

Motivation & Background

Walking disability

Lack of **physical, social, & mental** development^{2,3}

Potential **long term mobility loss**

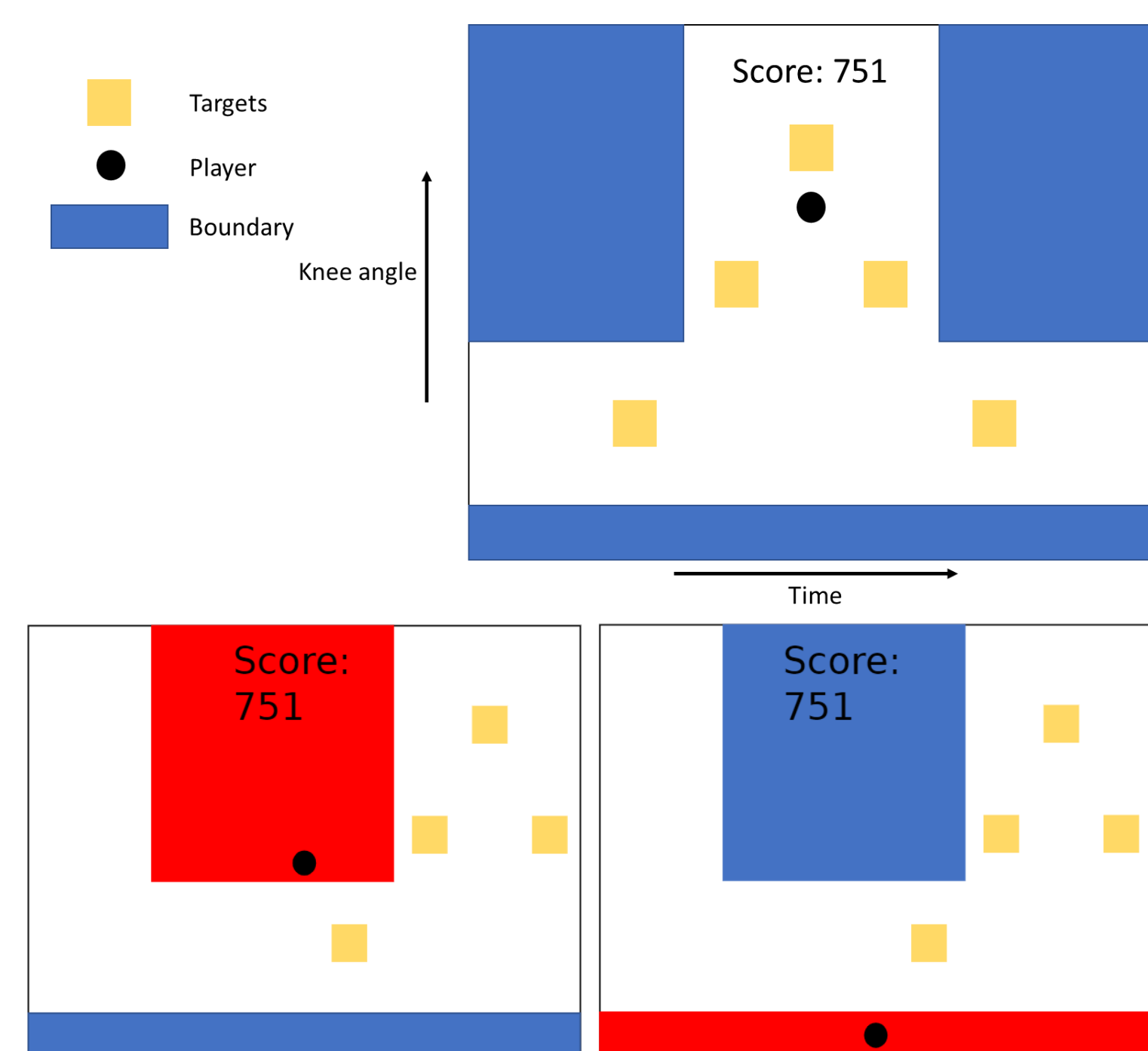
Neurological diagnoses in kids can result in decreased mobility and impairment in walking

- Current Interventions (Surgical, Botox, Physical Therapy) do **not always show long-term effects** and can be **time consuming** and impose a **clinical burden**¹

We aim to investigate how **biofeedback** can be coupled with **exoskeleton** training to **improve rehabilitation outcomes**

