

## Meet Our Members: Andrew Monaghan

Andrew Monaghan is a Ph.D. Candidate working in the Gait and Balance Disorders Laboratory at Arizona State University. He joined ASNR in 2020 to expand his network within the field of neurorehabilitation, and to have the opportunity to keep up to date with the latest developments and disseminate his research findings. In this interview, Andrew shares more about his career and his innovative rehabilitation research.



### 1) How did you get interested in science, and what steps did you take to get to your current role?

I never had a blueprint for my career with research as an end goal. And I would consider myself a relative newcomer to the world of research. After my twin brother Patrick and I moved from a small village in the north of Ireland to Mississippi State University on an athletic scholarship, I initially thought I would return home to Ireland. Patrick is currently completing his Ph.D. in the Locomotor Movement Control Lab under the guidance of Dr. Jamie Roper at Auburn University — we really do the twin thing right! Instead of moving back, my brother and I both found ourselves graduate teaching assistantships at Colorado State University (CSU). I have been extremely fortunate to take advantage of great opportunities. I would never have anticipated that ten years later, I would end up in Arizona following a stop in Colorado.

It was in Colorado that I was first exposed to research. Dr. Brett Fling had just joined the Department of Health and Exercise Science at CSU after a successful postdoctoral fellowship at Oregon Health and Sciences University in Portland. Brett's research at the time involved using transcranial magnetic stimulation and diffusion tensor imaging to study how the brain's structure and function are related to communication between the right and left sides of the brain in people with multiple sclerosis. I was immediately drawn to Brett's excitement and passion for his research, which was equally infectious. So, I joined his Sensorimotor Neuroimaging Laboratory (SNL) alongside three excellent graduate students who helped me immensely during the completion of my Master's degree.

When I discovered that I could continue to learn and conduct research as part of a Ph.D., I jumped at the opportunity. Dr. Daniel Peterson from Arizona State University (ASU) was invited as a seminar speaker at CSU. Also coming from Dr. Fay Horak's mentoring tree and having worked closely with Brett in the past, I was intrigued by his work, particularly his reactive balance research. I remember being equally fascinated and stunned when Dan showed videos of startling reactive balance responses using the treadmill. The stars aligned, and I joined Dr. Peterson's Gait and Balance Disorders Lab at ASU. After four years and thousands of treadmill perturbations later, I will be finishing up my Ph.D. this May.

## **2) What is the focus of your current research, and what are some of your findings?**

The bulk of my current work is centered on reactive balance responses. We know many falls occur due to sudden challenges to balance, such as a trip, slip, or poor weight shift. In such circumstances, rapid reactive balance responses, such as reactive stepping or maneuvering the weight beneath the feet, represent vital first lines of defense against a fall. Unfortunately, people with neurological diseases (Parkinson's Disease (PD) and Multiple Sclerosis (MS)) exhibit deficits in such responses, elevating their chances of falling.

We wanted to determine if we could improve reactive stepping using an adaptive, six-session, two-week reactive step training protocol in people with 1) Parkinson's Disease with postural instability and gait disorders (a classification of PD at a significantly higher fall risk with more pronounced balance deficits) and 2) multiple sclerosis.

In the PD study, we found improvements in reactive stepping were retained two months following practice. We also discovered that half of the participants reported fewer falls post-training and that the amount of improvement was related to fewer falls. I am also interested in identifying predictors of training responsiveness. With any training intervention, there will be a fair degree of variability in participants' responses; some participants will get much better, while others might not demonstrate any improvement. Our initial exploratory analyses show that participants with greater global cognition demonstrate greater reactive stepping improvements. We hope to expand this analysis to include a broader range of cognitive domains and identify the neural pathways mediating this relationship. Regarding our MS clinical trial, we are approximately halfway through data collection. The early results mirror what we saw in our PD trial and suggest that two weeks of reactive step training may be a viable approach to improve reactive stepping and prevent falls.

Further, the neural circuitry eliciting these critical responses remains unclear, particularly in neurodegenerative diseases like PD and MS. Within the central nervous system, many cortical and subcortical regions have been proposed to be implicated in reactive balance responses. Moreover, the peripheral nervous system, especially the somatosensory system, plays a vital role in detecting instability and initiating the reactive balance response. However, the unique role of the subsystems of somatosensation, the tactile and proprioceptive senses, in generating reactive balance responses is unknown. Therefore, I am working to understand better the central and peripheral nervous systems' role in reactive balance responses.

## **3) What are your longer term career goals?**

I would like to continue to pose and answer important research questions about neurorehabilitation — to ultimately help optimize treatments to improve gait and balance and quality of life for people with neurologic diseases. Recently, I have become intrigued by the interplay of cognition with freezing of gait and motor learning. These are topics that I would like to expand on in my future research career. I also thoroughly enjoy the mentoring and teaching

aspects of academia and research. This has informed my long-term career goals, where I aspire to find a position where I can continue high-impact research but also foster a sense of curiosity, critical thinking, and problem-solving with students and trainees.

To learn more, you can connect with Andrew on [Twitter](#) and [LinkedIn](#).