



# ABSTRACT PROCEEDINGS

Inaugural Meeting of the Ontario Society for Posture and Gait Research

**June 4-5, 2026**  
**York University**



# Schedule of Events

## Thursday June 4, 2026

**12:30 - 1:30PM** - Registration

(Vanier Foyer)

**1:30 - 2:30 PM** - Opening Remarks and Keynote

(Vanier College Rm. 135)

**2:30 - 3:30PM** - 3MT® - Three Minute Thesis

(Vanier College Rm. 135)

**3:30 - 3:45PM** - BREAK

(Founders Assembly Hall)

**3:45 - 5:00PM** - Panel 1: Priorities for Balance and Mobility in the  
Community: Lived Experiences

(Vanier College Rm. 135)

**5:00 - 7:00PM** - Poster Session 1

(Founders Assembly Hall)





# Schedule of Events

## Friday June 5, 2026

**9:00 - 10:00AM** - Mentorship and Networking Breakfast

(Founders Assembly Hall)

**10:00 - 11:00AM** - Panel 2: Where am I? Career Paths Outside of Academia

(Vanier College Rm. 135)

**11:00 - 12:00PM** - Conceptualizing Lab-to-Market: A Conversation Around  
Innovation and Regulatory Processes

(Vanier College Rm. 135)

**12:00 - 1:00PM** - LUNCH

(Founders Assembly Hall)

**1:00 - 2:30PM** - Poster Session 2

(Founders Assembly Hall)

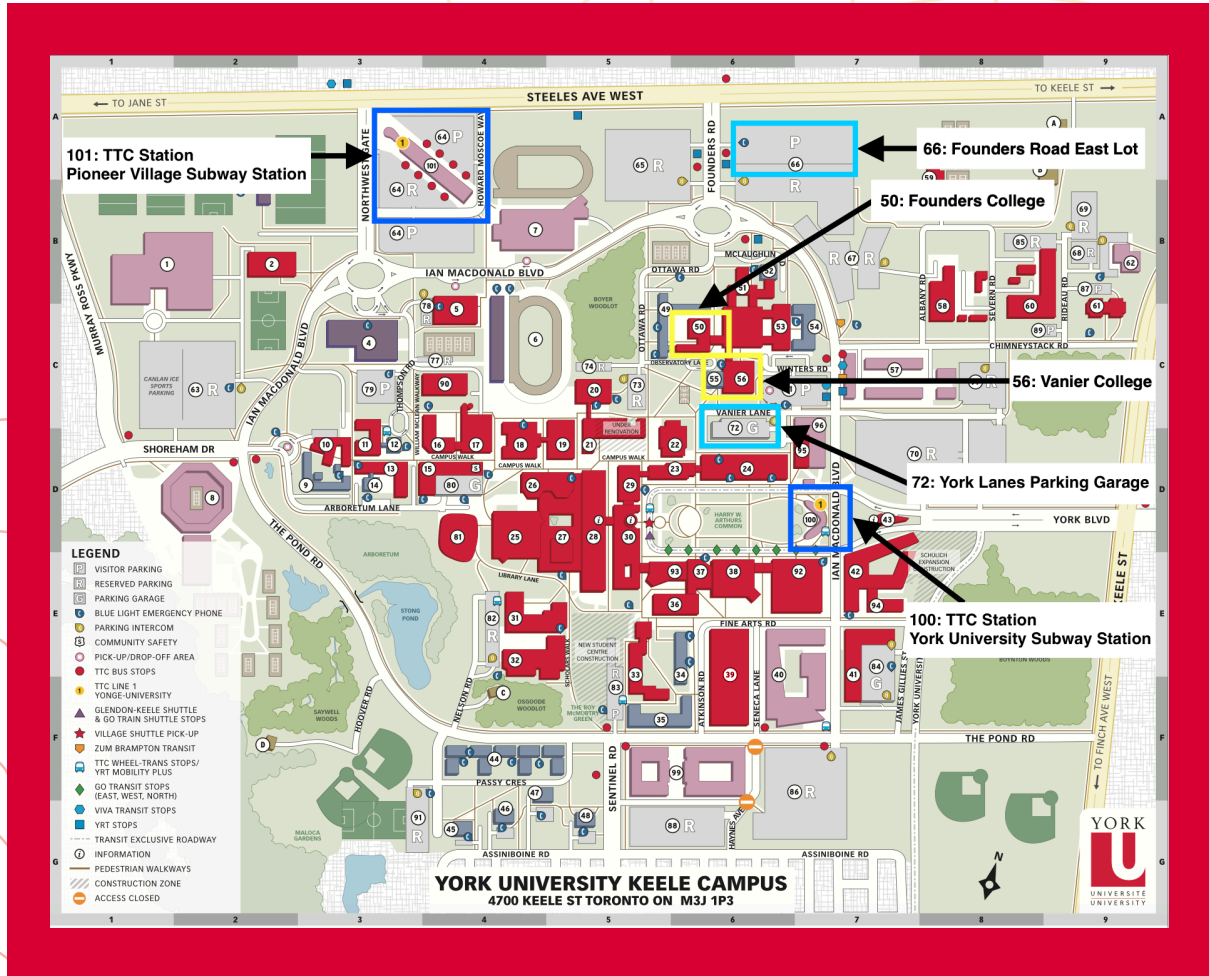
**2:30 - 3:30PM** - Discussion - Vision for the Future of OSPGR, Wrap Up, and  
3MT® Winners

(Vanier College Rm. 135)



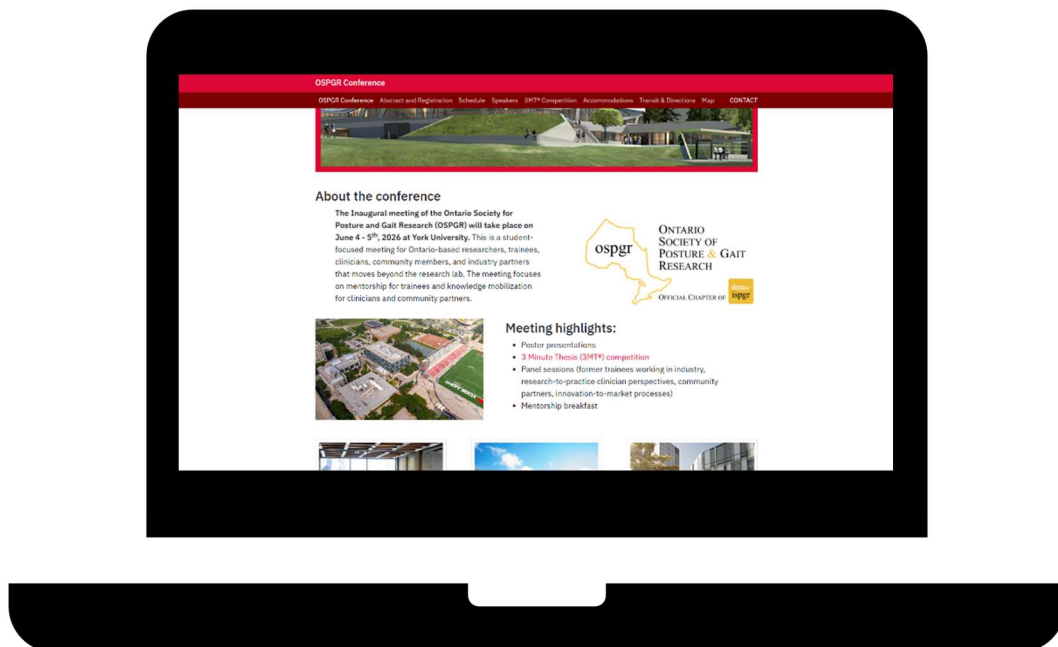


# Campus Map



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# OSPGR 2026 | Abstract Proceedings

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## **List of 3MT<sup>®</sup> Competitors & Poster Presentations**

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2. **Siobhan Gallagher**  
Pain in the Brain: How Pain Competes for Attention During Dual-Task Walking
3. **Nastassia Kaddour**  
The Relationship of Pre-Stroke Physical Activity and Post-Stroke Knee-Related Symptoms
4. **L. Maureen Krelove**  
Neurobehavioural Predictors of Mobility in Healthy Adults: a focus on the mid-life years
5. **Paul Oakley**  
The Identification of Distinct Fall-risk Phenotypes in Adults with Chronic Spine Pain: A Prospective Multi-center Study
6. **Fatemeh Shomal Zadeh**  
Ankle Co-Contraction Increases Joint Stiffness and Postural Sway During Quiet Standing
7. **Isabella Tait**  
A Functional Near-Infrared Spectroscopy Investigation into the Influence of Real-World Auditory Stimuli on Internal Perturbations in Healthy Young Adults

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Non-linear Analysis of the Center of Pressure as a Marker for the Changes in the Conscious Control of Balance in Athletes with and Without a History of Concussion
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## OSPGR 2026 | Abstract Proceedings

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**16. Nourallah Salem**

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Examining the effects of movement perception during balance tasks

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Influence of error augmented practice using internal and external errors for learning a new balance task

**9. Jackson Kelly**

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**12. Jennifer Le**

Fear-Induced Changes in Motion Detection Thresholds During Support-Surface Translations

**13. Kimia Mahdavian**

How does credit assignment of error during practice of a balance task influence generalizability of learning?

**14. Tessa Marengueur**

Does the number of approaching pedestrians and their configuration affect collision avoidance behaviours?

**15. Ariyana Morady**

A Heelstrike Detection Algorithm For Fractal Analysis of Gait

**16. Cecilia Power**

The Role of Plantar Sensation in Gait Complexity: Fractal Analysis of Sensory Modulation

**17. Kyle Sage**

Balance Considerations for Work Boots

**18. Marcel Tesolin**

A Frequency Evaluation of a Virtual Reality Sensory Interaction Balance Test (VR-SIBT)

## Emily McIntosh 3MT<sup>®</sup> Competition Abstracts

**Full name:** Patrick Crowley

**Affiliation:** Wilfrid Laurier University

**Title:** Do Insole Texture and Midsole Hardness Improve Dynamic Balance in Individuals with Parkinson's Disease?

**Authors:** Crowley, P. F., Perry S. D.

**Type:** 3-Minute Thesis

**Topic:** Gait, Falls, and Cognition;

**Abstract:** Falls are the leading cause of accidental deaths and injuries in older adults, with a significant financial burden on the Canadian healthcare system [1]. Fall risk increases in older adults with neurological disorders, such as Parkinson's disease (PD), further compromising balance control [2]. Footwear design has emerged as a potential intervention to improve balance in high fall-risk populations. Footwear has potential to improve mechanical stability and provide enhanced sensory feedback for improved balance outcomes, yet these functional characteristics are often not considered when selecting footwear. Features like insole texture, and high midsole hardness have shown promise in enhancing dynamic balance [3]. However, the effects of these features on balance control remain indeterminate, with limited research exploring their impact. This study investigated the neuromodulatory effects of insole texture and midsole hardness during a dynamic balance task, hypothesizing that both insole texture and increased hardness midsole would enhance balance by augmenting sensory input from the plantar surface of the foot. 10 older adults with PD (3 female; 65.1 (4.41) years), and 6 without (5 female; 67.3 (1.1) years), have been recruited thus far (target sample size: 15 per group). Participants performed a 10-meter walking task wearing standardized footwear (Converse, All-Star) during medication 'on phase'. Participants completed four blocks of ten trials, each representing one condition in a  $2 \times 2$  factorial design of insole texture (present or absent) and midsole hardness (typical to normal footwear or hard). To assess dynamic balance, gait termination (GT) was randomly cued during three trials per block using an auditory buzzer. Participants were instructed to stop suddenly into a side-by-side stance when cued, simulating the need for dynamic postural adjustment. Force plates will be used to determine foot contact and environmental force application (COP). Base of support (BOS), contact with the environment, and whole-body center of mass (COM), the central point of body mass, will be calculated from kinematic recordings. Surface electromyography of the tibialis anterior, medial gastrocnemius and peroneus longus will be used to assess compensatory muscle activation. Intervention effectiveness will be assessed through GT performance, using COM-COP and COM-BOS relationships during gait termination, supplemented by peak and average EMG activity between the GT cue. To date, data from 16 participants has been collected and analyzed. While statistical analysis is preliminary, trends suggest that in the PD group, both texture and hard midsoles increased mediolateral and anteroposterior COM-COP maximums on the stance leg following a GT cue. The combination of textured surface and hard midsole produced the greatest COM-COP maximum overall. Additionally, the textured-hard midsole condition appeared most effective in increasing anteroposterior COM-COP minimum.

**Full name:** Siobhan Gallagher

**Affiliation:** University of Ottawa, Human Kinetics

**Title:** Pain in the Brain: How Pain Competes for Attention During Dual-Task Walking

**Authors:** Gallagher, S., Salzman, T., Segura-Jiménez, V., Prasana, R., Scott, A., Fraser, S.

**Type:** 3-Minute Thesis

**Topic:** Gait, Falls, and Cognition;

**Abstract: Background:** Everyone experiences pain at some point in their life, and this does more than just hurt; it also shapes how we think and move in day-to-day activities. Pain can draw attention away from tasks, making it more difficult to concentrate and engage in activities that would normally feel easy. In situations that require more attention, for example walking and talking (or dual tasking), pain can interfere and compete for our limited attentional resources. This can alter a person's mobility, increase fall risk, and may contribute to avoidance of everyday activities and social isolation. The goal of this research is to understand how pain effects the ability to manage cognitive and physical tasks individually and simultaneously during dual-task walking.

**Methods:** Healthy younger adults (18-30 years old) will complete a working memory task (N-back), walking tasks, and dual-tasks under pain and no-pain conditions. Pain is safely induced using a pressure cuff and adjusted to each participant's individual pain tolerance. Brain activity is measured using functional near-infrared spectroscopy (fNIRS), a non-invasive neuroimaging technique that tracks prefrontal cortex activity associated with attention and decision-making. Performance outcomes will include gait speed, N-back task accuracy, and response times across both conditions.

**Expected Outcomes:** The goal of this study is to identify any changes in cerebral oxygenation and performance during dual-task walking in healthy younger adults comparing no pain and induced acute pain conditions. It is expected that younger adults will exhibit increased cerebral oxygenation levels in the dual-task condition compared to the single tasks. In the acute pain condition during the dual-task, it is expected that this increase in prefrontal cortex oxygenation will be attenuated. Finally, it is hypothesized that younger adults will maintain their walk and cognitive performance between no pain and pain induction conditions. Through identifying how pain disrupts the balance between movement and cognition, this work may improve the understanding of brain-behaviour interactions associated with pain.

**Full name:** Nastassia Kaddour

**Affiliation:** University of Western Ontario- Health and Rehabilitation Sciences

**Title:** The Relationship of Pre-Stroke Physical Activity and Post-Stroke Knee-Related Symptoms

**Authors:** Kaddour, N

**Type:** 3-Minute Thesis

**Topic:** Rehabilitation and Intervention; Aging and Development;

**Abstract:** One in three individuals requires rehabilitation globally, with stroke and knee osteoarthritis among the two major conditions driving this need. In Canada, more than 350,000 people live with long-term stroke-related impairments, and one-third also have arthritis. Knee osteoarthritis causes chronic pain, stiffness, functional limitations, and reduced mobility. Stroke survivors with knee OA report that it “holds them back” in their recovery and poses a greater barrier in their daily lives than the stroke itself. This highlights the need to investigate associations between knee-related symptoms and post-stroke recovery and to identify strategies to reduce the burden of recovery. One potential avenue to reduce this burden is engaging in moderate to vigorous physical activity before a stroke. The literature shows that higher levels of pre-stroke physical activity are associated with better post-stroke outcomes and are a primary predictor of survivors’ recovery trajectories. A systematic review further supports these findings, reporting a consistent association between longer duration, higher intensity, and greater overall volume of pre-stroke physical activity and post-stroke outcomes. Collectively, this evidence suggests that long-term physical activity exposure enhances overall physical resilience and provides musculoskeletal benefits.

