UNIVERSITY of WASHINGTON

RESNA Rehabilitation Engineering and Assistive Technology Society of North America

Kicking it off: Do toddlers with disabilities activate leg muscles while driving with a joystick?

Madeleine E. McCreary, Kimberly A. Ingraham, Heather A. Feldner, Katherine M. Steele

BACKGROUND



Self-Initiated Mobility: critical for cognitive, social, perceptual, and motor development in early childhood[1].

- Delayed onset in children with disabilities[2,3].

Permobil Explorer Mini (right): powered mobility device that minimizes barriers to self-initiated mobility.

- FDA-cleared device for children 12-36 months.
- Lightweight (24 kg) and inexpensive (under $3000).
- Promotes improvements in communication and gross motor development[4].

Reduced Selective Motor Control: impaired ability to activate specific muscles for a voluntary motor task.

- Common in children with disabilities[5].
- May result in leg activation while using joystick.



AIMS

1. Quantify **leg muscle activation** of toddlers with motor disabilities using the Explorer Mini

2. Assess whether leg muscle activation **changes with experience**

METHODS

Participants: 13 toddlers with disabilities (age: 22.2 ± 6.4 months)

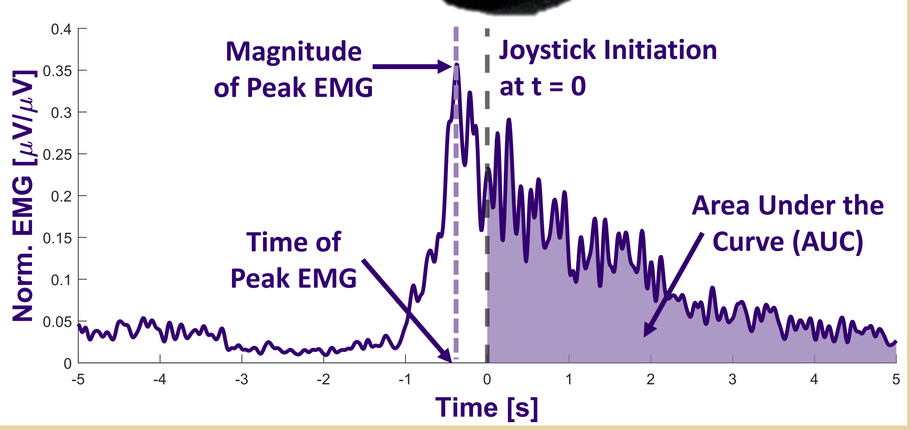
Experimental Protocol: 12 Visits { 15 – 20 min play session | 5 – 10 min break | 15 – 20 min play session }

Data Acquisition: Joystick position and muscle activity from electromyography (EMG) sensors on the quadriceps and hamstrings

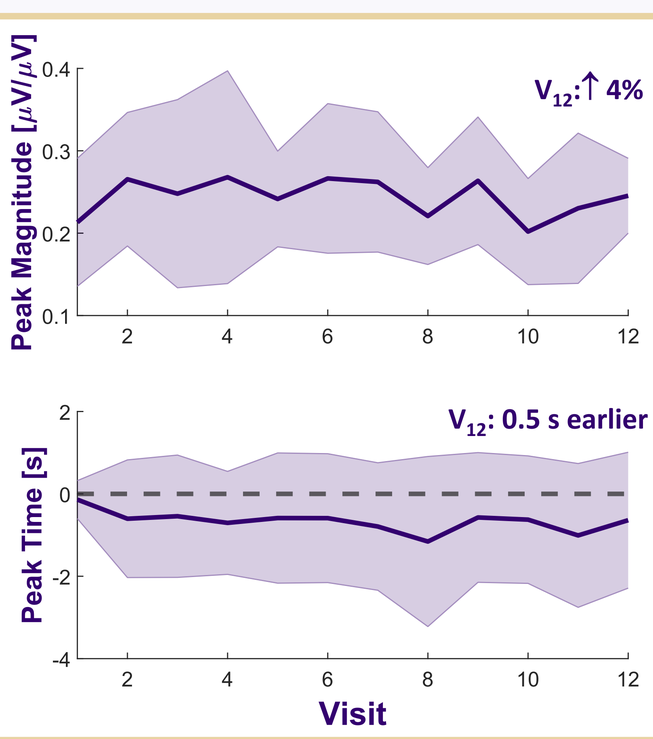
EMG Processing: 20 Hz highpass filter, demean, rectify, 10 Hz lowpass filter, normalize to visit maximum