Methods and Approach

Biofeedback Game



+ Exoskeleton Assist



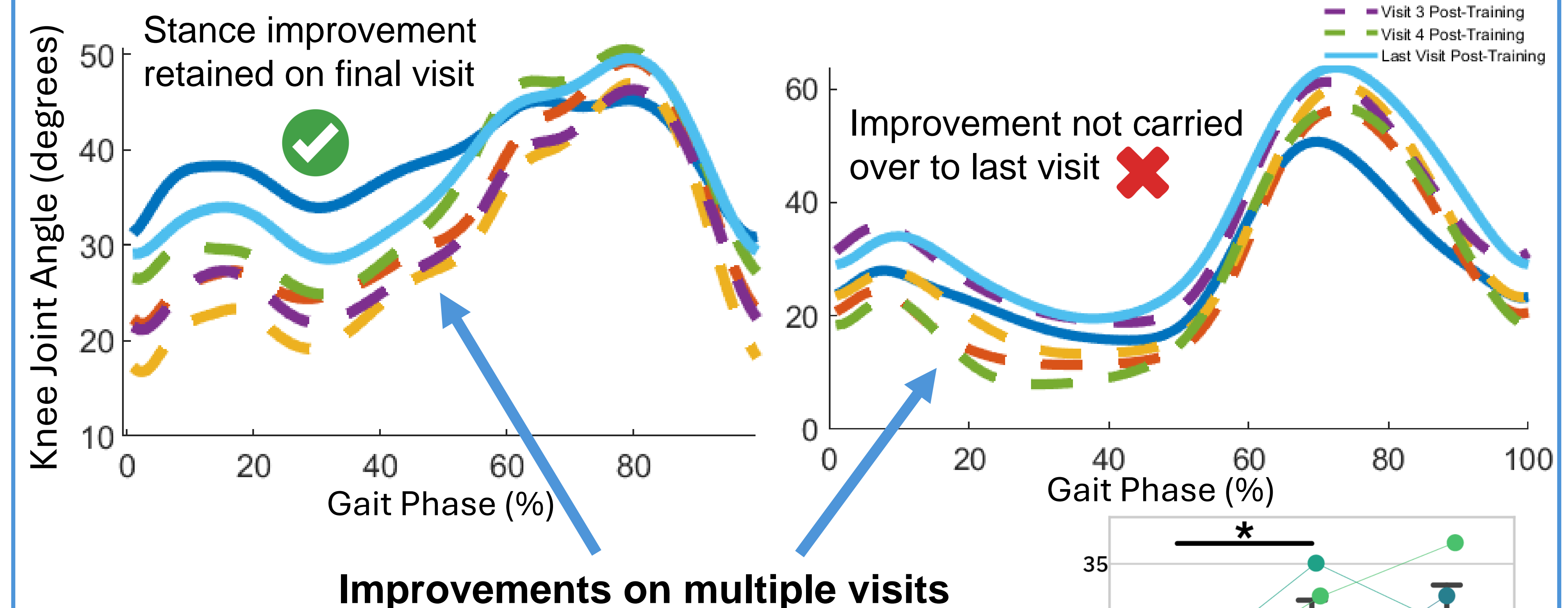
- N=7 Subjects
- Crouch Gait or Genu Recurvatum*
- 5 training sessions, 30 minutes
- Kinematic and EMG data collected

- Blocks indicate targeted knee ankles. Walls indicate regions of hyperflexion/extension
- Challenge level was tuned per subject