To find the relationship between pre-stroke physical activity and post-stroke knee symptoms, this study will aim to recruit a sample of 120 first-time stroke survivors from the stroke rehabilitation department at Parkwood Institute in London, Ontario. Pre-stroke physical activity will be measured using the Lifetime Physical Activity Questionnaire. The LTPAQ quantifies the amount of active physical activity an individual has performed across their lifetime in three domains: sports/recreation, work and household tasks. Post-stroke knee-related symptoms will be measured by the Knee Injury and Osteoarthritis Outcome Score and the Stroke Impact Scale. KOOS is a patient-reported outcome measure to assess outcomes from knee injury through to OA. The SIS is a patient-reported outcome measure that captures the patient's perspective on stroke recovery and patients’ impairments and disabilities. A multiple linear regression model will be used to find the relationship. The study is expected to examine the relationship between pre-stroke physical activity and post-stroke knee-related symptoms and to determine whether this relationship differs by sex, while accounting for relevant confounding variables. The hypothesis is that higher levels of moderate-to-vigorous pre-stroke physical activity will be associated with fewer post-stroke knee-related symptoms, and that this relationship will differ between males and females. Results will be shared with stroke survivors, physiotherapists, and researchers to highlight the relationship identified.

Results will also be presented at conferences to further raise awareness about this topic.

**Full name:** L. Maureen Krelove

**Affiliation:** York University, School of Kinesiology & Health Science

**Title:** Neurobehavioural Predictors of Mobility in Healthy Adults: a focus on the mid-life years

**Authors:** Krelove, L. M., Mochizuki, G.

**Type:** 3-Minute Thesis

**Topic:** Gait, Falls, and Cognition; Aging and Development;

**Abstract: Background:** Falls are a leading cause of injury in Canadian seniors. In the face of an aging population, fall prevention is a high research and public health priority. Fall etiology is complex and occurs at neural, cognitive, and behavioural levels. There are established age-related changes in neural function, motor output, and cognitive capacity between young (YA; age 18-34) and older adults (OA; age 65+). This includes the allocation of executive resources by the prefrontal cortex (PFC), which tends to increase with age, and associated behavioural outcomes, such as gait velocity, which tends to decrease with age. Current literature focusses on neurobehavioural differences between YA and OA from a mobility perspective; however, the physiological alterations associated with fall risk begin during middle-age (MA, age 35-64). This cohort also experiences an increase in fall occurrence. Despite this, MA remain an understudied population in mobility research. The objective of this work was to determine the timing of the divergence of neurobehavioral correlates of mobility capacity from YA levels towards OA neurobehavioural patterns. It was expected that PFC activity and gait velocity would deviate from YA patterns in the midlife range of 50-64.

**Methods:** Using a validated complex gait dual-task involving word recall and virtual obstacle avoidance, PFC activity and gait velocity were measured using fNIRS and a pressure sensitive mat across four conditions: walk, walk + distraction, walk + obstacles, and walk + obstacles + distraction.

**Results:** Locally weighted scatterplot smoothing was applied to neurobehavioural data from 113 healthy participants aged 18-79 years (mean age  $54.0 \pm 19.5$  years, 74 female) to produce a data-driven smoothed curve. A piecewise linear regression applied to the smoothed data revealed significant deviation from YA patterns of neural activity and gait behaviour between ages 52-56 across measures and conditions.

**Conclusions:** This work, for the first time, shows that PFC activity and gait velocity deviate from YA levels during mid-life. These outcomes may reflect the emergence of compensatory neural strategies in mid-life in response to brain and body aging, which can be modified through adulthood. These results suggest that mid-life may be a critical window for identifying risks of mobility decline and intervening to reduce the risk of falls before they happen.

**Full name:** Paul Oakley

**Affiliation:** York University, Kinesiology & Health Sciences

**Title:** The Identification of Distinct Fall-risk Phenotypes in Adults with Chronic Spine Pain: A Prospective Multi-center Study

**Authors:** Paul A. Oakley, William H. Gage, George Mochizuki

**Type:** 3-Minute Thesis

**Topic:** Gait, Falls, and Cognition;

**Abstract: Background:** Chronic spine pain is linked to altered sensorimotor control and impaired postural stability, potentially increasing fall risk across the lifespan. Although fall screening traditionally targets older adults, individuals with persistent neck and/or back pain may demonstrate balance deficits independent of age. We hypothesized that distinct fall-risk phenotypes exist within a chronic spine pain population and that demographic, psychosocial, radiographic postural, and balance characteristics would differentiate fallers from non-fallers.

**Methods:** In this prospective multi-center study, 325 adults with chronic spine pain were recruited from seven clinics (April–December 2024). Thirty-five participants reporting at least one fall in the prior 12 months were age- and sex-matched to 35 non-fallers ( $n=70$ ). Measures included demographics (age, sex, BMI), psychosocial variables (pain, disability, SF-36, Falls Efficacy Scale-International [FES-I], kinesiophobia), static radiographic posture, and force-plate center-of-pressure (COP) metrics from the modified Clinical Test of Sensory Integration and Balance. Between-group differences were assessed using Mann-Whitney U tests. Significant variables were entered into a two-step cluster analysis to identify homogeneous phenotypes. Cluster validity was evaluated using silhouette coefficients, chi-square testing for falls distribution, logistic regression odds ratios, and receiver operating characteristic (ROC) curve analysis.

**Results:** Fallers and non-fallers did not differ in age, pain intensity, disability, symptom duration, or kinesiophobia ( $p \geq 0.30$ ). Fallers demonstrated worse falls efficacy ( $p=0.020$ ), poorer SF-36 social and role-emotional scores ( $p \leq 0.033$ ), greater sagittal forward trunk inclination (T1S1SVA,  $p=0.026$ ), and higher mediolateral COP variability during eyes-open firm standing (ML-RMS,  $p=0.030$ ). Cluster analysis identified three phenotypes defined by age, FES-I, and mediolateral stability. Cluster 1 (older, higher fear) and Cluster 3 (younger, elevated mediolateral instability) showed significantly greater fall prevalence than Cluster 2 (younger, low fear, stable mediolateral control) ( $\chi^2 p=0.027$ ). Odds of falling were 3.27 times higher in Cluster 1 and 4.62 times higher in Cluster 3 compared to Cluster 2. ROC analysis demonstrated good discrimination for age (AUC=0.858; cutoff 41.5 years) and FES-I (AUC=0.780; cutoff 7.5) in identifying the age/fear phenotype.

**Discussion:** Two distinct fall-risk pathways were identified in chronic spine pain: (1) an age- and fear-related phenotype and (2) a mediolateral instability phenotype affecting younger individuals. Fall risk was not explained by pain intensity or disability alone, underscoring its multidimensional nature. These findings support phenotype-based screening incorporating falls efficacy and mediolateral stability, enabling targeted rehabilitation strategies beyond traditional age-centric fall prevention models.

**Full name:** Fatemeh Shomal Zadeh

**Affiliation:** Institute of Biomedical Engineering, University of Toronto

**Title:** Ankle Co-Contraction Increases Joint Stiffness and Postural Sway During Quiet Standing

**Authors:** Shomal Zadeh, F., Kumar N., Lee J., Lee J., Kumbhare D., Masani K.

**Type:** 3-Minute Thesis

**Topic:** Aging and Development; Rehabilitation and Intervention; Measurement and Modelling  
;Gait, Falls, and Cognition;

**Abstract:** Postural instability and falls are prevalent in older adults and individuals with neurological disorders, where increased ankle muscle co-contraction is commonly observed. Although co-contraction is thought to increase joint stiffness and improve stability, both experimental and modelling studies have shown that greater co-contraction is associated with increased postural sway during quiet standing. One key limitation of previous studies is that co-contraction has been induced voluntarily, making it difficult to distinguish the mechanical effects of co-contraction from concurrent changes in neural control. Therefore, it remains unclear whether increased sway results from altered neural control or from the mechanical consequences of co-contraction itself. Here, we investigated whether ankle co-contraction imposed using neuromuscular electrical stimulation (NMES) is sufficient to destabilize quiet standing. Seventeen healthy adults performed quiet standing under a control condition and three NMES-induced co-contraction conditions. NMES was applied bilaterally to the soleus (SOL) and tibialis anterior (TA) at three intensity levels to approximate physiologically relevant co-contraction levels (~30–40% maximum voluntary contraction). Muscle stiffness was quantified using shear wave elastography. Ankle joint quasi-stiffness was estimated using recorded kinematics and kinetics data. Postural sway was assessed using the standard deviation of center of mass acceleration and center of pressure velocity. Within-subject associations were evaluated using repeated-measures correlation, and linear mixed-effects models were used to determine the independent contributions of SOL and TA stiffness. NMES-induced co-contraction significantly increased ankle joint quasi-stiffness by 19–24% ( $p < 0.001$ ) and postural sway by 45–50% ( $p < 0.001$ ). Increasing co-contraction intensity produced progressive increases in both joint stiffness and sway, with evidence of a plateau at higher intensities. Repeated-measures correlation revealed that lower SOL/TA stiffness ratios (reflecting greater relative TA contribution) were strongly associated with increased joint stiffness and greater postural sway. Linear mixed-effects models showed that TA stiffness, but not SOL stiffness, was the only significant predictor of both joint stiffness and postural sway across all outcomes. NMES-imposed ankle co-contraction increased ankle joint quasi-stiffness and postural sway during quiet standing. These findings suggest that increased joint stiffness alone may not improve postural stability. Greater relative dorsiflexor contribution, reflected by a lower SOL/TA stiffness ratio, was associated with greater joint stiffness and postural sway. Although increased co-contraction may serve as a compensatory strategy in neurological populations, it may also contribute to increased postural sway, with important implications for rehabilitation strategies targeting balance control.

**Full name:** Isabella Tait

**Affiliation:** Western University, Department of Neuroscience

**Title:** A Functional Near-Infrared Spectroscopy Investigation into the Influence of Real-World Auditory Stimuli on Internal Perturbations in Healthy Young Adults

**Authors:** Tait, I., Green, T., & Peters, S.

**Type:** 3-Minute Thesis

**Topic:** Sensorimotor Control; Adaptation and Coordination of Posture and Gait;

**Abstract: Background:** Balance is not only challenged by external forces. Our own movements, such as stepping or reaching, create internal perturbations. During these moments, the brain integrates sensory information to maintain stability. Auditory information has been found to be a part of this process, as constant, low-salience noise provides spatial cues. However, sudden, salient noises can disrupt balance. Since multiple sounds occur simultaneously in everyday environments, the aim of this study is to demonstrate how these real-world auditory conditions influence internal balance control.

**Methods:** Healthy young adults will complete tasks of internal perturbations while listening to auditory stimuli of varying salience, including quiet, constant low-salience noise, and unpredictable high-salience sounds. Cortical activity will be measured using functional near-infrared spectroscopy (fNIRS), a portable neuroimaging technique that measures changes in cortical oxygenation during movement. Postural control will be assessed using pressure insoles to quantify postural sway. Analyses will focus on cortical regions associated with auditory processing, multisensory integration, attention, and motor planning.

**Expected Outcomes:** It is hypothesized that real-world auditory stimulation differentially modulates postural control and cortical engagement during internal perturbations depending on its salience. High-salience auditory stimuli are hypothesized to increase postural sway and cortical recruitment in regions associated with attentional control and movement planning, while low-salience sounds may provide a stabilizing auditory reference that supports balance control. Overall, this study will contribute to a more ecologically valid understanding of how sensory information influences balance. With this baseline established in healthy young adults, future work could compare these findings to those with sensory-processing or hearing deficits to inform sensory-based rehabilitation and fall-risk prevention strategies.

## Poster Session 1 Abstracts

**Full name:** Diana Ariana Kian

**Affiliation:** York University, School of Kinesiology and Health Science

**Title:** Non-linear Analysis of the Center of Pressure as a Marker for the Changes in the Conscious Control of Balance in Athletes with and Without a History of Concussion

**Authors:** Ariana Kian, D., Dang, N., & Mochizuki, G.

**Type:** Full Research

**Topic:** Adaptation and Coordination of Posture and Gait; Sensorimotor Control;

**Abstract: Background:** Balance impairments are among the most common acute consequences of sports related injuries. However, clinical tests and self-reported symptoms may fail to detect subtle persistent deficits in individuals with a history of concussion who have returned to activity. Spatiotemporal measures of the center of pressure (COP), such as root mean square (RMS) may not fully capture changes in postural control following concussion. In contrast, non-linear measures such as sample entropy (SampEn) may provide greater sensitivity to these subtle balance impairments. It remains unclear whether SampEn is more effective than RMS in distinguishing athletes with and without a concussion history across various balance tasks. This study investigated whether SampEn provides greater sensitivity than RMS in identifying postural control differences between varsity athletes with and without a history of concussion across balance task conditions of varying difficulty.

**Methods:** A secondary analysis was conducted using pre-season baseline data collected from first-year varsity athletes with ( $n = 50$ , mean age  $19.6 \pm 2.4$  years) and without a history of concussion ( $n = 50$ , mean age  $19.4 \pm 2.0$  years). Groups were matched for age, sex, and sport. For each trial, COP data were collected for 30 seconds at a sampling frequency of 25 Hz. Participants completed four quiet stance balance conditions on the BTrackS force platform: eyes open firm, eyes closed firm, eyes open foam, and eyes closed foam. SampEn and RMS values were calculated in the mediolateral (M/L) and anteroposterior (A/P) directions.

**Results:** Receiver Operating Characteristic (ROC) analyses demonstrated weak overall discrimination ( $AUC = 0.419\text{--}0.611$ ). However, SampEn Y during the eyes closed foam condition was the only measure significantly above chance ( $AUC = 0.611$ ,  $p = 0.048$ ), indicating that SampEn Y was the only measure that distinguished cohorts. Mixed-design ANOVAs revealed no significant main effects of concussion history or interaction effects. A significant main effect of task condition was observed across all measures ( $p < 0.001$ ), indicating that balance task difficulty influenced COP regularity and sway magnitude.

**Discussion:** Overall, both cohorts demonstrated similar balance control characteristics across various task conditions. The absence of significant differences between groups likely reflects the recovered athlete sample utilized in this study. Task difficulty affected COP regularity despite the absence of a main effect of concussion history. These findings suggest that SampEn may be useful as a complementary measure of postural control in addition to other markers of concussion history.

**Keywords:** Center of Pressure (COP), non-linear analysis, approximate entropy, sample entropy, balance, concussion

**Full name:** Shayna Borhan

**Affiliation:** School of Kinesiology and Health Sciences, York University

**Title:** Compensation in neural recruitment across aging and its association with balance and fall risk: A Scoping Review

**Authors:** Borhan, S., Labrovic, A., & Mochizuki, G.

**Type:** Full Research

**Topic:** Adaptation and Coordination of Posture and Gait;Gait, Falls, and Cognition;Aging and Development;

**Abstract: Introduction:** Impaired balance in older adults is increasingly associated with age-related cognitive decline and elevated fall risk. However, the relationship between age-related neural recruitment changes and their collective impact on balance control remains inconsistently explained across cognitive aging frameworks. Although these frameworks individually describe compensatory or efficiency-related neural shifts, their collective contribution to balance control remains unclear. This study aims to synthesize and examine gaps in existing literature to understand how theories of neural compensation in aging integrate with one another to support both cognitive performance and mobility.