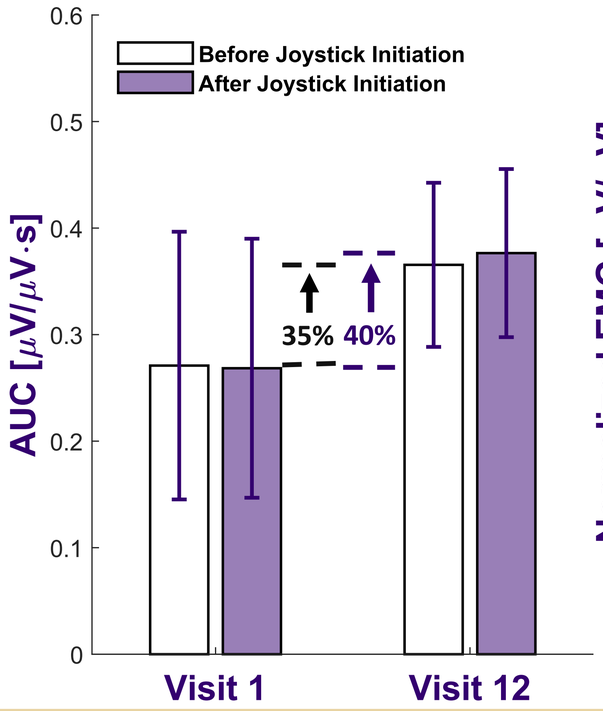
Segment EMG: 5 seconds around each joystick initiation by child (right)

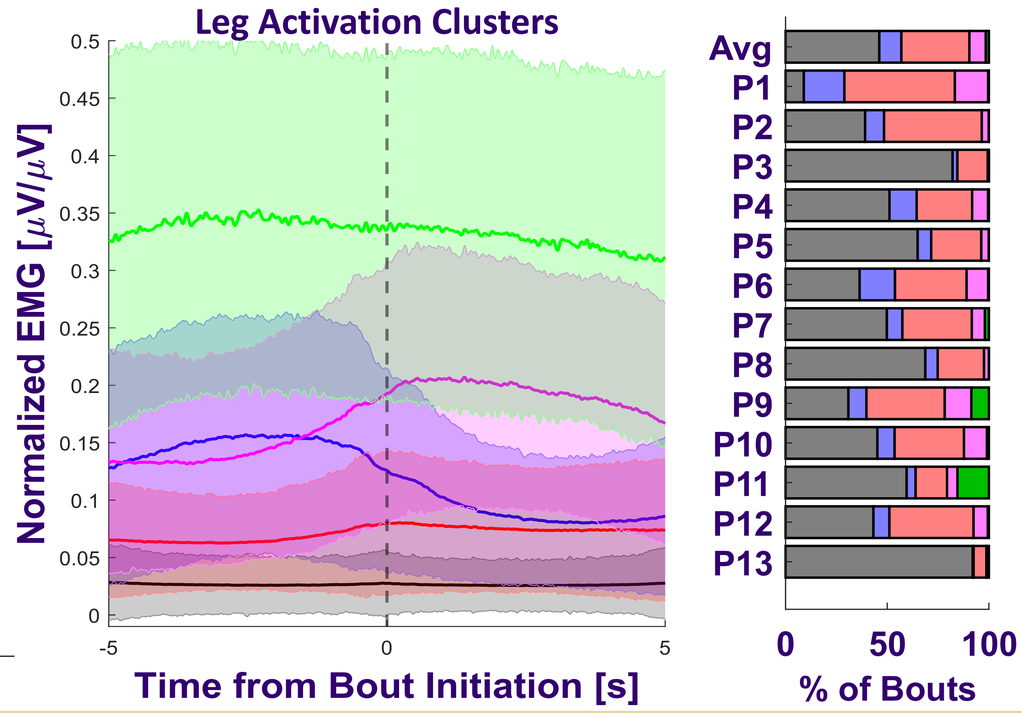
- **Peak EMG** (magnitude and timing) + Area Under the Curve (**AUC**)
- Identify common patterns: PCA and k-means clustering



RESULTS







TAKE AWAYS

Arm movement and leg activation are **often coupled.**

As children gain experience, they activate their legs **more.**

There are **child-specific differences** in leg activation patterns.

References: [1] Campos et al., 2000; [2] Begnoche et al., 2016; [3] Feldner et al., 2016; [4] Logan et al., 2023; [5] Cahill-Rowley & Rose, 2014.

Acknowledgements: We thank the Center for Research & Education on Accessible Technology and Experiences (CREATE) and the Institute for Learning and Brain Sciences (I-LABS) for their support of this work, as well as LUCI for instrumenting the Explorer Mini and Mia Hoffman, Nicole Zaino, Liesbeth Gijbels and Alexis Sinclair for data collection assistance.