assessment of current gait parameters (stride length, velocity, & cadence)
2. Frequency modulation at increment of 5%
3. Fading of [musical] stimulus
4. Reassessment of gait parameters. (Thaut & Rice, 2014)

The participant went through these steps with no stimulus for warm up, followed by a trial (auditory, visual, tactile). After each of the three trials, a test trial was done without a stimulus. After the test trials were complete, the participant was given a two minute break and then completed a final post test walk with no stimulus. Auditory cue was given through a metronome via iPad, and the visual cue was given by a visual metronome on an iPad. Somatosensory cue was administered as a physical tap on the shoulder given by researcher. Gait parameters were manually recorded by researchers for each trial.

References

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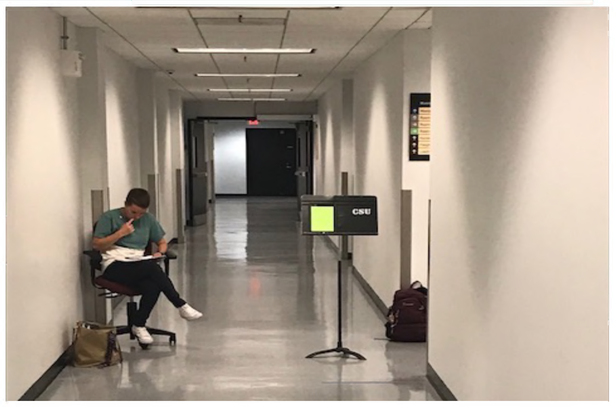
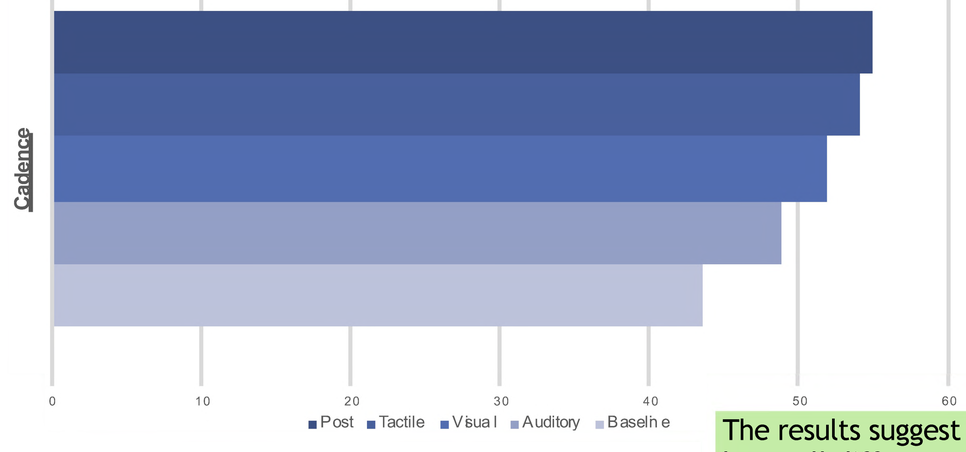
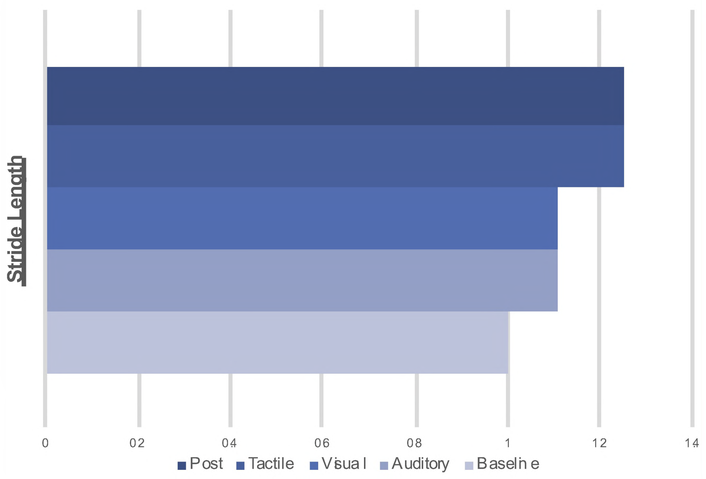
Results

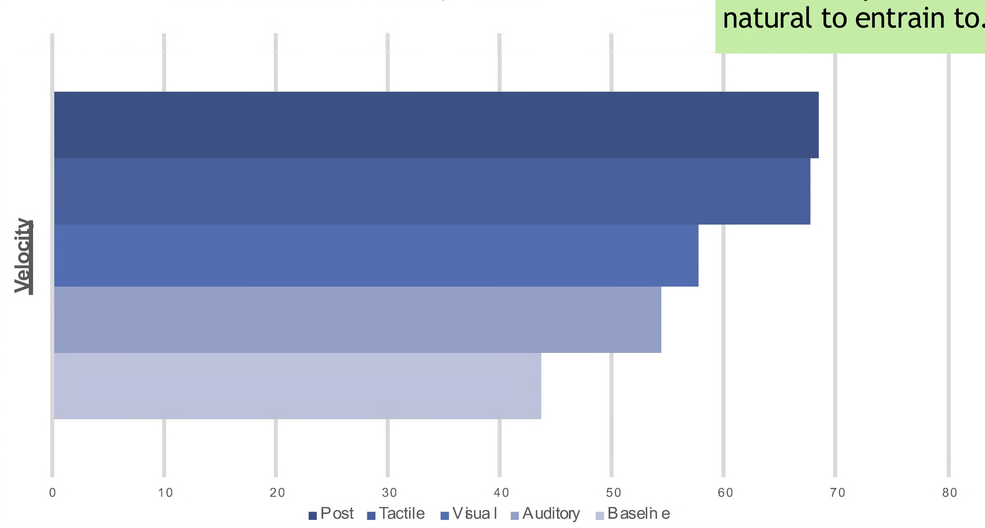
The results of this feasibility study are based on a single participant case study. The 70 year old, female participant has neurologic differences affecting gait due to stroke. Gait differences were a secondary effect from injury to the occipital lobe.

The participant's vision and hearing were within acceptable parameters for participation in the study.









The results suggest there may be small differences in the response of the brain to cue gait when provided different sensory cues. The participant's stride length, cadence, and velocity all increased over time, which suggests the importance of randomization during future clinical trials.

Anecdotally, the participant stated that the visual cue was very challenging and "almost anxiety producing." She stated the auditory cue felt most natural to entrain to.

Conclusion

The purpose of this feasibility study was to test the experimental integrity and design of a protocol that aimed to examine whether a steady temporal cue processed through visual or somatosensory systems will result in improved gait parameters that are comparable to improvements observed when provided an auditory cue.

The protocol was implemented with few issues. The researchers have updated plans on how to address those small matters. Items of importance included randomization of the trials, timing the stop-clock to the participant's step-off, and cueing the tactile stimulus without providing other sensory input.

We are confident to move forward into additional trials given the small modifications that have resulted from this feasibility study.