**Methods:** A search on a curated Zotero library and PubMed was conducted, targeting literature published between 2000 and 2025 based on the following criteria: a) studies including participants across a wide age range, enabling comparison between age groups and b) studies examining age-related changes in cognition and mobility. Search terms included concepts related to ‘aging’, ‘fall-risk’, ‘mobility’, ‘compensation’, ‘balance’, and ‘neural activation’, combined using AND to refine searches.

**Results:** A total of fifty-one peer-reviewed articles were identified. Forty-one were included in analysis after screening for eligibility based on the inclusion criteria. Collectively, they describe postural ability and neurological recruitment as age-related changes, which have been explored through a variety of frameworks: HAROLD, PASA, COMPENSATION, CRUNCH, STAC, and STAC-r. Aging is associated with reduced specificity, automaticity, and efficiency in cognitive and motor tasks, implying limited resources. Compensation preserves mobility initially, however, it becomes limited as neural efficiency and cognitive reserve decline. Combined with age-related musculoskeletal changes, shifts in neural activation are linked with compromised balance control and gait speed, leading to increased fall risk when task demands exceed available cognitive resources.

**Discussion:** The six theories highlight how underlying neural processes may interact to explain how interacting neural and physical age-related changes contribute to increased fall risk as cognitive load increases and resources become increasingly divided. Accurately differentiating compensatory mechanisms from task familiarity and retest effects is difficult in mobility-related experiments. Limited evidence exists in current literature for long-term changes in neural activation shifts. These frameworks suggest that mobility is influenced by an integration of neural activation, cognitive resource allocation, and physical constraints that progressively reduce the effectiveness of compensation during increases in task demands, ultimately reducing the quality of life.

**Full name:** Maya Crespi

**Affiliation:** York University, School of Kinesiology and Health Science

**Title:** Neural correlates of brain age and functional gait capacity during dual task treadmill walking in middle-aged and older adults: A research proposal

**Authors:** Crespi, M., & Mochizuki, G.

**Type:** Proposal

**Topic:** Gait, Falls, and Cognition; Aging and Development;

**Abstract: Background:** Features of structural brain scans can be used to infer one's 'brain age', with predicted age deviation (PAD) characterizing differences in comparison to one's chronological age. A positive PAD indicates an older appearing brain and is associated with increased risk of neurodegenerative disease, cognitive decline, and death. Although structural brain-age models capture age associated neurodegeneration, their relationship to age-related functional changes and the neural correlates underlying these changes have not been fully explored. Gait velocity and dual tasking are two key functions that decline with age and may reflect changes in executive function. The ability to increase speed from self-selected to maximal pace can be defined as functional gait capacity and is essential for effective community ambulation. Application of EEG during walking may identify the neural correlates of brain age during gait. Ongoing work in our lab also suggests that alterations in cortical activity and gait velocity begin to occur in the 5th decade of life. Menopause is an important midlife stage for women that has been linked to brain age. The aim of this research is to probe the relationship between PAD and functional gait capacity during single and dual task walking, and to characterize the neural correlates of this relationship in healthy middle age and older adults. A sub analysis on menopausal women in the study will investigate the relationship between reproductive lifespan and the neural correlates of brain age.

**Methods:** Participants aged 35 to 79 will be recruited for this study. Participants will undergo T1-weighted MR imaging to attain structural brain data and predicted brain age will be calculated using an MRI-based brain age prediction model. Self-selected and maximum walking speed will be measured using the 10-meter walk test. Then, participants will walk on a treadmill at the pre-determined self-selected and maximum paces with a dual task and without. A full head EEG system (64-channel, ANT-Neuro) will be used to determine spectral power changes in theta and beta bands within frontal and parietal regions. Expected outcome: Individuals with a positive PAD will experience lower gait capacity and greater increases in the theta-beta ratio in frontal and parietal regions, compared to individuals with negative PAD. Additionally, those with a lower gait capacity will show greater increases in theta-beta ratio during dual task activities compared to single tasks. In the sub analysis, it is expected that women with a shorter reproductive span will have an older predicted brain age and lower gait capacity, which will be associated with a greater frontal and parietal theta-beta ratio compared to women with longer reproductive spans. This work will deepen understanding of the relationship between age-related structural changes, functional brain changes, and declines in gait to provide better insight into the functional decline in mobility with age.

**Full name:** Kaitlyn Dang

**Affiliation:** University of Waterloo

**Title:** Neural and Autonomic Correlates of Static Postural Control in Healthy Aging and Parkinson's Disease

**Authors:** Dang, K., & Ehgoetz Martens, K. A.

**Type:** Proposal

**Topic:** Gait, Falls, and Cognition; Sensorimotor Control; Aging and Development; Measurement and Modelling ;

**Abstract: Background:** Postural control is crucial for fall prevention and is largely automatic in healthy young adults. In aging and Parkinson's disease (PD), reduced automaticity may increase cognitive reliance, especially during dual-tasking or altered sensory input. This increased reliance may involve greater prefrontal-motor activation linked to attention, executive control, and motor planning. Functional near-infrared spectroscopy (fNIRS), a non-invasive neuroimaging tool, can capture this activation through cortical blood oxygenation. However, elevated cortical activation remains ambiguous as it may reflect compensation, increased cognitive demand, or neural inefficiency. This is further complicated by slow hemodynamic responses, which limit fNIRS sensitivity to rapid cognitive shifts. Pupillometry may address this ambiguity by providing a sensitive index of cognitive effort via changes in pupil diameter. This study aims to determine whether pupil-indexed cognitive effort can differentiate adaptive compensation from inefficient prefrontal-motor cortical recruitment during static balance in young adults (YA), older adults (OA), and individuals with PD.

**Methods:** Using a cross-sectional, repeated-measures design, 25 healthy YA, 25 individuals with PD, and 25 age-matched healthy OA will complete balance trials under progressively greater sensory and cognitive demands to examine group differences in postural, neural, and physiological responses. Participants will perform 16 one-minute narrow-stance trials on a force plate, with dual-task type and vision condition (eyes-open/occluded) pseudo-randomized. Each trial will include 30 seconds of quiet standing, followed by 30 seconds of dual-tasking. Dual tasks will include a simple reaction time (SRT) task requiring button-press responses to tones and a choice reaction time (CRT) digit-monitoring task. Outcomes will include centre of pressure (CoP) displacement, sway velocity, sway area, prefrontal-motor oxygenation, pupil diameter, galvanic skin response (GSR), reaction time (RT), and perceived workload using the NASA Task Load Index (NASA-TLX). Analyses will examine group, task, and vision effects, as well as associations among outcomes.

**Expected Outcomes:** We hypothesize that increased prefrontal-motor activation and pupil dilation, alongside stable CoP outcomes (displacement, sway velocity, sway area), will reflect successful compensatory recruitment, whereas similar increases accompanied by poorer CoP outcomes may indicate inefficient cortical recruitment and impaired balance control. Effects are expected to increase with cognitive and sensory demand, especially during eyes-occluded CRT trials, and to be greatest in people with PD, followed by OA and YA. Additional changes may include increased GSR, RT, and perceived workload. Findings may support pupillometry as a sensitive marker of cognitive effort during postural control, aiding earlier identification of fall-risk-related changes in OA and PD.

**Full name:** Kristen De Melo

**Affiliation:** Department of Human Health Sciences, University of Guelph

**Title:** A Virtual Reality (VR) Simon Effect Approach to Assessing Motor-Cognitive Interference in Younger (YA) and Older (OA) Adults

**Authors:** De Melo, K., Marino, E., & Vallis, L.A.

**Type:** Full Research

**Topic:** Gait, Falls, and Cognition; Sensorimotor Control; Aging and Development; Rehabilitation and Intervention;

**Abstract: Background:** Maintaining motor-cognitive integration is essential for independence and quality of life (QoL), particularly in OA [1]. Dual-task performance declines with increasing task complexity and deteriorates with age, potentially reflecting early neurological dysfunction, increased fall risk, and interference within shared motor-cognitive pathways [2]. The Simon Effect [3] (SE) provides a framework to examine this interference. Although motor and cognitive training may improve dual-task performance, further work is needed to clarify underlying mechanisms and compare cognitive-only versus motor-cognitive training approaches.

**Methods:** Participants (N=48; 24M; YA:  $21.7 \pm 2.9$  years; OA:  $71.6 \pm 6.6$  years) completed a SE task in two VR environments (trail, hallway; HTC Vive Pro 2) at baseline. Participants walked in the direction indicated by an arrowhead while ignoring its spatial location. Trials were congruent, incongruent, or neutral based on alignment between arrow direction and spatial position. Participants were assigned to cognitive (CG), motor-cognitive (M-CG), or control groups. Training occurred twice weekly for 30 minutes over four weeks and included Task Switch (TS), Flanker (FL), and Posner (POS) tasks. The CG responded to the tasks using keystrokes, while the M-CG responded by walking; controls received no training. Baseline testing was repeated at Week 6, with an optional one-month retention follow-up at Week 10.

**Results:** Preliminary baseline data showed that, compared to YA, OA walked more slowly and took longer to approach the pathway obstruction (repeated measures ANOVA;  $p < 0.05$ ). OA also shifted from narrow, longer steps during straight walking to wider, shorter steps during obstruction trials, resembling typical YA gait patterns ( $p < 0.05$ ). During training, OA M-CG performance improved across all three tasks from Session 1 to Session 8, reflected by significantly decreased reaction/completion times (t-test;  $p < 0.05$ ), whereas YA M-CG improved only in the FL task ( $p < 0.05$ ). In the CG, both YA and OA improved only in the TS task from Session 1 to Session 8 ( $p < 0.05$ ). Data collection is complete, and early results of the retest session will be shared.

**Discussion:** At retest, we hypothesize that targeted training will reduce dual-task costs and improve functional performance, particularly in OA, with the greatest improvements expected in the MC-G, followed by the CG. Findings highlight age-related vulnerabilities in dual-task performance and suggest that cognitive control and movement coordination are promising training targets. Through targeted training, this protocol aims to enhance mobility and functional resilience, with findings that may inform scalable, low-risk interventions to support independence, QoL, and proactive, person-centred care.

**References:** [1] Ghai et al. (2017). Clin Interv Aging (12), 557.; [2] Zhou et al. (2023). Lancet Healthy Longev 4(3), e98-e106.; [3] Scorolli et al. (2015). Cogn Sci, 39(5), 972-991.

**Full name:** Julia De Oliveira

**Affiliation:** University of Guelph, Human Health Sciences

**Title:** Mind, Motion, and Maturity: Comparing Cognitive-Locomotor Performance and Practice Effects in Children and Young Adults

**Authors:** De Oliveira, J., & Vallis, L.A.

**Type:** Full Research

**Topic:** Gait, Falls, and Cognition; Aging and Development; Adaptation and Coordination of Posture and Gait; Sensorimotor Control;

**Abstract: Background:** Everyday activities often involve cognitive-motor dual-tasking (CMDT) where concurrent movement and external sensory processing tasks are performed simultaneously [1]. CMDT can lead to cognitive interference between tasks due to limited cognitive resources and, in adaptive locomotor tasks, has shown altered performance, such as increased foot clearance [1]. Following long-term task-specific CMDT training, a decrease in locomotor variability has been observed in young adults (YA) [2]. However, less is known about the effects of cognitive interference on adaptive locomotor performance in school-aged children and age-appropriate training strategies. Although children adopt adult-like gait patterns by 7 years of age, executive function development such as inhibition (the ability to ignore irrelevant information) continues to develop [3,4]. Therefore, the purpose of this study is to examine age differences in cognitive-motor integration through CMDT performance and the effects of task-specific training in children and YA.

**Methods:** Participants (YA, 18-25 yrs; typically developing children, 7-9 yrs) wore a microphone on their chest to capture cognitive task responses while locomotor task responses were recorded by a 12-camera system tracking 32 retroreflective markers placed on the body (Optitrack; 120Hz; Corvallis, USA). After familiarization, participants completed 20 consecutive single-task (ST) obstacle clearance and auditory Stroop trials followed by 20 dual-task (DT) trials (obstacle avoidance + auditory Stroop). Next, participants completed one of three training paradigms; No Training (watched nature video, seated), ST training (20 ST auditory Stroop and 20 ST obstacle trials), or DT training (20 DT trials). Following ~1hr break, participants completed a DT retest (20 trials).

**Results:** Preliminary multivariate ANOVA results (N=4 YA; N=3 children) revealed a main effect of age at baseline for step width standard deviation (SD) ( $p=0.005$ ) and trail foot clearance ( $p=0.015$ ). Following training, a main effect of age was also observed for step width SD ( $p=0.008$ ) and trail foot clearance ( $p=0.010$ ). Of note, child mean step width SD was ~double that of YA and reduced by 3.9 cm in children compared to YA.

**Discussion:** Although children may appear to have adult-like gait by the age of 7 years, there are still age-related differences. Children demonstrated increased variability in base of support control and reduced safety margin for trail limb obstacle clearance compared to YA. As visual guidance of the trail foot over the obstacle is absent, the latter finding could suggest immature sensorimotor integration. Future analysis will explore DT effects in more detail and focus on possible mechanisms for age differences, including segmental control strategies.

References: [1] Worden et al, Gait & Post, 2016; [2] Worden & Vallis, J Mot Behav, 2014; [3] Assaiante & Amblard, Hum Mov Sci, 1995; [4] Best & Miller, Chil Dev, 2010

**Full name:** Allegra Favaretto

**Affiliation:** York University, School of Kinesiology and Health Science

**Title:** Sensory Re-weighting Mechanisms During Postural Control Following Concussion

**Authors:** Favaretto, A. 1., Dang, N. 2., Mochizuki, G.3.

**Type:** Full Research

**Topic:** Adaptation and Coordination of Posture and Gait; Sensorimotor Control;

**Abstract: Background:** To optimize balance control, the brain modulates reliance on inputs from visual, vestibular, and somatosensory systems (sensory re-weighting). This process is impacted following concussion. This study examined differences in sensory re-weighting in those with acute concussion (AC) and persistent concussion symptoms (PCS) during quiet standing.

**Methods:** Fourteen healthy controls, thirteen AC participants, and eleven with PCS completed the Clinical Test of Sensory Interaction on Balance (CTSIB) on a forceplate; participants maintained postural control while standing for 30 seconds under six conditions, each affecting the reliability/availability of each sensory modality. Center-of-pressure (COP) spectral power was calculated for frequency bands corresponding to each sensory modality; ultra-low frequency bands ( $< 0.1$ Hz, vision), very-low frequency bands (0.1 - 0.39 Hz, vestibular), and low and moderate frequency bands (0.39 – 6.25 Hz, proprioception). These were used to derive the mean power frequency, the proportional power of each band, and the ratio of vestibular and proprioception to vision (VESTPROP:VIS) across conditions in both antero-posterior (AP) and medio-lateral (ML) directions.

**Results:** There was a significant main effect of group and condition for VESTPROP:VIS in both ML and AP directions, with AC showing lower ratios than PCS, which persisted in eyes-closed (EC), eyes-closed, foam surface (ECF), visual conflict dome (D) and visual conflict dome, foam surface (DF) conditions. There was a significant main effect of group and condition for proportional power in the ultra-low frequency band (PROPUL) in both AP and ML directions, with PCS showing lower values compared to AC.

