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IRB Approval

This study was granted approval for participation by human volunteers from the Institutional Review Board of the University of Puget Sound on April 3, 2014; Protocol #1314-083.

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INTRODUCTION

Available research on altering gait spans a wide breadth of study questions, ranging from increasing preferred walking cadence for weight management in healthy adult populations to maintaining and increasing walking cadence for enhanced functional ability in both adult and infant diseased populations.[1,2,3,4] A common link throughout much of this research is the focus on normalizing or increasing cadence and velocity of gait with no mention of the prospect for decreasing gait speed. In fact, at the time of this study there is no available research focused on decreasing an individual's gait speed or cadence through any form of gait training intervention. This leaves a large gap in the existing research on gait training with the potential for training a slow gait speed unknown.

Treadmills and auditory cuing have both been used extensively in research focused on initiating walking, maintaining specific walking speeds, and training regular gait patterns in individuals with Alzheimer's disease and Parkinson's disease.[5] The efficacy of both intervention methods has been supported throughout the literature, however key benefits of auditory cuing are that it is relatively inexpensive and readily accessible to the general population. In fact, metronome training has produced equivalent results to treadmill training in altering sedentary individuals' gait speeds.[1] Additionally, standard metronome training has been shown to effectively increase gait velocity, stride length, and cadence following an eight-week training protocol.[6]

PURPOSE

The purpose of this study is to determine whether healthy adults can maintain a steady, slowed gait speed after a seven-day training period using an auditory metronome set to his or her natural cadence at 0.22 m/sec.

SUBJECTS

Participants in this study included twenty students age 18-45 (7 males, 13 females, average age 24.7 years) recruited from the University of Puget Sound who were able to walk without pathology or assistance for 30 minutes, had no recent musculoskeletal injuries, no auditory, balance, or vestibular impairments, and owned a smartphone.

METHODS

This study utilized a within subject cohort design and was completed over the course of two visits, separated by a 7-day training period.

At visit one (pre-test), participants walked on a treadmill set to 0.22m/sec and a metronome was set to match each individual's natural cadence at this slow speed. Subjects then walked along a predetermined path over a Gait-Rite mat, which measured cadence and velocity, both with and without metronome guidance. The training protocol was explained to each subject, which consisted of walking with a smartphone metronome (Pro Metronome application) pre-set to his/her cadence for 10 minutes per day over five of the next seven days. A daily training log was provided for each participant to track days and minutes spent training over the next week.

At visit two (post-test), daily logs were collected and participants walked over the same path and Gait-Rite mat with and without metronome guidance.

Figure 1. Outlined path (25 ft. x 8 ft. x 32 ft) and Gait-Rite mat used in this study.

ANALYSIS

SPSS software was used to perform a 2 (conditions)x2(visits) repeated measures ANOVA for both cadence and velocity values. Metronome and non-metronome results at pre- and post-test were compiled to investigate condition and visit effects for cadence and velocity separately. A t-test was performed to determine if the post-test velocity, for non-metronome and metronome conditions separately, was significantly different from the desired 0.22m/s gait speed.

RESULTS

The average cadence in steps/min at visit one was 35.3(±10.2) and 36.3(±5.2) and at visit two was 30.6(±7.6) and 36.98(±5.5), no metronome and metronome, respectively. The average velocity in m/sec at visit one was 0.25(±0.07) and 0.27(±0.05) and at visit two was 0.23(±0.07) and 0.28(±0.06), no metronome and metronome, respectively.

Condition	Pre-Test	Post-Test
Velocity NM	0.25 m/sec (±0.08)	0.23 m/sec (±0.07)
Velocity Metronome	0.27 m/sec (±0.05)	0.27 m/sec (±0.06)
Cadence NM	35.3 steps/min (±10.2)	30.6 steps/min (±7.6)
Cadence Metronome	36.3 steps/min (±5.2)	36.98 steps/min (±5.5)

There was no significant difference between pre- and post-test cadence (P=0.41) or velocity (P=0.47). Cadence and velocity were both significantly higher in the metronome condition than in the non-metronome condition (P=0.004 and P=0.001, respectively). An interaction effect showed that cadence did not significantly change between visit one and visit two when using the metronome, however cadence did significantly decrease between visits without the metronome (P=0.02). Lastly, velocity at visit one and two was not significantly different than the desired speed of 0.22 m/sec in the non-metronome condition (P=0.095, P=0.56), however was significantly different (faster) at visit two in the metronome condition (P=0.001).

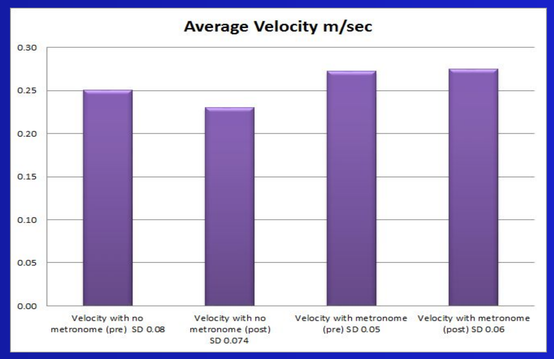

Figure 2. Comparison of velocity with no metronome at both pre- and post-test and with metronome at pre- and post- test.

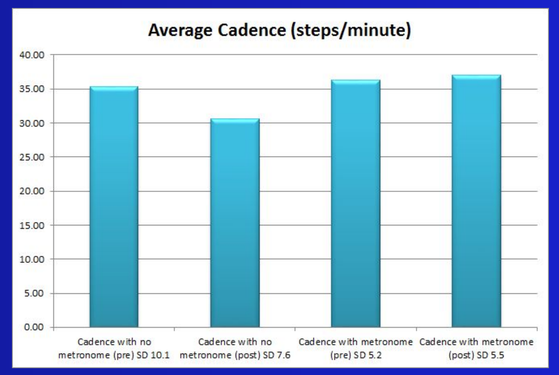

Figure 3. Comparison of cadence with no metronome at both pre- and post-test and with metronome at pre- and post- test

CONCLUSIONS

In conclusion, using an auditory metronome in attempt to slow gait speed is an effective method only after the auditory cue is removed as participants were able to maintain a gait speed not significantly different from 0.22m/s at visit two only in the non-metronome condition. Constant auditory cueing is helpful in maintaining a consistent cadence and velocity, however metronome guidance alone is not effective for producing a single desired slowed gait speed.

RELEVANCE

These results suggest that healthy adults can maintain a slow gait speed after metronome-based training, which has the potential to be applied to pediatric research showing that infants with Down syndrome benefit from gait training at 0.2m/sec.[7] Auditory cueing may allow parents to assist children in gait training at this speed.