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Title: Investigating an adaptive target biofeedback paradigm to reduce gait asymmetry in older adults post-stroke

Stroke is one of the most common causes of long-term disability. Asymmetric walking patterns due to hemiparesis are energetically costly, making them an important target for clinical gait training and post stroke rehabilitation research. Visual gait biofeedback training is an effective, well-studied way to alter walking patterns in people post stroke. However, there exists large methodological variability between studies. The objective of this study was to determine the utility of a novel, adaptive target biofeedback paradigm to reduce step length asymmetry after stroke and explore its use as a standardized methodology.

Participants with chronic stroke completed a single session of step length biofeedback training that consisted of four five-minute walking bouts with biofeedback. A retention trial was then performed without biofeedback. Kinematic data was recorded through a 3D motion capture system. Step lengths were calculated by the distance between ankle markers along the anterior-posterior axis at each heel strike. The step length biofeedback target zones adapted during the course of the experiment based on the participant's performance. At the start of the experiment, the targets were large and easy to achieve. If the participant consistently walked with step lengths in the target zone, the targets would adapt, moving toward the predicted step length value. The final target was set as a function of the individual's predicted pre-morbid step length that was established based on height, body mass, age, leg length, and gait speed. The primary outcome measures were 1) the difference between the actual step lengths and predicted step lengths (target error) and 2) the change in step length asymmetry between baseline and the final biofeedback trial.

Five participants (3 male, 2 female) with chronic stroke (3 right-sided) ranging from 53 to 76 years of age were enrolled. At baseline, the mean target error was 0.038 +/- 0.031cm and 0.054 +/- 0.034cm on the paretic and non-paretic lower extremities, respectively. This increased to 0.052 +/- 0.044 on the paretic limb and decreased to 0.04 +/- 0.03 on the non-paretic limb during the last trial, with significant inter-participant variability. These biofeedback driven changes led to a decrease in the step length asymmetry in 3 out of the 5 participants.

This work provides preliminary evidence that it is feasible for people post-stroke to use adaptive-target biofeedback to change their step length asymmetry within a single training session. Further biofeedback training should be explored to determine the feasibility and efficacy of this paradigm as a standardized approach.