**Discussion:** AC individuals demonstrate an increased reliance on vision for postural control. Persistence of visual reliance in conditions designed to disrupt/remove visual input (EC, ECF, D and DF) may suggest an abnormal reliance on visual feedback. The PCS group suggest a shift towards reliance on vestibular and proprioceptive feedback. This shift may reflect progression towards more typical sensory integration patterns, indicating partial recovery of physiological mechanisms for postural control. However, recovery in PCS may be incomplete. As CTSIB task difficulty increased, particularly in D and DF conditions, PCS individuals illustrated a re-emergence of visual reliance. Thus, postural control recovery following concussion may be characterized by evolving and context-dependent control strategies. **Conclusion:** Mechanisms of sensory re-weighting differ between those with acute concussion and persistent concussion symptoms. Visual use is predominant in AC injury. Those with persistent symptoms have partial resolution of task-dependent sensory re-weighting, but some deficits persist. The CTSIB may be a tool that identifies lingering balance impairments as targets for intervention.

**Full name:** Rayna Ghosh

**Affiliation:** University of Toronto - Insitute of Biomedical Engineering

**Title:** Destabilizing Functional Electrical Stimulation as an Internal Perturbation Paradigm for Studying Gait Adaptation

**Authors:** Ghosh, R., Miyata, T., Kimura, K., Masani, K.

**Type:** Proposal

**Topic:** Adaptation and Coordination of Posture and Gait;

**Abstract: Background:** Perturbation paradigms were widely used to investigate the mechanisms of gait stability and motor adaptation during walking. Most existing paradigms rely on externally applied mechanical disturbances such as slips, trips, or treadmill perturbations. Functional electrical stimulation (FES), which is typically used to facilitate movement by activating specific muscles, can also be applied at non-physiological timings to deliberately disrupt gait. Destabilizing functional electrical stimulation (DFES) uses this approach to generate controlled internal perturbations during walking. Whereas external mechanical perturbations challenge gait by applying forces to the body, DFES perturbs locomotion by artificially generating mistimed muscle activation patterns during walking, potentially mimicking abnormal neuromuscular activity. Our prior findings demonstrated that stimulation of the biceps femoris (BF) at 75% of the gait cycle produced quantifiable perturbations in gait kinematics. Here we investigated whether DFES induces the characteristic behavioral signatures of motor adaptation during walking, including progressive adaptation, catch-trial responses, and aftereffects, similar to those observed in split-belt treadmill walking.

**Methods:** Three neurologically intact participants completed treadmill walking trials consisting of baseline walking (5 minutes), dysfunctional functional electrical stimulation (DFES; 12 minutes), and post-stimulation walking (8 minutes). DFES was applied during walking trials targeting the biceps femoris (BF) using surface electrodes, with stimulation triggered relative to specific gait phases. Kinematic data were collected using a marker-based motion capture system. Marker trajectories were used to extract spatiotemporal gait parameters and lower-limb kinematics across walking conditions.

**Expected Outcomes:** Preliminary findings demonstrate characteristic features of motor adaptation. DFES produced an immediate perturbation in gait variables, followed by gradual recovery toward baseline during continued stimulation. Removal of the stimulation elicited aftereffects in the opposite direction, indicating short-term recalibration of locomotor control. These findings support the feasibility of DFES as a controlled internal perturbation paradigm for studying gait adaptation and motor control during locomotion.

**Full name:** Tim Green

**Affiliation:** University of Western Ontario- Health Rehabilitation Sciences

**Title:** A Multimodal Investigation of Corticomuscular Coupling During Internal Perturbations in People with Chronic Stroke, Healthy Young Adults, and Age-Matched Adults

**Authors:** Green, T., Tait, I., Fleet, J., Viana, R., Peters, S.

**Type:** Proposal

**Topic:** Adaptation and Coordination of Posture and Gait; Sensorimotor Control;

**Abstract: Background:** Motor impairments are a common sequela of stroke and can result in postural imbalance and decreased functional independence<sup>1</sup>. Maintenance of balance requires communication between cortical motor regions and muscles through feedforward and feedback control processes<sup>2</sup>. Post-stroke, altered cortical activation, delayed postural muscle activation, impaired balance responses, and compensatory strategies have been noted<sup>3-13</sup>. However, cortical and muscular activity post-stroke is commonly examined independently, limiting the understanding of how these systems interact during functional movement. A multimodal approach integrating electroencephalography (EEG), functional near-infrared spectroscopy (fNIRS), and surface electromyography (sEMG) will address limitations of uni-modal approaches and will provide a comprehensive understanding of spatiotemporal cortical activation and corticomuscular coupling<sup>14-18</sup>. Improved understanding of these relationships can provide insight into the neuromuscular mechanisms underlying impaired postural control following stroke.

**Methods:** 84 participants, evenly split between healthy young adults, chronic stroke patients, and healthy age matched adults, will complete two internal perturbation tasks: (1) a rapid shoulder flexion of the dominant/non-paretic arm and (2) a unilateral step of the non-dominant/paretic foot<sup>12,19</sup>. Participants will wear EEG, fNIRS, sEMG, accelerometers, and pressure insoles during testing. EEG and fNIRS will assess cortical activation within the supplementary motor area (SMA) and primary motor cortex (M1)<sup>20-24</sup>. sEMG will assess activation of the bilateral medial gastrocnemius and biceps femoris muscles. Accelerometers will identify movement onset, while pressure insoles will quantify center of pressure changes associated with the perturbation. Dynamic causal modelling (DCM) will be used to examine effective connectivity and directional relationships between cortical regions and postural muscles during the perturbations. The DCM parameters will subsequently be compared between groups using a multivariate analysis of covariance.

**Expected Outcomes:** During the preparatory phase of the perturbations individuals post-stroke are expected to demonstrate significantly reduced effective connectivity between the SMA and the M1 compared to healthy controls. Additionally, during the perturbation it is expected that effective connectivity between the M1 of the lesioned hemisphere and the contralateral postural muscles will be significantly reduced compared to healthy controls. In contrast, individuals post-stroke are expected to exhibit significantly increased effective connectivity from the contralesional M1 to bilateral postural muscles, suggesting compensatory cortical recruitment strategies. Collectively, these findings will reveal altered corticomuscular network organization associated with stroke and provide insight into the neurophysiological mechanisms underlying impaired postural control.

**Full name:** David Imeson

**Affiliation:** University of Waterloo, Kinesiology and Health Sciences

**Title:** Effects of Ladder Type and Orientation on Joint Moments and Stability During Manual Materials Handling

**Authors:** Imeson, D.H., Hooper, L., Patten, D., Laing, A.C.

**Type:** Proposal

**Topic:** Rehabilitation and Intervention; Measurement and Modelling ;

**Abstract: Introduction:** In Ontario musculoskeletal disorders (MSDs) accounted for nearly 34% of all lost time claims to the workplace safety insurance board (WSIB) between 2020 and 2024 [1]. Within the retail sector specifically, 41% of all claims during this period were the result of sprains or strains [1]. Manual materials handling (MMH) tasks performed from ladders and step stools are common in retail environments and impose unique biomechanical challenges on workers which may exacerbate the risk of developing MSDs or falling [2,3]. Specifically, performing MMH on ladders can result in elevated arm postures, greater reach distances, constrained bases of support for the feet, [3,6] all of which may amplify shoulder joint loading while reducing postural stability [2,3,4]. Additionally, little evidence exists on how self-perceived safe reach distances change as the result of ladder use. Despite these potential challenges to biomechanical demands and risk exposures, current ergonomic risk assessment tools provide no validated adjustments for ladder-based lifting tasks.

**Aim:** This study will quantify net joint moments of the shoulder, the minimum margin of stability (MMOS), and changes in self perceived safe reach distances during an MMH task across ladder conditions and multiple reach distances and box masses. This work will provide evidence to help refine safe-practice guidelines or risk assessment tools for performing MMH on ladders.

**Methods:** Thirty healthy adults (15 male, 15 female) will complete 56 trials across combinations of four ladder conditions, two load magnitudes, three anterior-posterior reach distances, and one “balance prioritization” trial where participants are asked to prioritize balance over all other task constraints. Full body kinematics will be collected using an optoelectronic motion capture system. Kinematic data will be analyzed using Visual 3D, where top-down inverse dynamics will be used to calculate peak net shoulder joint moments for each trial. Additionally, full body CoM position and CoM velocity during each trial will be used to assess postural stability based on the MMOS derived from the extrapolated center of mass model and base of support formed by the feet [5].

**Expected Results:** It is expected that outcomes will differ between ladder and no-ladder conditions, with ladder use (step stool or step ladder) leading to increased joint moments and reduced stability. These differences are expected to be amplified under more demanding MMH task conditions, such as handling heavier boxes and reaching outside the midline. Additionally, it is expected that ladder type (step stool vs. step ladder) will produce distinct biomechanical and stability demands, such that in all task configurations use of the step ladder will result in greater peak net joint moments and decreased postural stability.

**Full name:** Lianna Montanari

**Affiliation:** University of Toronto & KITE Research Institute UHN

**Title:** Longitudinal Effects of Hearing Aids on Mobility: A Research Proposal

**Authors:** Montanari, L., Campos, J.L.

**Type:** Proposal

**Topic:** Gait, Falls, and Cognition; Aging and Development; Rehabilitation and Intervention;

**Abstract: Background:** Age-related hearing loss (ARHL) is a significant but under-acknowledged risk factor for falls and mobility problems. Individuals with even mild hearing loss are at 3x greater risk of falling than age-matched peers, a risk that increases 1.4x with every 10 dB increase in hearing loss severity. Several mechanisms have been hypothesized to underlie this relationship including: 1) increased cognitive load as a result of greater listening effort which reduces the available overlapping cognitive resources required to support mobility and 2) limited access to environmental auditory cues leading to reduced situational and environmental awareness. Though evidence remains limited, hearing aids may mitigate fall risk by reducing cognitive load during mobility-related activities and improving environmental awareness and auditory feedback during walking. This longitudinal randomized controlled trial therefore aims to determine whether hearing aid use improves mobility-related outcomes in older adults with ARHL, and to identify the mechanisms through which these improvements may occur.

**Methods:** Eighty participants with untreated mild-moderate ARHL will be randomized to an intervention group, where they will be given hearing aids, or a control group (20 males and 20 females in each group, 65+ years of age, with no major health conditions). In-lab assessments will occur at baseline, 3 months, and 18 months, with interim self-report measures (e.g., self-perceived hearing, mobility, awareness abilities, falls, and near misses) completed at home. In lab assessment will use StreetLab, a virtual reality simulator at the KITE Research Institute. Participants will be immersed in a dynamic urban environment while performing a listening task (speech-in-noise task), a walking task (crossing an intersection), and/or responding to emerging environmental hazards (e.g., approaching vehicles). Tasks will be performed under single-task (walking and listening independently) and dual-task (walking while listening) conditions. Outcome measures will include gait and balance performance, dual-task walking stability (e.g., walking speed, stride time/length variability, double support time, centre of pressure excursions) and self-reported fall rates. Secondary outcomes will include hazard reaction time and dual-task costs to listening performance.

**Expected Outcomes:** It is hypothesized that hearing aid use will improve mobility, reduce dual-task costs and hazard detection time, and lower self-reported falls. By rigorously tracking several different measures of gait and balance longitudinally pre- and post-hearing aid intervention, we can more definitively quantify how hearing aids affect one's ability to maintain safe mobility. Findings may inform clinical practice, device design, and the integration of hearing care into broader healthy aging strategies.

**Full name:** Paul Oakley

**Affiliation:** York University, Kinesiology & Health Sciences

**Title:** A selective review of Chiropractic BioPhysics® methods employed to correct sagittal cervical spine misalignment after motor vehicle collision

**Authors:** Paul A. Oakley, Carly A.J. Hallett, Jason W. Haas, Deed E. Harrison

**Type:** Full Research

**Topic:** Rehabilitation and Intervention;

**Abstract: Background:** Motor vehicle collisions (MVCs) expose occupants to acceleration–deceleration forces that can alter normal cervical lordosis. Sagittal plane deformities such as hypo-lordosis, kyphosis, and increased anterior head translation (AHT) are associated with whiplash-associated disorders (WAD), persistent neck pain, headache, and disability. Recovery is often incomplete when symptoms extend beyond the acute phase. Chiropractic BioPhysics® (CBP®) utilizes mirror-image exercises, spinal manipulation, and cervical extension traction to restore sagittal alignment. This selective review characterized clinical evidence describing CBP structural rehabilitation of sagittal cervical misalignment in patients with cranio-cervical symptoms following MVC.

**Methods:** The CBP NonProfit research database was reviewed to identify clinical studies reporting CBP cervical extension traction in MVC-injured patients. A supplemental search (August 2025–May 1, 2026) was conducted in PubMed and the Index to Chiropractic Literature. Eligible studies included case reports, case series, and cohort designs describing patients with radiographically documented sagittal cervical misalignment following MVC treated with CBP methods targeting lordosis restoration and AHT reduction. Outcomes included radiographic measures, pain intensity, neck disability, treatment duration, and follow-up findings.

**Results:** Eight case reports, two case series, and one cohort study (n=51) met inclusion criteria. Case reports/series described 22 patients (mean age  $42 \pm 13$  years) treated over  $3.2 \pm 1.8$  months ( $33.7 \pm 11.5$  visits). Mean improvements included a  $12.2 \pm 7.3^\circ$  increase in C2–C7 lordosis,  $11.4 \pm 6.3^\circ$  increase in atlas plane line, and  $9.3 \pm 14.0$  mm reduction in AHT. These structural changes corresponded with a  $4.4 \pm 1.7$ -point pain reduction and  $29.6 \pm 19.0\%$  decrease in neck disability. Follow-up ( $\approx 11$  months) in six reports demonstrated maintenance of alignment and symptom improvement, often with supportive care. The cohort study reported a  $12.2 \pm 4.3^\circ$  lordosis increase and  $12.6 \pm 4.2$  mm AHT reduction over  $7.9 \pm 1$  months ( $64.5 \pm 4.7$  treatments), with a  $4.8 \pm 0.9$  pain reduction and  $47.5 \pm 9.0\%$  disability reduction.

**Discussion:** CBP methods demonstrated consistent restoration of sagittal cervical alignment after MVC, accompanied by clinically meaningful reductions in pain and disability. Improvements of approximately  $12^\circ$  in lordosis and 9–13 mm in AHT support the premise that post-collision sagittal deformity may contribute to persistent symptoms and represent a rehabilitation target. Durability at follow-up suggests possible viscoelastic remodeling with extension traction. However, evidence is largely limited to case reports and series, with one cohort study. The absence of randomized controlled trials and potential publication bias limit firm conclusions. Prospective controlled studies are needed to clarify the role of structural cervical rehabilitation in WAD management.

**Full name:** Allison Penner

**Affiliation:** Wilfrid Laurier University

**Title:** The effects of textured foot orthoses on balance during gait perturbation in diabetic peripheral neuropathy

**Authors:** Penner, A., & Perry, S.

**Type:** Proposal

**Topic:** Gait, Falls, and Cognition; Rehabilitation and Intervention;

**Abstract: Introduction:** Diabetic peripheral neuropathy (DPN) is a common complication of diabetes characterized by progressive sensory loss in the plantar surface of the foot [1]. This sensory impairment is associated with reduced balance control and an increased risk of falls, which occur in approximately 39% of adults with diabetes over the age of 65 [2]. Reduced plantar sensory input limits the ability to detect foot-ground interactions, leading to altered plantar pressure distribution, delayed neuromuscular responses, and impaired balance during gait [3, 4]. Interventions such as textured insoles and foot orthoses have been proposed to improve balance through distinct mechanisms, including sensory augmentation and mechanical support; however, their combined effects during gait perturbation in DPN remain unclear. **Aim:** This study aims to investigate the effects of textured insoles, foot orthoses, and their combination on balance during gait perturbations in individuals with DPN.

