



### FUTURE PLANS

Kelly has accepted a position as a post-doctoral fellow in the lab of Dr. Julia Choi, assistant professor in the department of applied physiology and kinesiology at the University of Florida.

Public oral examination for the degree of Doctor of Philosophy  
**Rehabilitation Science  
Dissertation Defense**

*“Walking Control after  
Stroke and the Feasibility of  
Transcutaneous Spinal Direct  
Current Stimulation during  
Locomotor Training after  
Spinal Cord Injury”*

# Kelly Hawkins

Tuesday, October 27th

9:30am

Via Zoom



### **Doctoral Committee:**

**Emily J. Fox, PT, DPT, PhD, NCS**

**David Clark, ScD**

**Dorian Rose, PT, PhD**

**Daniel Ferris, PhD**

## ABSTRACT

Neurologic injuries, such as stroke and spinal cord injury, impair walking function, including the abilities to step independently and perform walking adaptability tasks necessary for community mobility. Although walking recovery is a priority of rehabilitation, understanding of walking control is limited and based primarily on steady-state walking performance. Therefore, knowledge of walking adaptations and the attentional demands of walking is limited. Further, many walking interventions do not sufficiently target underlying impairments, such as the reduced spinal excitability after spinal cord injury.

The objective of this dissertation is to address these gaps through 1) examination of backward walking biomechanics in adults post-stroke; 2) quantification of prefrontal brain activation in adults with varying levels of walking impairment, including adults post-stroke; and 3) assessment of a novel intervention approach, transcutaneous spinal direct current stimulation combined with walking rehabilitation, in adults with incomplete spinal cord injury. Results demonstrated that post-stroke community ambulators with relatively well-recovered forward walking had considerable impairment in backward walking kinematics and spatiotemporal characteristics. Backward walking assessment, therefore, may unmask impairments that are not apparent during forward walking and should be considered when determining readiness for community mobility. Additionally, individuals post-stroke had higher prefrontal brain activation during walking indicating greater attention to walking tasks. Greater use of prefrontal brain regions or, essentially, “thinking about walking” may put these individuals at higher risk for adverse mobility events.

For individuals with spinal cord injury, insufficient spinal excitability may limit walking recovery. Outcomes from a feasibility study demonstrated that use of transcutaneous spinal direct current stimulation, a neuromodulatory approach, in combination with an intense walking rehabilitation strategy, locomotor training, is achievable, tolerable and safe in adults with mild to severe walking impairment. Furthermore, gains in spinal cord excitability, evident by changes in Hoffman reflex excitability, and improved walking performance were detected in some participants. Further investigation is warranted to examine the efficacy of this combined intervention on walking outcomes. Overall, this dissertation aims to contribute to evidence of walking function after neurologic injury and development of effective interventions to promote recovery.

## PUBLICATIONS

Chatterjee SA, Fox EJ, Daly JJ, Rose DK, Wu S, Christou EA, **Hawkins KA**, Otzel DM, Butera KA, Skinner J, Clark DJ. Interpreting prefrontal recruitment during walking after stroke: influence of individual differences in mobility and cognitive function. *Frontiers in Human Neuroscience*. 2019 Jun 18;13:194.

**Hawkins KA**, Balasubramanian CK, Vistamehr A, Conroy C, Rose DK, Clark DJ, Fox EJ. Assessment of backward walking unmasks mobility impairments in post-stroke community ambulators. *Topics in Stroke Rehabilitation*. 2019;26(5):382-8.

**Hawkins KA**, Fox EJ, Daly JJ, Rose DK, Christou EA, McGuirk TE, Otzel DM, Butera KA, Chatterjee SA, Clark DJ. Prefrontal over-activation during walking in people with mobility deficits: interpretation and functional implications. *Human Movement Science*. 2018; 59: 46-55.

**Hawkins KA**, Clark DJ, Balasubramanian CK, Fox EJ. Walking on uneven terrain in healthy adults and the implications for people after stroke. *NeuroRehabilitation*. 2017;41(4):765-774.

## SELECTED HONORS AND AWARDS

2020 Frederick Family Scholarship, Rehabilitation Science PhD program

2020 Poster Award, Spinal Cord Injury Special Interest Group of the Academy of Neurologic Physical Therapy APTA Combined Sections Meeting

2019 Outstanding Student Publication Award University of Florida Rehabilitation Science PhD program

2017 Promotion of Doctoral Studies I Scholarship Foundation for Physical Therapy

2015 Florence P. Kendall Post-Professional Doctoral Scholarship Foundation for Physical Therapy