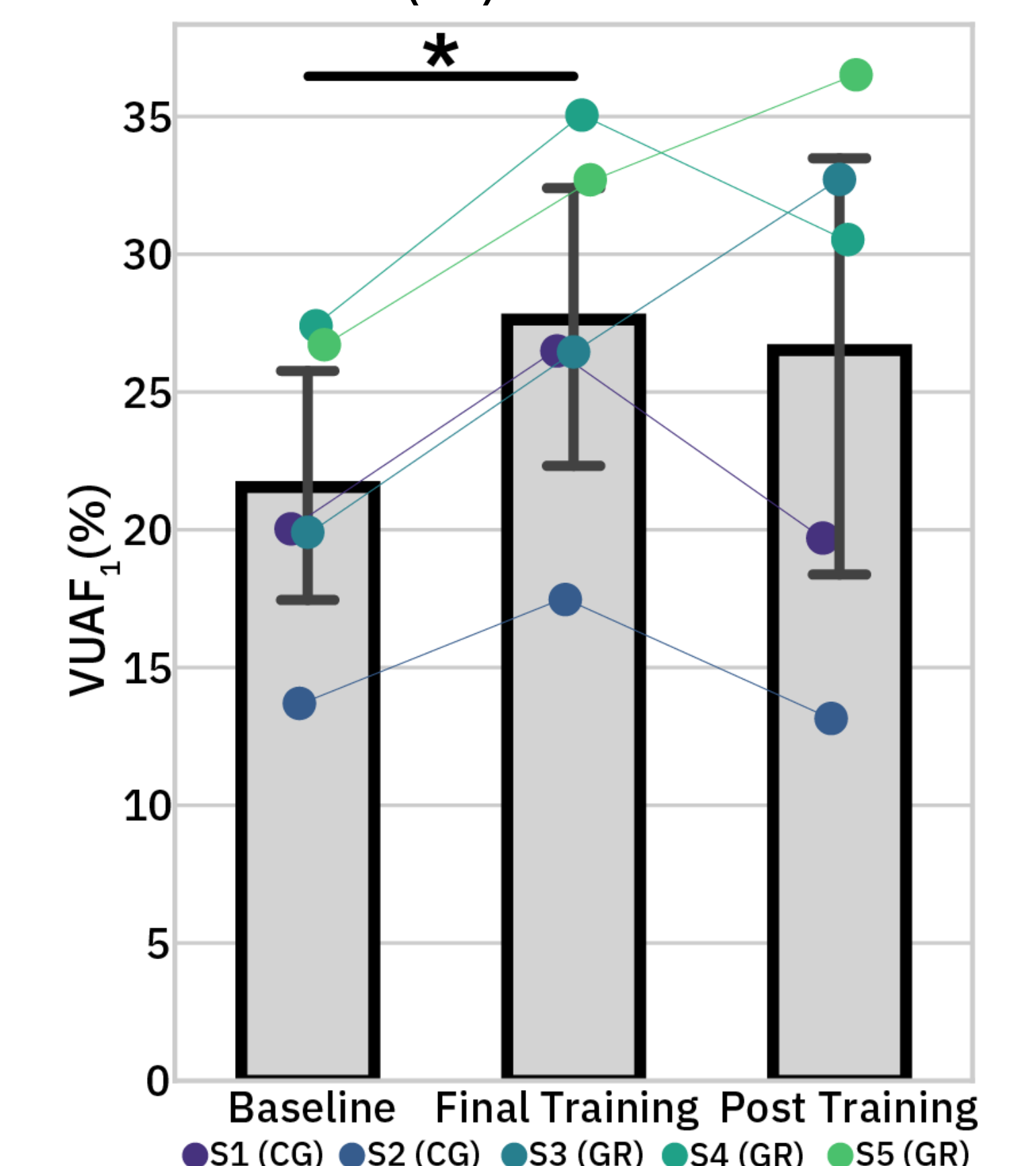
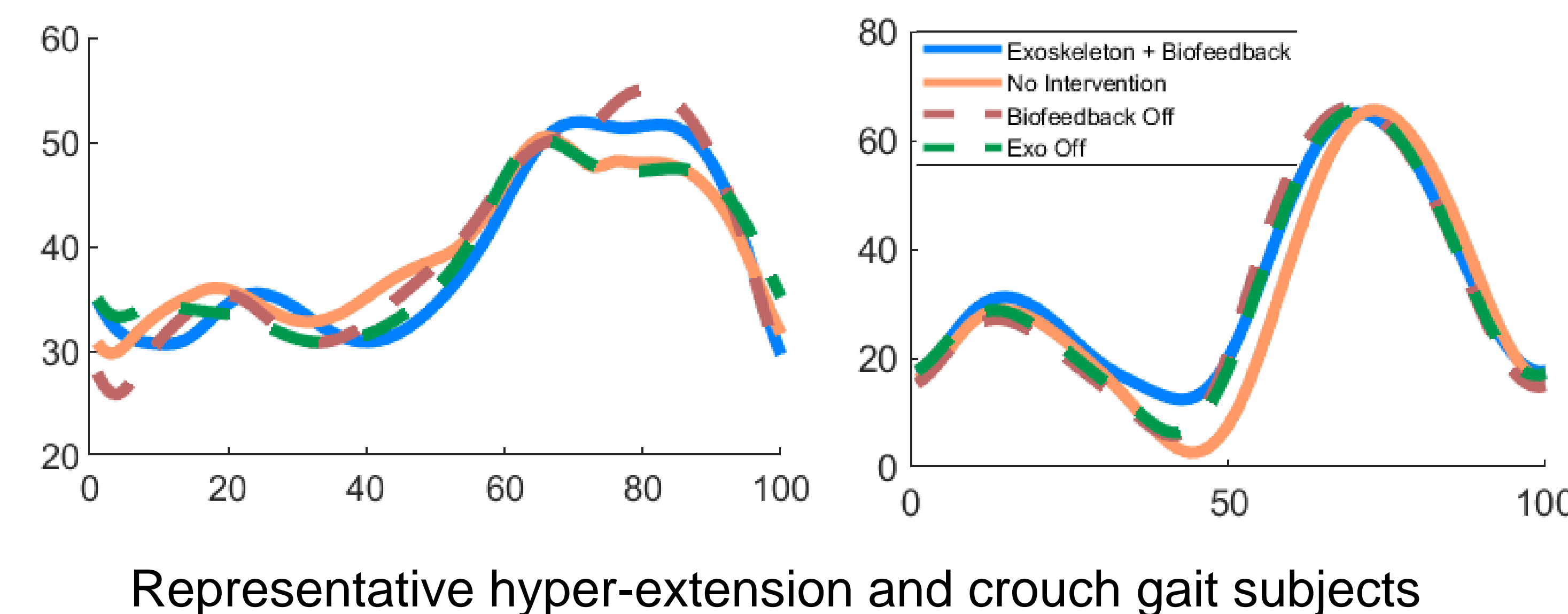
- Exoskeleton provided “assist as needed”
- Torque provided was proportional to error once knee angle deviated out of threshold