**Methods:** Twenty adults aged 30-50 years with diabetes and reduced plantar sensation will be recruited from local clinics. Participants will complete walking trials along a 10 m walkway with embedded perturbation plates producing medial-lateral tilts. Four conditions will be tested in a block-randomized design: control (standard insole), textured insole, foot orthosis, and combined condition. Kinematic, kinetic, electromyography, and plantar pressure data will be collected. Primary outcome measures include medial-lateral center of pressure displacement, center of mass-center of pressure separation, muscle onset latency, and peak plantar pressure. Data will be analyzed using repeated-measures ANOVA with condition as a within-subject factor.

**Expected Results:** It is hypothesized that both sensory augmentation and mechanical support will improve balance during perturbed gait, with the combined condition producing the greatest improvements in balance and neuromuscular control.

**Full name:** Nora Pourhashemi

**Affiliation:** York University, School of Kinesiology & Health Sciences

**Title:** Examining the relationship between visually evoked postural responses and functional age

**Authors:** Pourhashemi, N., & Cleworth, T.W.

**Type:** Full Research

**Topic:** Aging and Development;

**Abstract: Background:** Falls are a major concern in aging populations and are associated with sensorimotor declines that increase visual reliance for upright stance. Although visual dependence increases with age, chronological age alone may overlook variability in functional capacity that influences balance. Age-related changes in postural control are associated with functional capacity, including muscle strength, plantar sensation, and visual motion sensitivity. To examine the influence of vision on balance control, dynamic visual cues can be presented in virtual reality (VR) to evoke postural responses associated with visual input, known as visually evoked postural responses (VEPRs). Previous work has shown that visual feedback manipulations reveal age-related differences in postural control; however, further work is needed to understand how sensorimotor-related functional measures explain variability in visual contributions to balance control beyond chronological age alone. Therefore, the purpose of this study is to examine changes in VEPRs during quiet and dynamic stance to determine how functional age assessments may influence visual contributions to balance control. It is hypothesized that VEPRs will be larger during dynamic stance, particularly in individuals with higher functional age, suggesting that functional assessments may identify age-related changes in postural control beyond those explained by chronological age alone.

**Methods:** 48 adults were recruited for this study. Prior to experimental trials, participants completed functional assessments, including tactile sensitivity, muscle strength, visual acuity, motion sensitivity, and visual dependence (computerized rod and frame task). Participants stood for eight 120-second trials while wearing a VR head-mounted display (HMD): four quiet standing trials on a stationary platform and four dynamic standing trials on a motorized tilting platform, under either a visual perturbation or sham condition. A pseudorandom visual stimulus was presented at frequencies  $<2\text{Hz}$  for visual perturbation conditions only. During dynamic stance conditions, participants stood on the platform, which pseudorandomly tilted in the anteroposterior (AP) direction at frequencies  $<1\text{Hz}$ . Whole-body kinematics and surface electromyography (EMG) from lower-leg muscles were recorded. Mean activity, spectral power, and gain (output/input; postural response/platform or visual stimulus) were calculated for centre of mass and normalized EMG.

**Results:** Functional assessments showed variability in muscle activity-related postural responses beyond chronological age. Results indicated larger VEPRs during dynamic stance, while platform-evoked responses were greater during visual perturbation than sham conditions. **CONCLUSION:** Visual contributions to balance control are better revealed under dynamic stance conditions. Age-related changes in balance are not fully explained by chronological age, supporting the inclusion of functional assessments.

**Full name:** Ria Prasana

**Affiliation:** University of Ottawa, Interdisciplinary School of Health Sciences

**Title:** Exploring Cerebral Oxygenation and Executive Function in Older Adults with Subjective Cognitive Decline: A Dual-Task Verbal Fluency and Walking Study

**Authors:** Prasana, R., Fenwick, B., Gallagher, S. & Fraser, S.

**Type:** Proposal

**Topic:** Gait, Falls, and Cognition;

**Abstract: Background:** Subjective cognitive decline (SCD) is considered a potential early indicator of Alzheimer's disease and related dementias, yet it remains difficult to detect due to the absence of objective impairments on standardized cognitive tests. Functional near-infrared spectroscopy (fNIRS) is a portable, non-invasive neuroimaging technique that enables the measurement of cerebral oxygenation during movement. Dual-task paradigms that combine cognitive and motor demands may reveal subtle cognitive changes by increasing executive load and reducing compensatory mechanisms. This study investigates cerebral oxygenation and executive function of older adults with and without SCD during a cognitively demanding dual-task involving walking and alternating verbal fluency.

**Methods:** Forty older adults aged 60 years and older (20 with SCD; 20 without SCD) are being recruited from the Ottawa community. Day 1 included health screening, neuropsychological, mood, and motor assessments. SCD classification was based on self-reported cognitive concerns. On Day 2, participants wearing an fNIRS device completed single- and dual-task conditions involving walking and alternating verbal fluency. Prefrontal cortex activity (PFC): changes in oxygenated ( $\Delta\text{HbO}_2$ ) and deoxygenated hemoglobin ( $\Delta\text{HbR}$ ) and behavioural measures [gait speed (m/s) and verbal fluency performance (words/second)] were captured. Data will be analyzed using task by group repeated-measures ANOVAs.

**Expected Outcomes:** Preliminary findings ( $n = 23$ ) suggest greater left PFC activation, slower gait speed during dual-tasking, and reduced word production during more demanding alternating verbal fluency tasks. Larger changes in  $\Delta\text{HbO}_2$  and  $\Delta\text{HbR}$  have also been observed under higher executive demand conditions. In comparison to older adults without SCD, those with SCD are expected to demonstrate greater PFC during dual-task conditions, reflected by increased  $\Delta\text{HbO}_2$  and decreased  $\Delta\text{HbR}$ , suggesting compensatory neural recruitment. Individuals with SCD are anticipated to show poorer dual-task performance, including slower gait speed, reduced verbal fluency, and greater dual-task costs compared to non-SCD individuals. Findings from this study may contribute to identifying early neural and behavioural markers of cognitive decline and support the development of more sensitive approaches for early dementia risk detection using ecologically valid tasks.

**Full name:** Nourallah Salem

**Affiliation:** York University, Department of Kinesiology and Health Sciences

**Title:** Investigating cortical contributions to the visual control of balance using an MRI-compatible balance simulator

**Authors:** Salem, N., Cleworth, T. W.

**Type:** Proposal

**Topic:** Sensorimotor Control; Aging and Development;

**Abstract: Background:** Balance control has been historically understood to involve subcortical activation; however, previous work has shown cortical involvement in a context-dependent manner. With aging, older adults demonstrate increased reliance on vision for balance due to peripheral sensory decline in the vestibular and somatosensory systems, associated with a compensatory shift from subcortical to attentional cortical control. The neural substrates underlying the visual control of balance and age-related changes in visual reliance remain poorly understood, partly because upright balance is incompatible with the supine posture required for functional magnetic resonance imaging (fMRI). To address this, our group developed and validated an MRI-compatible balance simulator using visual feedback to investigate brain networks involved in visual balance control. However, this version of the simulator lacked visual cues relevant to upright stance such as optic flow, depth, and distance cues that provide information on the body's position relative to the environment. To address this limitation, this current study aims to: 1) validate an updated version of the simulator that provides more realistic, balance-relevant visual cues through a virtual room paradigm, and 2) investigate age-related changes in brain networks underlying visual balance control.

**Methods:** Validation: Data were collected from 19 healthy young adults (mean age  $20.2 \pm 3.6$  years). Participants completed real standing balance trials on a custom-built force plate and simulated balance trials while lying supine in a mock MRI setup, maintaining simulated postural equilibrium using ankle-driven corrective centre of pressure (COP) displacements guided by optic flow feedback in a virtual art gallery scene on a monitor above them. Amplitude (RMS) and frequency (MPF) of anteroposterior COP displacements were compared across conditions to quantify balance behaviour. Preliminary results show no significant RMS or MPF differences between real and simulated balance.

**fMRI Investigation:** Data will be collected from 20 young (18–40 years) and 20 older adults (65–75 years) using a 3T MRI scanner. Participants will complete four 7.5-minute runs with alternating 120s blocks of: 1) simulated balance task, 2) visual-only control task, and 3) motor-only control task, separated by 30s rest fixation. Generalized Psychophysiological Interactions (gPPI) analysis will examine functional connectivity (FC) during simulated balance relative to controls, compared between age groups to identify age-related differences in task-related network organization.

**Expected Outcomes:** Regions implicated in simulated balance are expected to include visual association and multisensory integration cortices in the parietal, temporal, and occipital lobes. Greater FC between these regions and frontal areas is predicted in older adults, reflecting increased visual reliance and attentional demand during balance.

**Full name:** Sara Weinberg

**Affiliation:** York University, School of Kinesiology and Health Science

**Title:** Balance and skilled motor performance are associated with brain structure and function in female elite athletes with sub-concussive exposure

**Authors:** Weinberg, S. E., Smeha, N., Gorbet, D. J., Sergio, L. E., & Cleworth, T. W.

**Type:** Full Research

**Topic:** Sensorimotor Control;

**Abstract: Background:** Mild traumatic brain injuries are a significant health concern in Canada. Individuals suffer from a myriad of symptoms, which impacts their ability to perform daily activities. Many skills necessary to perform activities of daily living (ADLs) require individuals to think and move at the same time, an ability known as cognitive-motor integration (CMI). A validated upper extremity CMI task has demonstrated how CMI performance breaks down with age and neurotrauma; however, the addition of a whole-body postural-related CMI task may allow for a more comprehensive analysis of skills required for ADLs. While previous work has validated this whole-body CMI task in healthy individuals, it has yet to be used to assess individuals with sub-concussive impact exposure. Therefore, the purpose of this study is to examine the long-term impacts of concussion and sub-concussive exposure in elite female athletes.

**Methods:** Elite female athletes with concussion history (or sub-concussive exposure) between the ages of 30 – 65 years were recruited, with 12 of 30 participants collected thus far. Participants completed 2 CMI tasks: a tablet task to assess upper extremity CMI and a balance task to assess whole-body CMI. Both tasks varied in difficulty, ranging from direct interactions with targets to indirect interactions requiring increased CMI, including visual feedback reversal. Next, participants performed a balance assessment, where vision and support surface were manipulated. Lastly, participants underwent magnetic resonance imaging (MRI), consisting of T1-weighted anatomical scans, diffusion tensor imaging, and resting-state functional MRI.

**Results:** For both the upper extremity and whole-body CMI tasks, conditions requiring increased CMI resulted in poorer task performance. In addition, performance differences between the standard and CMI conditions were larger in the whole-body task compared to the upper extremity task. For the balance assessment, vision (eyes open vs. eyes closed) and surface (firm vs. foam) affected quiet stance. For the neuroimaging data, CMI performance was associated with age and white matter integrity (WMI), where poorer performance was evident with increased age and lower WMI (corticospinal tract, corpus callosum). Furthermore, balance was associated with age, functional connectivity (FC), and WMI, whereby increased age, higher FC (somatomotor network), and lower WMI (corticospinal tract, superior longitudinal fasciculus II) were associated with poorer balance performance.

**Discussion:** These results suggest a relationship between sensorimotor integration and brain changes following exposure to repetitive head impacts. Lower WMI may reflect less effective white matter communication, while increased FC could represent a reduction in network efficiency. In comparison to volumetric measures, WMI and FC may serve as more sensitive measures for detecting subtle brain deficits and its influence on skilled motor performance.

**Full name:** Linyun Wu

**Affiliation:** Institute of Biomedical Engineering, University of Toronto

**Title:** A Mechanical Interpretation of Rambling and Trembling During Quiet Standing: Validation Using Able-Bodied and Spinal Cord Injury Data

**Authors:** Wu, L., Shomal Zadeh, F., & Masani, K.

**Type:** Full Research

**Topic:** Measurement and Modelling ;

**Abstract: Background:** Rambling–trembling (RT) analysis decomposes center-of-pressure (COP) trajectories into rambling (RM) and trembling (TR) components. These components are often interpreted as reflecting distinct neural control mechanisms, although direct evidence supporting such interpretations is limited. In this study, we adopted a conservative mechanical interpretation in which RM approximates center-of-mass (COM) motion and TR approximates the displacement between COP and COM (COP–COM). Because COP–COM is theoretically proportional to COM acceleration (COMACC) during quiet standing, we hypothesized that TR would be strongly associated with COMACC. We further expected that individuals with incomplete spinal cord injury (SCI) would exhibit larger RM, TR, and COMACC than able-bodied (AB) controls.

**Methods:** Quiet standing data were analyzed from AB participants and individuals with motor incomplete SCI. COP and horizontal ground reaction forces were recorded using a force platform. Horizontal force was filtered (0.15–4 Hz band-pass) to identify instantaneous equilibrium points, and COP was low-pass filtered at 4 Hz. RM and TR were computed using RT decomposition, and COMACC was calculated from horizontal ground reaction force divided by body mass. Root mean square (RMS) values of RM, TR, and COMACC were calculated in the anterior–posterior (AP) and mediolateral (ML) directions. Cross-correlation analysis was used to quantify the peak correlation coefficient ( $r_{\text{peak}}$ ) and corresponding time lag between TR and COMACC.

**Results:** TR was strongly associated with COMACC across participants in both AP and ML directions ( $r = 0.951$  and  $0.961$ , respectively). Cross-correlation analysis showed strong negative correlations in both groups (typically  $r_{\text{peak}} \approx -0.8$  to  $-0.9$ ) with minimal time lag. Individuals with SCI exhibited significantly larger RM, TR, and COMACC than AB controls in both directions (all  $p < 0.05$ ). Despite these larger amplitudes, the strength and timing of the TR–COMACC relationship were preserved.

**Discussion:** These findings support the interpretation of TR as a practical COP-based approximation of COP–COM dynamics, and RM as a corresponding COM-like trajectory. Using this framework, individuals with incomplete SCI demonstrated increased COM-like sway and increased corrective activity (i.e., COP–COM) during quiet standing. Rambling–trembling analysis therefore provides a simple and mechanically meaningful approach for quantifying standing balance control, with potential applications in both methodological and clinical research.

## Poster Session 2 Abstracts

**Full name:** Saeed Omar Hussein Ali

**Affiliation:** Department of Kinesiology and Health Science, York University

**Title:** Investigating the Attentional Demands Associated with Entraining Gait to a Metronome

**Authors:** Ali, S. O. H., & Gage, W. H.

**Type:** Proposal

**Topic:** Adaptation and Coordination of Posture and Gait; Sensorimotor Control;

**Abstract: Background:** Human gait is naturally variable, with stride-to-stride fluctuations in the time between consecutive heel strikes (inter-stride interval, ISI). Fractal patterns are observed in the variability structure, reflecting long-range temporal correlations organized across multiple time scales. Fractality is quantified using the Fractal Scaling Index (FSI). Healthy gait exhibits persistent correlations ( $FSI \approx 0.7-0.9$ ) whereas values approaching 0.5 reflect a loss of temporal structure and complexity. Gait can be entrained to a fractal metronome, such that the temporal structure of the gait pattern adopts that of the metronome, reflected by closely matching FSI values. Attention reflects a limited processing capacity allocated across concurrent tasks. Insufficient attentional resources during gait are associated with postural instability and increased fall risk. Synchronizing footfalls to a metronome requires continuous monitoring of the cue and ongoing adjustment of step timing to maintain synchrony, potentially increasing attentional demands relative to un-cued walking. It is unclear whether changes in gait FSI during metronome-paced walking reflect genuine entrainment to the temporal structure of the cue, increased attentional demands, or a combination of both mechanisms. The purpose of this study is to investigate the attentional demands associated with metronome entrained walking.

