Experimental protocol from IRB Approved Final

Participants will be asked to step onto the treadmill and walk for 5-10 minutes at a speed of 1.25m/s to get familiar with the ExoBoot. During which the rise time will be set at 25.3% of stride period and the fall time will be set at 10.3% of stride period. Rise time refers to the proportion of the gait cycle, measured from heel strike to heel strike (detected by the ExoBoot), over which the ankle torque assistance gradually increases from zero to its peak value. Similarly, fall time refers to the proportion of the gait cycle over which the torque decreases from its peak value back to zero. These baseline values, derived from prior research (Peng et al., 2022), will remain constant during familiarization to provide participants with a reference timing before experimental variations are introduced.

After a brief rest period of 2 minutes, participants will begin the main experimental task. Each trial consists of two walking conditions, presented in random order: a reference timing and a comparison timing. The reference timing represents a fixed torque profile that is held constant throughout the experiment (Rise time 25.3% of stride period). The comparison timing will vary across trials.

Each condition is presented for 5 strides, resulting in 10 strides per trial. At the end of each trial, the participant will be asked: “Were the two torque profiles the same or different?” Participants will respond with a yes/no answer. A subset of 25% of the trials will be catch trials, where both conditions are identical, to estimate false-alarm rates. These catch trials will be presented randomly.

For the comparison timing, an up-down method will be used to determine the following non-catch-trial comparison timing: if a user answers ‘different’, the comparison timing in the next non-catch-trial will change by 1% of stride period closer to the reference timing, if a user answers ‘same’ the following non-catch-trial comparison timing will be 1% of stride period further from the reference timing. The initial comparison timing will be set to be 3% stride period away from the reference timing. Participants will be asked to complete 9 total sweeps. A sweep contains comparison timing changes in two directions (increasing and decreasing from previous value). This test will be done twice to approach the reference timing from both above and below. Meaning, 9 total sweep tests will be conducted to approach the reference timing from above and 9 total sweep tests will be done to approach the reference timing form below for a total of 18 total sweeps. Participants will be notified when each condition starts and will have an 8second break between trials to rest. Participants’ responses will be recorded manually.

The approximate duration of each sweep is response-dependent, because the comparison level is adapted to a participant’s response. Meaning the number of trials needed to complete a sweep will vary with each participant’s “same/different” response. As an estimate, based on prior research (Peng et al., 2022), each sweep is expected to be roughly 4-7 trials. With each trial lasting for a total of 10 strides (roughly 8 seconds) this gives an estimate for each sweep lasting roughly 2-3 minutes. Thus, we expect the total walking time to be 20-30 mins for the main task.