

# Modulating Gait Symmetric Adaptation via Split-Belt Treadmill Distortion and Visual Feedback Distortion and Evaluating the Aftereffects of Adapted Step Length Symmetry

Emily Tanner, MS Biomedical Engineering  
Mentor: Dr. Hyunglae Lee, Assistant Professor  
School for Engineering of Matter, Transport and Energy

## Research Question

What are the effects of combining **split-belt speed modulation** with **visual feedback distortion** on a subject's step-length symmetry during gait training, and how long are these effects retained once the stimuli are removed?

## Methods

### Equipment:



Figure 1: Marker placement on subject's lower limbs.



Figure 2: Split-belt instrumented treadmill (Bertec).

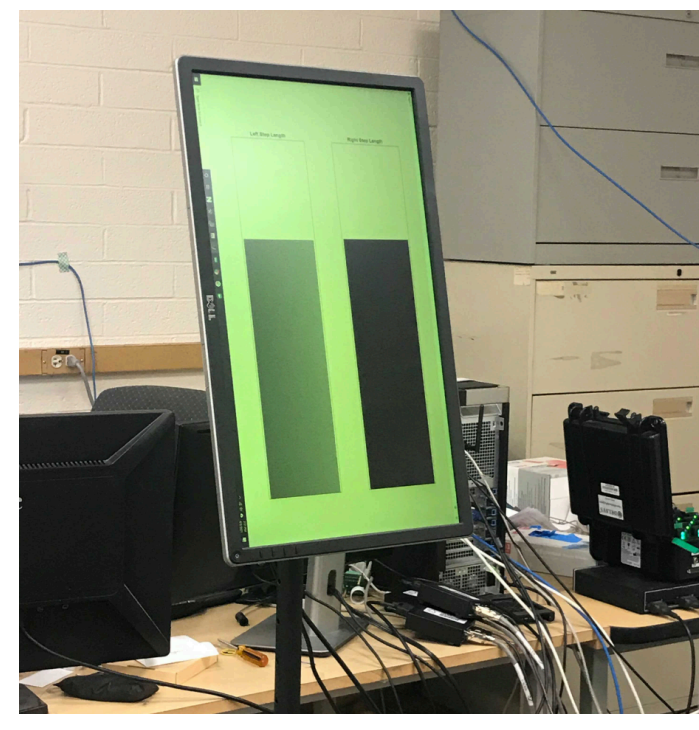
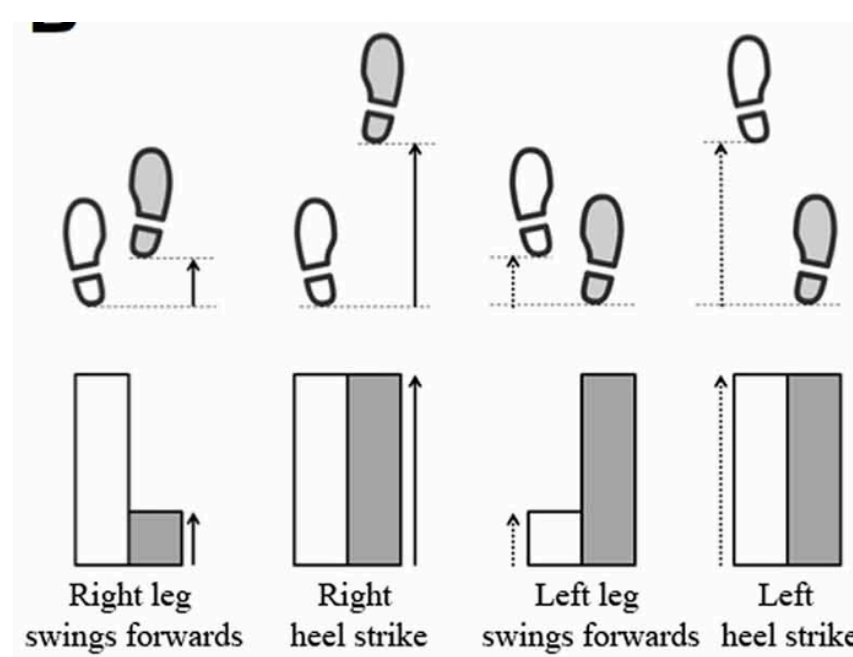


Figure 3 (above, below): Real-time visual feedback representing the subject's right and left step-lengths during walking trials.