**Methods:** Healthy young adults will complete a preferred walking speed (PWS) test on a motorized treadmill, followed by a three-minute baseline trial to determine mean ISI, used to generate the inter-beat interval for individualized metronome pacing. Participants will complete four 10-minute walking trials at their PWS under each of three counter-balanced conditions: (1) un-cued baseline walking, (2) metronome pacing with  $FSI \sim 1.0$ , and (3) metronome pacing with  $FSI \sim 0.5$ . Attentional demands imposed by walking can be assessed using the probe reaction time (PRT). In this study, a visual probe will appear for 10% of steps ( $\sim 90$  probes per trial) in two of the four trials per condition. Participants will press a handheld button as quickly as possible when the probe appears, and increases in response time will indicate greater attentional demand. Kinematic data will be collected using motion capture, and an ISI time series generated from consecutive heel strikes. Detrended Fluctuation Analysis (DFA) will be used to derive FSI values. Gait FSI will be compared with the metronome FSI to assess whether temporal entrainment to the cue occurred.

**Expected Outcomes:** Gait FSI is expected to adopt the temporal structure of the respective metronome. Walking to a metronome is expected to impose the greatest attentional demand when compared to un-cued walking, this is likely due to the increased temporal complexity and reduced predictability of the auditory cueing pattern. Consequently, probe reaction time is expected to progressively increase from un-cued to metronome walking.

**Full name:** Ayan Amjad

**Affiliation:** University of Toronto - Department of Physical Therapy

**Title:** Reliability and Validity of the Visual Annotation of Locomotion Using a Mobile Application in Adults

**Authors:** Amjad, A. Bezuyen, C. Moghadam, G.H. Humphreys, J. Kulafi, M. Lau, G. Zabjek, K.

**Type:** Proposal

**Topic:** Measurement and Modelling ;

**Abstract: Background:** Observational gait analysis is a fundamental component of physiotherapy assessment; however, its accuracy and consistency are limited by subjectivity and variability, particularly among novice clinicians. Effective clinical assessment requires a standardized framework grounded in the eight sub-phases of gait—loading response, terminal swing, etc.—to ensure consistent identification of deviations and clear communication across care teams. Three-dimensional (3D) motion capture functions as the gold standard for gait analysis, but its cost and lack of portability restrict its pragmatism. Mobile-based annotation platforms may serve as an accessible alternative, but their measurement properties have not been well established. This study aims to evaluate the reliability and validity of a mobile application for visual annotation of spatiotemporal gait events.

**Methods:** In this prospective cross-sectional study, ten able-bodied adults (18–65 years) will complete walking trials under two conditions—typical gait and hindered gait (using an ankle-foot orthosis to induce asymmetry)—recorded simultaneously via a mobile annotation platform and an eight-camera Vicon Bonita 3D motion capture system. To evaluate the application's sensitivity to gait abnormalities, an AFO will be used as a controlled perturbation to induce asymmetries. Twenty second-year MScPT students will independently annotate gait events from video recordings across two sessions separated by one week. To ensure baseline competency, raters will complete a thorough training protocol on gait events and must demonstrate 100% accuracy during practice trials. Temporal parameters (e.g., stance time, swing time, asymmetry indices) will be derived from annotated timestamps. Intra-session, inter-session, and inter-rater reliability will be assessed using two-way random-effects intraclass correlation coefficients (ICC; absolute agreement) and Bland–Altman analyses. Concurrent validity of the mobile annotation platform will be evaluated through agreement with the 3D motion capture gold standard.

**Expected Outcomes:** We expect the mobile-based annotations to show high intra- and inter-rater reliability ( $ICC \geq 0.90$ ), suggesting that student raters can consistently and correctly identify gait parameters across sessions. We also hypothesize that the mobile application will demonstrate strong concurrent validity ( $r \geq 0.80$ ) when compared to 3D motion capture. Finally, we will use paired t-tests to compare early versus late trial blocks to determine if rater accuracy improves as they become more familiar with the software—a potential intra-session learning effect. These results will help validate the platform as a practical tool for gait analysis in both physiotherapy education and clinical settings where advanced instrumentation is unavailable.

**Full name:** Katerina Colalillo

**Affiliation:** York Univeristy, Department of Psychology

**Title:** Investigating the influence of modified optic flow on the perception of balance-related movement

**Authors:** Colalillo, K., Cleworth, T.

**Type:** Proposal

**Topic:** Sensorimotor Control;Adaptation and Coordination of Posture and Gait;

**Abstract: Background:** Effective balance control depends on the nervous system accurately detecting and integrating sensory information from the proprioceptive, vestibular, and visual systems to maintain postural stability. In doing so, the nervous system can use sensory information to guide motor and postural responses to reduce sway and influence the perception of self-motion. Although visual information plays a well-known role in postural control, its contribution to perceptual sensitivity for balance-related movement requires further exploration. In virtual reality (VR) environments, reducing visual information, such as optic flow, can disrupt the relationship between sensory feedback and physical motion, leading to individuals perceiving they are moving less than they are. Previous research has explored the effect of modified optic flow on postural control; however, it remains unclear how much individuals rely on visual information during perceptual postural behaviour while standing quietly. By manipulating optic flow gain using virtual reality, this study aims to determine if vision contributes to the early perception of movement.

**Methods:** Thirty adults between the ages of 18-40 years with no reported neurological, sensorimotor, or musculoskeletal deficits will be recruited for this study. Participants will be asked to stand on a force plate that is mounted on a motorized translating platform that will move in the anterior-posterior (AP) direction (4mm vs 20 mm). Participants will be asked to wear a VR headset that immerses them in a controlled virtual environment where optic flow will be manipulated across three different conditions: reduced, normal, and amplified. Optic flow will be manipulated by applying a gain factor of 0x, 1x, and 4x to the visual display, where a gain of 0 will provide no optic flow feedback while a gain of 1 reflects typical real-world motion. A participant's perceptual threshold for platform movement will be estimated using an adaptive staircase method that will adjust stimulus intensity across trials. Kinematic data will be collected using Vicon motion capture in which reflective markers will be placed on the head, trunk, and lower body and tracked for the duration of the trial. Centre of pressure (COP) data from the force plate will also be used to assess postural responses during perturbations.

**Expected Outcomes:** We hypothesize that an increase in optic flow gain will lead to reduced thresholds. However, lowering optic flow gain is expected to have little to no impact on the perceptual thresholds for balance related movement. Through this research, we aim to enhance our understanding of vision's role in the perception of balance related full body movement and further explore perceptual thresholds involved in balance control

**Full name:** Megan Goar

**Affiliation:** University of Waterloo

**Title:** Vestibulomotor Weighting Associated with Cybersickness in Virtual Reality

**Authors:** Goar, M.H, Barnett-Cowan, M.

**Type:** Full Research

**Topic:** Sensorimotor Control;Adaptation and Coordination of Posture and Gait;

**Abstract:** Cybersickness is a major barrier to the widespread adoption of virtual reality (VR), yet its underlying neurophysiological mechanisms remain poorly understood. This study investigated the relationship between vestibulomotor weighting and cybersickness. Vestibulomotor weighting was quantified using electrical vestibular stimulation (EVS), with coherence and gain between the EVS input and medial-lateral center-of-pressure (ML-CoP) responses indexing the contribution of vestibular input to postural control. Thirty-eight healthy young adults (females  $n=21$ , males  $n=17$ ) completed a standing VR rollercoaster task while receiving continuous stochastic EVS (0–25 Hz;  $\pm 4.5$  mA), with ML-CoP responses recorded using a force plate. Cybersickness was assessed using the Fast Motion Sickness Scale (FMS) and participants were classified as non-sick ( $FMS < 5$ ), medium-sick ( $FMS \geq 5$ ), or high-sick (terminated the VR exposure early due to intolerance). Baseline EVS-ML-CoP coherence across 2.5–8 Hz was significantly greater in high-sick than in non-sick participants, indicating elevated vestibulomotor weighting in individuals with greater susceptibility. During VR, coherence declined over time in symptomatic groups (mean slope =  $-0.0027$  for medium-sick), whereas non-sick participants maintained consistently low coherence (mean slope =  $-0.0005$ ). Despite this reduction, postural sway increased in the high-sick group relative to the medium- and non-sick groups (+29% vs.  $-7\%$  and  $-30\%$  change in ML-CoP RMS), while vestibular-evoked response amplitude decreased (gain reduced by 64% across 2.5–3.5 Hz). These findings indicate that greater baseline vestibulomotor weighting is associated with increased susceptibility to cybersickness, whereas reductions in vestibular contributions during VR reflect adaptive reweighting that is insufficient to prevent instability and symptom progression.

**Full name:** Lauren Hong

**Affiliation:** University of Toronto, KITE - University Health Network

**Title:** Influence of Visual Motion Predictability on Balance and Postural Control

**Authors:** Hong, L. L., Leung, G., Campos, J. L.

**Type:** Proposal

**Topic:** Gait, Falls, and Cognition; Sensorimotor Control;

**Abstract: Background:** Balance control relies on the dynamic integration of multiple sensory inputs, including visual, proprioceptive, and vestibular signals. The brain typically optimizes this process by weighting each sensory input according to its relative reliability. While prior work has examined how degraded or conflicting sensory signals affect balance, less is known about how the predictability of sensory inputs influence this process. Predictable visual motion (optic flow) may enable anticipatory postural control and stable sensory weighting, whereas unpredictable visual motion may disrupt these processes, thereby compromising postural stability. Accordingly, the objective of this study is to examine how the temporal predictability of global optic flow perturbations influences postural stability and neuromuscular responses in physically stationary observers during standing balance.

**Methods:** Participants (18+) will complete a standing balance task in an immersive virtual reality environment while postural sway and lower-limb muscle activity are recorded during optic flow manipulations. Visual stimuli will simulate forward self-motion through a virtual environment, varying in speed (1.5-4.5 m/s) and predictability (predictable vs. unpredictable). Predictability will be manipulated by keeping the temporal onset of each subsequent visual perturbation either consistent or inconsistent. Specifically, predictable blocks will consist of perturbations occurring at fixed temporal intervals (every 3.67 seconds), whereas unpredictable blocks will consist of perturbations occurring at randomized temporal intervals (1-5 seconds). Postural control will be quantified using centre-of-pressure (COP) measures, including path length and velocity, as well as muscle co-contraction metrics (e.g., co-contraction index). Mixed-effects models will be used to examine the effects of perturbation predictability on postural and muscle activity outcomes.

**Expected Outcomes:** It is hypothesized that predictable visual perturbations will result in less postural sway (e.g., shorter COP path length and mean velocity) and earlier, lower amplitude muscle activity compared to unpredictable perturbations due to efficient anticipatory adjustments. Unpredictable perturbations are also expected to induce more variability in postural sway and muscle onset latencies and activation amplitudes, indicating more reactive adjustments. These findings will reveal the potential influence of predictability in postural control and provide insight into sensory integration in balance and adaptive motor control.

**Full name:** Quintin Jaipaul-Rodriguez

**Affiliation:** York University

**Title:** The Effects of Modifying Optic Flow on Vestibular-evoked Balance Responses

**Authors:** Jaipaul-Rodriguez, Q., Weinberg, S. E., & Cleworth, T. W.

**Type:** Proposal

**Topic:** Adaptation and Coordination of Posture and Gait; Sensorimotor Control; Measurement and Modelling ;

**Abstract: Background:** Human balance during upright stance relies on the integration of visual, vestibular, and somatosensory inputs. Within the visual system, optic flow provides cues for self-motion and postural stability. Increasing optic-flow gain reduces sway amplitude and increases sway frequency, whereas reduced optic flow increases sway and decreases stability. Although optic-flow manipulations influence balance, the underlying sensory integration mechanisms remain unclear. One proposed explanation is sensory reweighting, where the central nervous system increases reliance on salient sensory input while down-weighting others. If this mechanism underlies optic-flow effects, increased visual-motion may reduce vestibular contributions to postural control. Electrical vestibular stimulation (EVS), which modulates vestibular afferent firing to evoke reliable postural responses, provides a direct method to quantify vestibular contributions during stance. Therefore, this study will examine how optic-flow gain within virtual reality alters EVS-evoked responses to elucidate sensory mechanisms underlying visual–vestibular interactions in balance control.

**Methods:** Thirty healthy young adults (18–40 years) with no neurological, musculoskeletal, vestibular, or visual deficits will be recruited. Participants will stand barefoot on a force plate while ground-reaction forces and moments are recorded, and unilateral surface electromyography (EMG) is collected from the medial gastrocnemius and tibialis anterior. Vestibular input will be perturbed using stochastic EVS delivered bilaterally over the mastoid processes through an isolated current stimulator ( $\pm 10$  mA output) with a randomly varying amplitude ( $\pm 4$  mA peak-to-peak) and frequency (2–25 Hz). To evoke sagittal-plane vestibular responses, participants will stand with feet together, arms at their sides, head oriented  $90^\circ$  leftward, and elevated  $\sim 19^\circ$ . Participants will also maintain a slight forward lean to ensure continuous plantar flexor muscle activity. The experiment will be conducted in virtual reality using a head-mounted display, where optic-flow gain (0.25x, 1.0x, 4.0x) will be manipulated relative to head motion. EVS and sham conditions will be applied during 90-second trials. Vestibular-evoked balance responses will be assessed using coherence, cumulant density, and gain derived from EVS–EMG relationships. Root mean square and mean power frequency of COP displacement will also be analyzed.

**Expected Outcomes:** It is hypothesized that increasing optic-flow gain will reduce vestibular–muscle coupling and vestibular contributions to postural control through sensory reweighting. Overall, this study will provide insight into how the central nervous system dynamically reweights visual and vestibular information to maintain balance, advancing our understanding of sensory integration mechanisms underlying human postural control.

**Full name:** Kayton Jaksic

**Affiliation:** York University - Kinesiology & Health Sciences

**Title:** Examining the effects of movement perception during balance tasks

**Authors:** Jaksic, K., Pourhashemi, N., & Cleworth, T. W.

**Type:** Full Research

**Topic:** Sensorimotor Control;

**Abstract: Background:** Detecting changes in self-motion is essential for maintaining balance. Vision provides critical sensory information about self-motion relative to the environment, and cortical responses involved in processing these cues are important in controlling upright stance. Previous work has shown that individuals can accurately perceive their movement during dynamic balance; however, it is unknown how movement perception affects balance responses. Cortical activity is modulated during postural tasks, but the relationship between movement perception and these cortical responses remains unclear. Therefore, this study aims to examine the effects of movement perception on cortical activity, objective postural responses, and subjective balance measures during static and dynamic balance tasks.

**Methods:** 21 young adults (18-40 years old) stood upright for 60s during 2 visual conditions (eyes open; EO, and eyes closed; EC), 2 stance conditions (quiet and dynamic), and 2 tracking conditions (tracking and non-tracking) for a total of 8 conditions. For dynamic conditions, participants stood on a support surface that pseudorandomly tilted in the mediolateral direction ( $\pm 2^\circ$ , below 0.5 Hz). For tracking conditions, participants tracked their perceived trunk position using a handheld controller. Electroencephalography (EEG) was used to capture cortical activity from 64 scalp locations, grouped into frontal, parietal, occipital, and temporal regions. Electromyography (EMG) was used to record bilateral muscle activity from erector spinae, tibialis anterior, medial gastrocnemius, and gluteus medius. Kinematic data were recorded using 3D motion capture. Max correlations quantified the relationship between trunk and tracked displacement. Mean spectral activity, frontal-parietal coherence, root mean square of centre of mass (COM) displacement, mean muscle activity, and perceived stability were used to quantify balance responses.