Results

Biofeedback coupled with Exoskeleton Assistance shows improvements in multiple subjects post-training



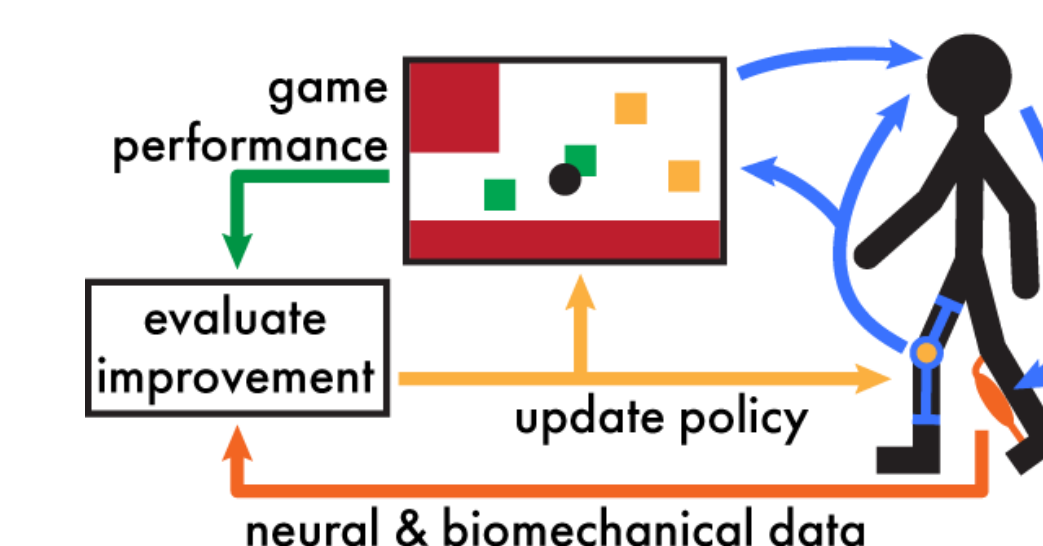
Better together: Improved engagement & Manual exo guidance



- Motor control complexity improves during training**
- But retention inconsistent**

Future Goals

Personalization of rehabilitation parameters through online optimization



References

- [1] Galey SA, et al. 2017 *Gait and Posture*
 - [2] D. C. Johnson et al. 1997 *J. Ped Ortho*
 - [3] M. Bottos et al. 2003 *Dev Med & Child Neuro*
 - [4] D. Lee et al. 2023 *IEEE Trans Biomed Eng*
- We would like to acknowledge Shriners' International Hospital for Children for their contributions to funding this work*