### Subjects:

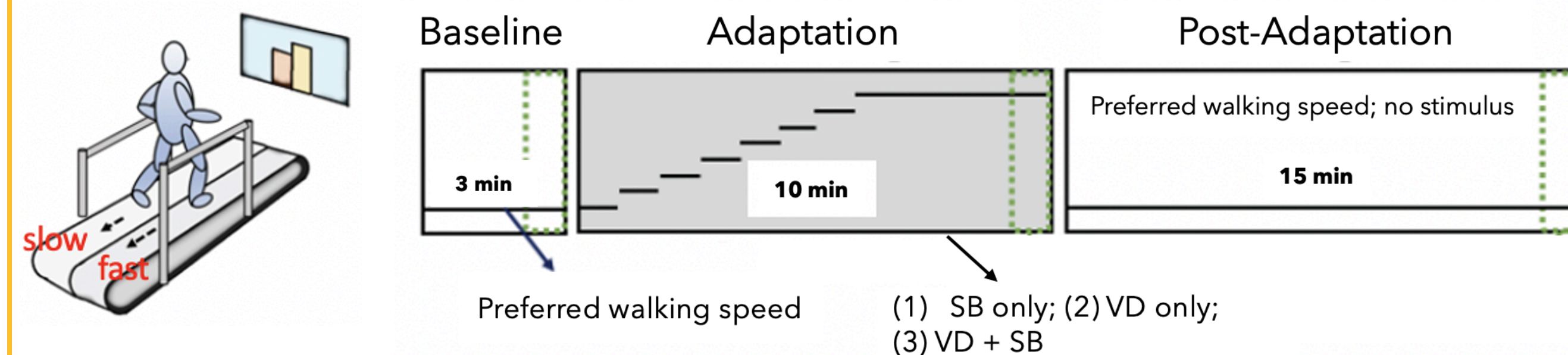
For this study, healthy adult human subjects were recruited from the Arizona State University population. Data from **six subjects** were collected for each experimental condition.



### Experimental Groups:

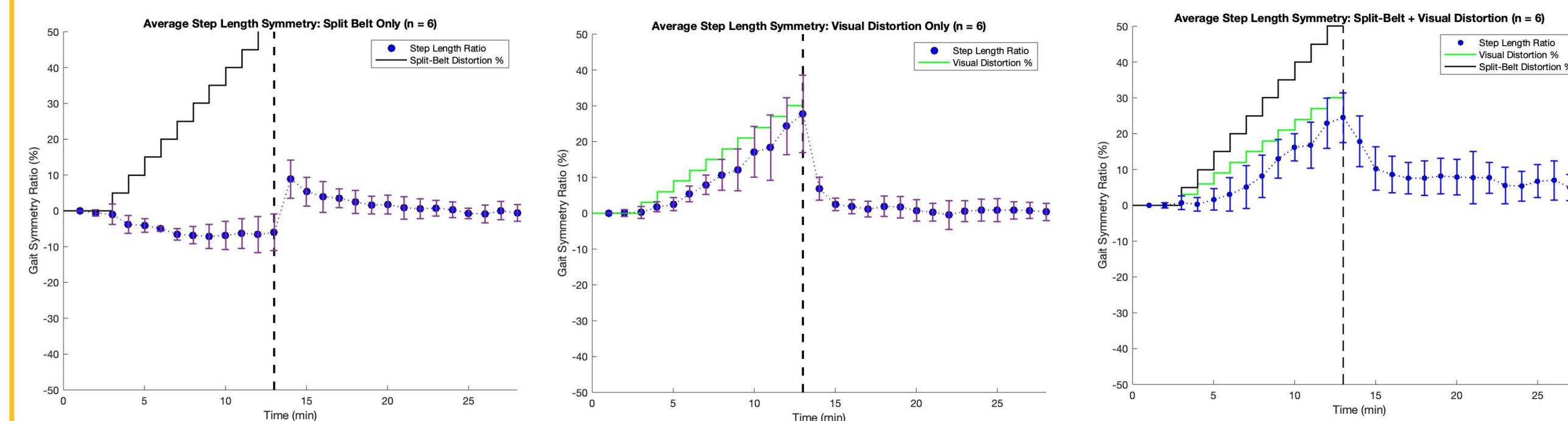
1. Split-belt speed modulation only (**SB**)
2. Visual distortion only (**VD**)
3. Visual distortion + split-belt (**VDSB**)