**Results:** Trunk and tracked displacement demonstrated a strong correlation in dynamic conditions, confirming participants tracked sufficiently. Tracking increased theta power (4-7 Hz) in the frontal region yet had no effect on alpha power (8-13 Hz), beta power (13-30 Hz), or frontal-parietal coherence. Eyes closed increased alpha power in the occipital region, while dynamic stance decreased beta power across all regions and increased frontal-parietal coherence in theta and beta bands. Tracking increased COM amplitude, gluteus medius activity, yet reduced perceived stability during EO conditions.

**Conclusion:** Tracking altered balance behaviour, increasing movement amplitude and muscle activity while decreasing perceived stability when eyes were open. Further work is needed to examine movement perception and balance behaviour within populations with increased fall risk.

**Full name:** Alex Kalli

**Affiliation:** University of Toronto and KITE UHN

**Title:** Influence of error augmented practice using internal and external errors for learning a new balance task

**Authors:** Kalli, A., Mahdavi, K., Tremblay, L., Patterson, K.K., Mansfield, A.

**Type:** Proposal

**Topic:** Gait, Falls, and Cognition;

**Abstract: Background:** Error augmented practice is a way of increasing the size or magnitude of errors during practice trials. In motor learning, there are two main types of errors: internal (within our body), and external (outside/the environment). Previous studies have found that when people experience errors during motor skill tasks they learn the skill better. Additionally, there is some debate whether the size of error has an effect on learning outcomes. When errors are large and presented abruptly, the individual will likely assign the source of error to an external source. Conversely, when the errors are small and presented gradually, the source is more likely to be assigned to an internal source. This idea is known as credit assignment, which is a hypothesis that the brain differentiates between error sources. The purpose of this study is to try and understand whether large internal or external errors are better for learning a new balance skill.

**Methods:** We will recruit 36 healthy young adults between the ages of 20 to 35, with no musculoskeletal or neurological injuries that affect balance control for a 2-day transfer\retention balance study. On day 1, participants will be asked to perform 42 forty-second trials on one balance board and 4 forty-second trials immediately after on another balance board. On day 2, participants will perform 4 forty-second trials like they did on day 1. Participants will be randomly assigned to 1 of 3 groups: Group 1 (external), the balance board is easier to control but the floor underneath moves left to right; Group 2 (internal), the balance board is harder to control but the floor doesn't move; Group 3 (control), the balance board is easier to control but the floor doesn't move.

**Expected Outcomes:** We expect to see improved learning and transfer in the internal group compared to the external group. The impact of this research could help inform future studies on how people learn to control their balance using errors.

**Full name:** Jackson Kelly

**Affiliation:** Wilfrid Laurier University

**Title:** Evaluating the decision-making ability of basketball players using a virtual reality perceptual assessment

**Authors:** Kelly, J. K. A. & Cinelli, M. E.

**Type:** Full Research

**Topic:** Sensorimotor Control; Adaptation and Coordination of Posture and Gait;

**Abstract: Background:** An essential component of individual and team success in basketball is decision-making ability. Critically, basketball coaches require reliable and valid tools to assess this skill to aid their talent evaluation processes. To address previous challenges in examining decision-making, the current study aimed to create a laboratory-based perceptual task that could serve as a proxy for in-game decision-making ability.

**Methods:** A HTC VivePro 2 head-mounted display that supplied the immersive virtual environment. To create a collision affordance, the participant stood on a white home square, and a virtual pedestrian (VP) faced the participant 13-meters directly across from them. As the participant walked, the VP simultaneously approached at one of the various speed multipliers of the participant's average walking speed (0.9x, 0.95x, 1.0x, 1.05x, 1.10x). The participants were instructed to avoid the collision with the virtual pedestrian when they were exactly one arms-length away. To create the aperture affordance, a virtual aperture (4-meters wide, created by two doors) was located 7.5-meters away from the participant's starting location. Both doors simultaneously closed at one of the various speed multipliers (0.9x, 0.95x, 1.0x, 1.05x, 1.10x) of the participant's average walking speed when the participant was approximately 4-meters from the doors. The participants were instructed to "pass through the doors when they are exactly your shoulder-width

**Results:** The study sample included Canadian university basketball players and non-sport-playing Canadian university students ( $\bar{x} = 21.14$  years  $\pm 2.43$ ; 17 athletes and 19 non-athletes). Two separate two-way mixed ANOVAs revealed that basketball players were more accurate ( $F(1, 34) = 4.327$ ,  $p = 0.045$ ,  $\omega^2 = 0.052$ ) and more consistent ( $F(1, 34) = 7.695$ ,  $p = 0.009$ ,  $\omega^2 = 0.156$ ) than non-athletes on the perceptual task. Correlational analyses suggested that consistent performance on perceptual task was moderately associated with higher assists ( $r(14) = 0.41$  [-0.11, 0.75],  $p = 0.119$ ), higher turnovers ( $r(15) = 0.42$  [0.05, 0.79],  $p = 0.093$ ), and higher box creation scores ( $r(15) = 0.47$  [0.10, 0.78],  $p = 0.060$ ).

**Discussion:** Overall, the current study lays the foundation for a more holistic testing of athletes and challenges traditional approaches to evaluating decision-making. Future iterations of the perceptual task could prove useful for talent identification and investigations of decision-making ability in basketball players.

**Full name:** Ellora Khandekar

**Affiliation:** Rehabilitation Sciences Institute, University of Toronto

**Title:** Developing patient education materials to aid the informed consent process for biomechanics studies

**Authors:** Khandekar, E., Jagroop, D., Majoni, N., Danells, C., & Mansfield, A.

**Type:** Proposal

**Topic:** Rehabilitation and Intervention;

**Abstract: Background:** Informed consent is essential for ethical research participation; however, complex procedures, such as those used in biomechanics studies, can be difficult for potential participants to fully understand through traditional written forms or verbal explanations alone. Misunderstandings during the consent process may contribute to participant anxiety, reduced willingness to enroll, or withdrawal due to mismatched expectations. Although patient education materials (PEMs) have demonstrated effectiveness in improving knowledge and decision-making in medical and surgical contexts, little is known about how PEMs could enhance informed consent for research procedures, particularly within non-surgical clinical trials.

**Methods:** This qualitative study aims to identify the ideal characteristics of PEMs that could support the informed consent process for future participants in FallsLab studies at the Toronto Rehabilitation Institute. We aim to answer the following question: “Can the informed consent process for biomechanics studies be improved using patient education materials?” We will recruit 24 previous participants from two ongoing studies involving chronic stroke survivors and healthy older adults. These clinical trials aim to determine the optimal intensity of reactive balance training, a novel exercise aiming to improve stepping ability and control of balance reactions during repeated balance perturbations. The procedures involved in these studies are difficult to describe to potential participants using traditional methods. Therefore, the previous participants of these studies may provide insight into how we can improve the informed consent processes for these and future biomechanics studies. Semi structured interviews will explore participants' experiences with the existing consent process and their perspectives on the most effective PEM format, content, delivery method, and length. Data will be analysed using a deductive coding approach grounded in the Integrated Behavioural Model to identify themes related to attitudes, perceived norms, and personal agency, all of which influence research participation decisions. An answer to the research question will be determined using the responses gathered following semi-structured interviews.

**Expected Outcomes:** We expect to determine what PEMs previous participants of two studies believe would most benefit the informed consent process. The findings from this study will allow for creation and testing of evidence-based tools to strengthen informed consent processes within biomechanics research and may serve as a model for other research contexts. Furthermore, the outcomes of this and future studies may lead to a guideline for researchers in other fields to create their own PEMs to aid their informed consent processes.

**Full name:** Olivia Laviolette

**Affiliation:** University of Guelph

**Title:** Training the Brain in Motion: HIIT and Task Specific Approaches to Dual Task Performance

**Authors:** Laviolette, O., De Oliveira J., & Vallis LA.

**Type:** Proposal

**Topic:** Adaptation and Coordination of Posture and Gait; Gait, Falls, and Cognition; Sensorimotor Control;

**Abstract: Introduction:** Cognitive-motor dual-tasking (CMDT) is the simultaneous execution of movement and mental tasks(1). Due to limited cognitive resources our ability to execute these tasks may be impaired; for example, with dual-tasking (DT) a decrease in gait speed and increase in variability (i.e. step length) may occur, increasing fall risk(1). DT practice can improve CMDT performance by enhancing processing of simultaneous inputs(5) while exercise triggers the release of catecholamines (dopamine) and neuroplastic factors (BDNF) supporting improved executive function(2). Combining exercise and motor task practice appears effective for improving balance 24hrs post training(3) while improved upper-limb motor performance has been reported 24hrs and 7 days post-training(4). Few studies have investigated the effects of exercise on locomotor task practice under DT conditions and if timing of exercise, pre or post practice, results in greater improvements.

**Aim:** To determine if combining exercise and dual-task practice influences CMDT performance in young adults (18-30 yrs) when HIIT is done before or after task practice. Findings from this study may guide practitioners during rehabilitation sessions to aid the learning of complex locomotor tasks.

**Methods:** Day 1. A biking ramp protocol to measure peak power output (PPO;Velotron, USA). Day 2. Gait will be analyzed with 3D motion capture system (OptiTrack;Corvallis, USA), tracking 32 retroreflective markers placed on anatomical landmarks (e.g. feet). Participants will step over an obstacle while performing an auditory Stroop (AS) task. The AS test will require participants to identify the pitch of a word (e.g. words “high/low” spoken in low or high pitch). Participants will be assigned to one of three groups: no exercise, pre-exercise (exercise before DT practice) and post-exercise group (exercise after DT practice). Exercise groups will complete a HIIT protocol: 10x1 min biking at 70% peak power output, interspersed by 1 min of recovery (50W). DT practice consists of concurrent obstacle crossing and AS training (32 trials). Re-testing will occur 24 hr (Day 3) and 7 days following (Day 4). Visual3D software will be used to analyze gait parameters, including obstacle clearance and gait velocity. Python will be used to analyze cognitive task performance (reaction time).

**Expected Results:** Gait and cognitive parameters are expected to improve in the exercise groups compared to the no exercise group. And the post-exercise group will have the greatest performance improvements, compared to the pre-exercise group. Improvements are demonstrated through decreased obstacle clearance variability, gait velocity and faster reaction times at retest.

**References:** 1. Bayot et al (2018) Clinical Neurophysiology.48(6);361-375; 2. Basso & Suzuki (2017) Brain Plasticity.2(2);127-152; 3. Roig et al (2012) PLoS ONE.7(9); e44594; 4. Wanner et al (2020) Neuroscience.426;115-128; 5. Worden & Vallis (2014) J Motor Behavior46(5);357-368

**Full name:** Jennifer Le

**Affiliation:** York University, School of Kinesiology and Health Science

**Title:** Fear-Induced Changes in Motion Detection Thresholds During Support-Surface Translations

**Authors:** Le, J., & Cleworth, T. W.

**Type:** Proposal

**Topic:** Sensorimotor Control; Adaptation and Coordination of Posture and Gait; Measurement and Modelling ;

**Abstract: Background:** Maintaining upright stance depends on integrating visual, vestibular, and somatosensory inputs to detect and correct self-motion. This process is shaped by emotional state, as postural threat increases perceived consequences of losing balance and alters balance control. Height-induced threat increases muscle co-contraction and stiffness, modulates sensory and cortical processing related to movement perception, and can amplify balance-related cues. Recent findings show that individuals perceive suprathreshold ankle rotations as larger under high threat yet require greater ankle rotation to detect small movements at height, indicating reduced sensitivity. Although baseline thresholds for support-surface translations have been established, it remains unclear how fear alters detection of whole-body translations. Therefore, this study will determine how height-induced fear alters motion detection thresholds.

**Methods:** Thirty healthy adults aged 18-40 years with no neurological, orthopedic, or sensorimotor deficits will be recruited. Participants will stand on a force plate mounted on a motorized translating platform that delivers brief, randomized anterior-posterior displacements of 4 mm and 20 mm. During testing, participants will wear a VR head-mounted display showing an immersive virtual laboratory environment. Postural threat will be manipulated by altering the visual scene: in the low-threat condition, participants will stand at ground level, whereas in the high-threat condition, the scene will be elevated to 7 m, placing them at the edge of a virtual platform. After practice trials, participants will complete a single-interval direction discrimination task. Each trial will contain one randomized forward or backward platform translation, and participants will indicate the direction of movement using a handheld controller. Within each displacement condition, platform acceleration will be manipulated using a 4-2-1 adaptive staircase, with reversals at progressively smaller step sizes used to estimate the minimum acceleration required for reliable direction discrimination. Emotional arousal will be quantified using electrodermal activity from the non-dominant hand. Following each trial, participants will rate their fear, stability, and anxiety. Three-dimensional motion capture will quantify platform motion and whole-body displacement, while centre-of-pressure data from the force plate will characterize postural behaviour.

**Expected Outcome:** Although threat reduces sensitivity to isolated ankle cues, height threat amplifies perception of whole-body sway. Therefore, we hypothesize that height threat will increase motion sensitivity, resulting in reduced motion-detection thresholds. This work will advance understanding of the emotional and multisensory mechanisms influencing conscious perception during balance and may clarify how fear alters balance-related motion perception in populations where fear and instability increase fall risk.

**Full name:** Kimia Mahdavian

**Affiliation:** University of Toronto, Rehabilitation Science Institute

**Title:** How does credit assignment of error during practice of a balance task influence generalizability of learning?

**Authors:** Mahdavian, K., Tremblay, L., Novak, N., & Mansfield, A.

**Type:** Full Research

**Topic:** Adaptation and Coordination of Posture and Gait; Sensorimotor Control;

**Abstract: Background and aim:** A mismatch between the predicted and the actual state of the body during a movement is interpreted by the internal model as an error signal. This error signal is used to update an internal model resulting in modified motor output appropriate to the conditions. An error signal could come from an external or internal source. The credit assignment hypothesis posits that the central nervous system estimates the source of error, with errors assigned to internal source more likely to generalize to novel situations than external errors. This study's purpose was to directly determine if credit assignment of error influences the generalization of motor learning while participants learn a novel balancing task. We hypothesized that participants who practice a motor task in the presence of small external perturbations but are unaware of them would show improved generalization compared to those aware of them.

**Methods:** Participants practiced and learned a novel balancing task. In the practice task, participants stood on a stabilometer and were asked to keep it level as long as possible for 42 trials. Participants were assigned to one of four practice conditions: perturbed-external, perturbed-internal, unperturbed-external, and unperturbed-internal. Participants in the perturbed groups experienced small external perturbations to the stabilometer during practice. Participants in external groups were informed that they would experience platform perturbations and should attribute errors in performing the task to the external perturbations. Participants in the internal groups were told that no perturbations would occur and should attribute errors with the task to themselves. The transfer task, standing on a 'tilt board' with no perturbations, was completed immediately after practice and 24 hours later.

**Results:** Our primary results (20 participants) suggest an improved stabilometer balance performance after practice for all groups. During the immediate transfer task, external and internal unperturbed groups spent more time in balance (mean±standard deviation: 30.3±9.1 and 34.2±5.8 seconds out of 40 seconds, respectively), compared to internal and external perturbed groups (24.1±13.0 and 24.3±8.8, respectively). For the retention and transfer task, the internal-perturbed group spent more time in balance on the tilt board task after 24 hours (34.8±4.3) compared to other groups (28.9±7.3, 30.2±7.0, and 30.3±6.3 for external-perturbed, external-unperturbed, and internal-unperturbed group, respectively). **Conclusion:** Our primary results suggest that participants who experience external perturbations during practice but assign the perturbation errors to themselves have a better generalization to a novel balance task compared to those who assign errors to the external source. The findings of this study may help to improve motor skill learning with perturbation-based training by tailoring individualized plans via a careful selection of perturbation types.

**Full name:** Tessa Marengueur

**Affiliation:** Wilfrid Laurier University, LPMB lab

**Title:** Does the number of approaching pedestrians and their configuration affect collision avoidance behaviours?

**Authors:** Marengueur, T., & Cinelli, E. M.

**Type:** Full Research

**Topic:** Sensorimotor Control; Adaptation and Coordination of Posture and Gait;

**Abstract:** When walking in cluttered environments, we often must avoid collisions with objects and other pedestrians. In natural environments, pedestrians form groups that vary in size and configuration, creating increasingly constrained conditions on collision avoidance behaviours. The current study examined whether young adults' avoidance behaviours differed as a function of the number, configuration, and lateral position of approaching virtual pedestrians (VPs) while immersed in a virtual environment. It was expected that avoidance behaviours (repulsion) would be affected by the group size, configuration, and the relative medial-lateral (M/L) position of approaching VPs (i.e., greater combined repulsion with a larger/or and closer group). Participants ( $n=15$ ,  $\bar{x} = 21.1 \pm 1.3$  years) walked along a 8m pathway in a virtual environment towards a goal line while avoiding five configurations that were positioned at 0.1, 0.3, and 0.5m from midline of the pathway. The five conditions represented common interaction scenarios: one-vs-one; one-vs-two either walking side-by-side or in a linear formation; and one-vs-four with VPs arranged in a square or diamond configuration. Results revealed that there was a significant effect of VP number and lateral position on M/L deviation at ToC between the individual and the approaching VPs. The findings suggest that when multiple pedestrians are present, especially in cohesive groupings, these repulsive forces combine, producing an additive repulsive effect that results in greater path deviations.

**Full name:** Ariyana Morady

**Affiliation:** York University, School of Kinesiology and Health Sciences

**Title:** A Heelstrike Detection Algorithm For Fractal Analysis of Gait

**Authors:** Morady, A., Martins, P. A., Gage, W. H

**Type:** Proposal

**Topic:** Measurement and Modelling ;

**Abstract: Background:** Non-linear gait analyses, such as detrended fluctuation analysis (DFA), are used to evaluate the adaptability and stability of human gait. Previous studies have demonstrated that gait dynamics are influenced by environmental, sensory, and cognitive factors [1,2] resulting in a complex interaction of systems that drive gait patterns. The fractal scaling index (FSI), derived from DFA, represents the complexity of these gait patterns across time scales. However, the effects of obstacle avoidance on gait dynamics are not understood. Since DFA requires a large stride count, [3] data may be best collected outside the lab environment, using a mobile device.

**Aim:** Phase 1 – A Matlab algorithm has been developed to detect heel strike events using data from a cellphone accelerometer system. Phase 2 – The algorithm will be used to quantify changes in FSI during obstacle avoidance.

**Methods:** In phase 1, a custom MatLab algorithm is being developed to detect heel strikes from accelerometer data [4]. The algorithm applies a minimum amplitude threshold to eliminate insignificant local maxima from each stride cycle, and a forward-looking exclusion window to prevent duplicate stride detections within a single cycle. A secondary verification loop is used to search backward from each detected peak to identify whether other local maxima are present. If a more suitable local maximum is detected, the originally detected peak is replaced and the scan continues forward. This algorithm has improved peak detection and consistency over previous iterations, evidenced by fewer peak detection errors on visual inspection. Given this, some issues remain related to differentiating peak detection from noise, notably in the obstacle-avoidance trials. These issues will most effectively be mitigated using machine learning in a later stage of the larger associated project. In phase 2, participants will walk around a large hallway loop (approximately 200 meters) for 15 minutes for three trials. For two of the three trials, they will navigate strategically placed obstacles in half of the loop.

**Expected Results:** It is hypothesized that obstacle navigation will alter fractal gait dynamics compared to the no obstacle condition. Specifically, FSI is expected to increase during obstacle avoidance, demonstrating higher adaptability and locomotor reorganization in response to environmental demands.

**References:** [1] S. Ahmadi et al (2017), Biomech Eng.; [2] J. Chien et al (2016), Ann Biomed Eng.; [3] V. Marmelat and R. L. Meidinger (2019), Gait Posture.; [4] V. E. Di Bacco and W. H. Gage (2023), J. Biomech.

**Full name:** Cecilia Power

**Affiliation:** York University

**Title:** The Role of Plantar Sensation in Gait Complexity: Fractal Analysis of Sensory Modulation

**Authors:** Power, C.R., Ali, S.O.H., Di Bacco, V.E., Perry, S.D., & Gage, W.H.

**Type:** Full Research

**Topic:** Sensorimotor Control;

**Abstract:** Background. Walking is a complex task involving many sensory inputs. Research shows that plantar sensation helps shape linear gait metrics (i.e. averages and variability) like speed, stride length, and stride time. It is not well known, however, how non-linear gait metrics (i.e. variability structure) such as sample entropy (SampEn) and fractal scaling index (FSI) are influenced by plantar sensation. Studies have shown lower FSI and higher entropy with different motor control or sensory conditions, but no differences with peripheral neuropathy. So, we aimed to further assess how healthy young adults' gait is influenced by decreased (cold exposure induced) and increased (insole induced) plantar sensation.

**Methods.** 30 healthy young adults (15F, 15M; Age  $23.2 \pm 3.2$  years) participated.

Anthropometrics, preferred walking speed, plantar surface temperature (PST), and plantar tactile sensitivity (PTS) were recorded. Three 10-minute trials were completed with motion capture in a randomized order with rest breaks and returned sensation between trials: baseline (BT), insole (IT), and cold exposure (CET). For IT, participants inserted BalancePro insoles into their shoes. For CET, participants placed their feet on a tray of ice for 14 minutes with PST and PTS checks every 2 minutes, completed the first 5 minutes of walking, re-iced for 4-minutes with 2-minute mark PST and PTS checks, then completed the last 5 minutes of walking. The two 5-minute walks were concatenated for analysis. Metrics calculated were cadence, stride time, stride length, gait velocity, FSI, and SampEn

**Results.** There was a significant main effect of condition for linear measures of cadence ( $F(2,56) = 8.844$ ,  $p < 0.001$ ), stride time ( $F(2,56) = 8.632$ ,  $p < 0.001$ ), and stride length ( $F(2,54) = 6.698$ ,  $p = 0.003$ ) with post-hoc tests showing significance between the IT and CET conditions. For FSI, a significant main effect of condition was observed ( $F(2, 46) = 3.396$ ,  $p = 0.042$ ), with difference between the BT and CET condition. For SampEn, there was no significant effect of condition ( $F(1.143, 21.709) = 0.988$ ,  $p = 0.343$ ).

**Discussion.** We aimed to test plantar sensation effects on linear and non-linear gait metrics. Linear metrics differed between the increased sensation and decreased sensation conditions, consistent with previous studies. For non-linear metrics, FSI showed a difference between baseline and the decreased sensation condition, with lower baseline values. The FSI change direction was different than predicted based on previous studies of impaired gait, but interesting given others found no differences in individuals with neuropathy. Participants of this study were healthy and young, so sensory loss recognized by the CNS could have resulted in a compensatory effect whereby fractal scaling was more tightly controlled or adapted. Thus, this study may support the idea that fractal scaling is controlled by the CNS, and overall shows that plantar sensation plays a role in gait patterns.

**Full name:** Kyle Sage

**Affiliation:** Wilfrid Laurier University, Department of Kinesiology and Physical Education

**Title:** Considerations for Work Boots

**Authors:** Sage, K. R., & Perry., S. D.

**Type:** Proposal

**Topic:** Gait, Falls, and Cognition;

**Abstract: Introduction:** Safety footwear is required within occupational workspaces; however, this footwear can impede balance leading to an increased risk of falling. Within the workplace, 67% of falls are due to overground walking, leading to hospitalizations and workplace injury<sup>1</sup>. The design of safety footwear is a potential cause for falling. Key design features of safety footwear include high shafts, soft midsoles, and an increased heaviness compared to everyday footwear<sup>2</sup>. Shaft height can limit ankle dorsiflexion for toe clearance, while soft midsoles have shown to impede balance through changes in the centre of mass (COM) and base of support (BOS) relationship<sup>3</sup>. Boot weight further increases risk by decreasing toe clearance of obstacles<sup>2</sup>. Foot orthotics may provide a practical solution to the balance issues imposed by safety footwear. Specifically, orthoses may improve dynamic balance control during obstacle navigation through mechanical support and sensory information. However, the effects of orthotics in safety footwear during a trip perturbation have not been investigated.

**Aim:** Investigate whether foot orthotics improve dynamic balance and trip-recovery performance in safety boots by counteracting the biomechanical constraints imposed by boot design

**Methods:** Recruitment of 30 adults aged 18-50 who wear safety footwear ~35 hours per week and are currently or have been employed in an industrial workspace for at least 6 months. Participants will walk along a 10m platform where an obstacle requiring elevating over will appear at random, producing a trip perturbation. This will be done using standardized safety footwear with a standard insole and orthotic condition. Kinetic, kinematic, and electromyography data will be collected. Primary outcome measures include COM-BOS relationship, minimum toe clearance, ankle sagittal range of motion, and muscle amplitude. Data will be analyzed using a 2x2 repeated measures ANOVA.

**Expected Results:** We hypothesize that the foot orthotic condition will improve dynamic balance and trip recovery during the perturbation event.

**References:** 1. Canadian Centre for Occupational Health and Safety. Prevention of slips, trips and falls. 2023.; 2. Orr R et al. The impact of footwear on occupational task performance and musculoskeletal injury risk: A Scoping review to inform tactical footwear. *International journal of environmental research and public health*. 2022;19(17). <https://doi.org/10.3390/ijerph191710703>; 3. Munk-Hansen M et al. Does ankle support of safety shoes increase trip-related risk of falling? – A randomized crossover study. *Gait and Posture*. 2025;122:183–189. <https://doi.org/10.1016/j.gaitpost.2025.07.310>

**Full name:** Marcel Tesolin

**Affiliation:** York University

**Title:** A Frequency Evaluation of a Virtual Reality Sensory Interaction Balance Test (VR-SIBT)

**Authors:** Tesolin, M., Gage, W., Cleworth, T.

**Type:** Full Research

**Topic:** Sensorimotor Control;

**Abstract: Introduction:** Balance is maintained through integration of sensory information from the visual, proprioceptive and vestibular systems. The relative contributions of each system to upright stance have been related to specific frequencies of postural control variables. The Frequency-Specific Sensory Contribution Framework (FSCF) postulates four frequency “bins”: ultra-low (0.0-0.1Hz); low (0.1-0.40Hz); medium (0.40-1.56Hz); and high (1.56-5.0Hz), and each bin is associated with the visual, vestibular, cerebellar, and proprioceptive system, respectively. However, virtually induced amplified optic flow evidence suggests that visual contributions extend beyond the defined ultra-low bin. The purpose of this study was to critically examine the FSCF to challenge the characterization of how sensory information regulates balance control. It was hypothesized that absolute frequency power would differ between sensory conditions, showing that unreliable or removed vision would result in increased total band power across the 0-5Hz range. Further, it was hypothesized that frequency bin composition across conditions would identify that visual contributions to balance will extend beyond the hypothesized bins of the FSCF.

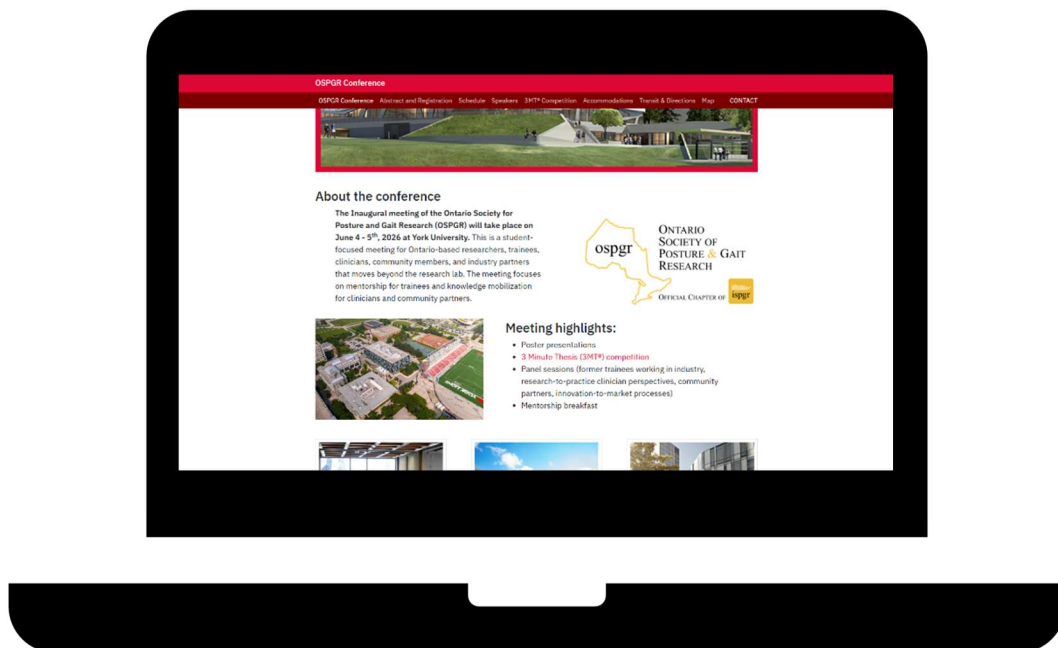
**Methods:** 32 healthy young adults aged 18-40 performed a Virtual Reality Sensory Interaction Balance Test consisting of eight randomized conditions. Participants stood quietly on firm and foam surfaces during four visual conditions (normal, removed, amplified, unreliable) delivered using a realistic virtual scene through a virtual reality head-mounted display. Normal vision involved 1:1 real-world coupling between head and visual motion. In the “removed” vision condition, participants kept their eyes closed and a blacked-out virtual scene was presented. Amplified vision increased optic flow by providing four times more scene motion than head motion in the sagittal and frontal plane. In the “unreliable” vision condition, motion cues were removed by locking scene motion to head position in all six degrees of freedom. Kinetic, kinematic and electromyographic data were recorded to quantify balance behaviour. The absolute total band power (TBP) ranging 0-5Hz and the relative FSCF frequency bin compositions were calculated for the anteroposterior (AP) centre of pressure (COP), centre of mass (COM), and right soleus muscle.

**Results:** Absolute TBP increased from firm to foam surface for all dependent measures. On the foam surface, TBP decreased when vision was amplified for AP COP and AP COM. Relative frequency bin composition of the AP COP and AP COM indicated that effect of amplified visual information extended beyond the ultra-low frequency bin associated with visual contributions to balance.

**Significance:** Overall, results showed both absolute and relative frequency shifts between sensory conditions. These results indicate that the FSCF may not be robust enough to depict the full scope of frequency-specific sensory contributions to balance.

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