## Experimental Setup



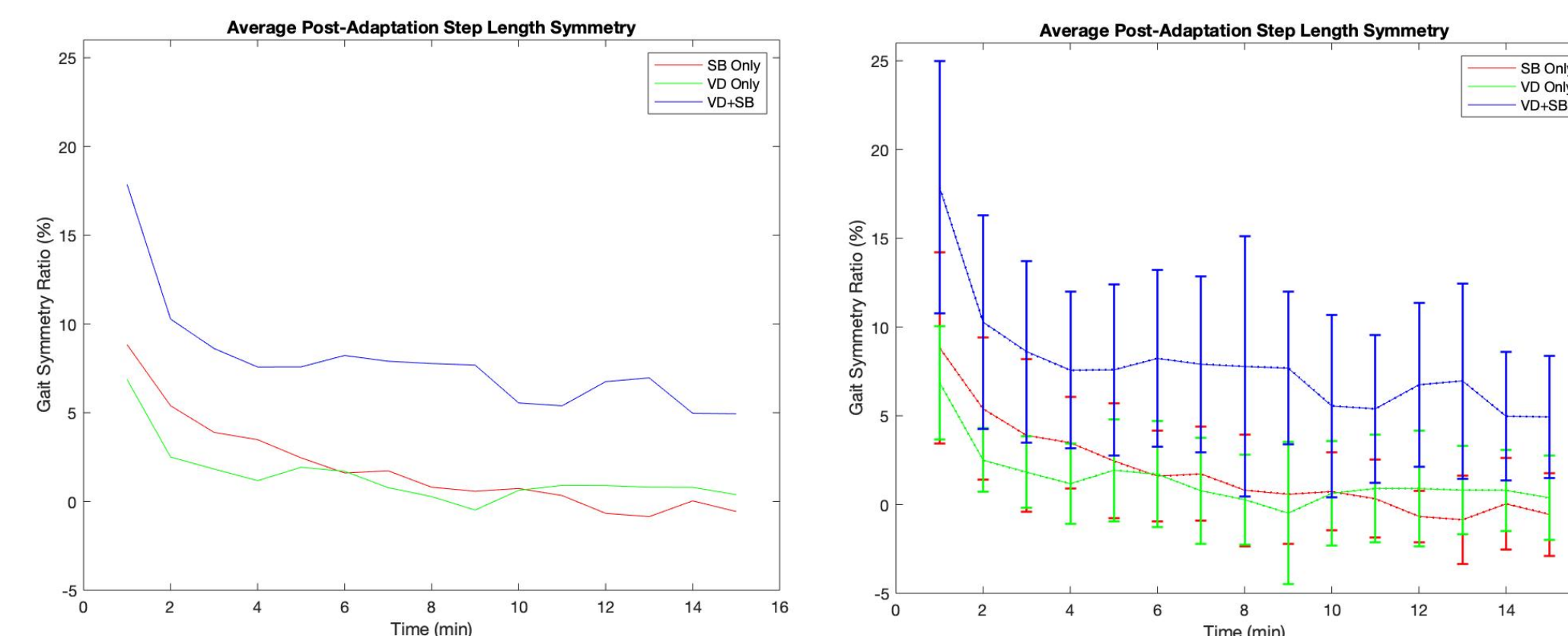
## Preliminary Results

### Step-Length Ratio vs. Time Plots



**Step-length ratio** was calculated as the ratio between the subject's right step-length (RSL) and their left step-length (LSL) using following formula:  $SLR = 200 * \frac{RSL - LSL}{RSL + LSL}$ . **Average SLR** was calculated for each minute during walking trials.

### Post-Adaptation Analysis



**Post-Adaptation SLRs** demonstrate the magnitude of step-length asymmetry once the experimental stimuli have been removed.

## Conclusions

- This study helped characterize the effects of different gait modulation techniques on a subject's step-length symmetry over time.
- *Initial results **show promise that VD+SB gait modulation will lead to greater gait asymmetry retention over time** when compared to SB or VD alone.*
- These findings will help develop more robust gait training techniques for rehabilitation following neurological disease or injury.

## Future Work

- Continue data collection with a larger sample size
- Ensure data collection remains consistent with previous work
- Statistical analysis to evaluate the magnitude and retention time of gait asymmetry aftereffects between experimental groups

## Acknowledgements

Thank you to Dr. Hyunglae Lee and Omik Save for their valuable mentorship and guidance throughout the semester. Additional thanks to Lauren Everett for her assistance with the project, and to all my lab mates for their support and encouragement. This research was funded by MORE.