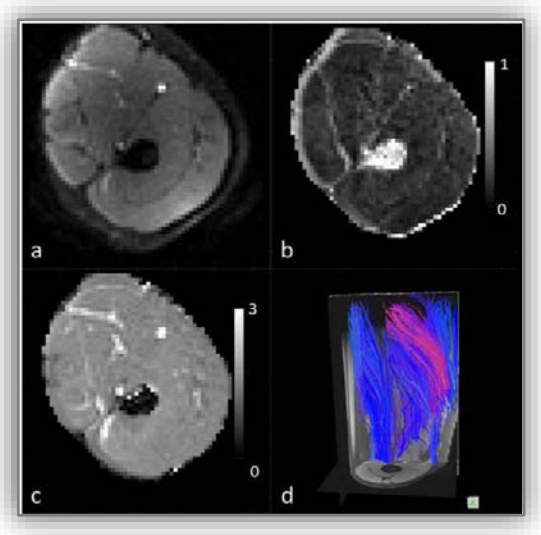



# Clinical, Biomechanical, and Novel Imaging Biomarkers of Hamstring Strain Injury Potential in Elite Athletes

**Funding Agency:**
NBA/GE Healthcare Orthopedics and Sports Medicine Collaboration

**Research Team:**,
Mikel Stiffler-Joachim, Grant Thomas, Christa Wille, Jen Sanfilippo, Dr. Dan Cobian, Dr. Bryan Heiderscheit

**Collaborators:**
Dr. Richard Kijowski (UW Radiology), Dr. Kenneth Lee (UW Radiology), Dr. Stephanie Kliethermes (UW Orthopedics & Rehabilitation), Dr. Nagesh Adluru (UW Waisman Center), Dr. John Wilson (UW Orthopedics & Rehabilitation)

**Abstract:**
The hamstrings are the most commonly injured muscle group among athletes who sprint regularly and thus represent a particular burden in sports such as basketball, football, soccer, and track. Effective treatment of hamstring strain injury (HSI) remains a challenge, as demonstrated by an approximately one-third rate of injury recurrence within the first year. A better understanding of the risk factors associated with HSI could provide further insight into injury prevention. Furthermore, clinical assessments of muscle strength, flexibility, and functional performance at the time of return to sport are inadequate to assess the risk of re-injury. Thus, more refined image-based measures of muscle properties and more detailed assessments of neuromuscular and biomechanical function are needed to characterize the effects of HSI and evaluate re-injury risk. The overall goals of this study are to identify risk factors associated with HSI in athletes and to investigate whether biomechanical measures in combination with novel magnetic resonance imaging (MRI) and ultrasound (US) methods can better assess time to return to sports and risk of re-injury.

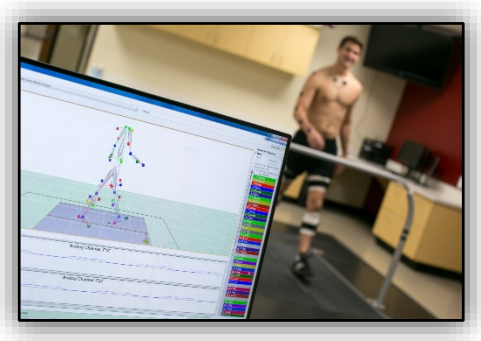
# Reliability and Validity of a Next-generation Sensory Organization Test

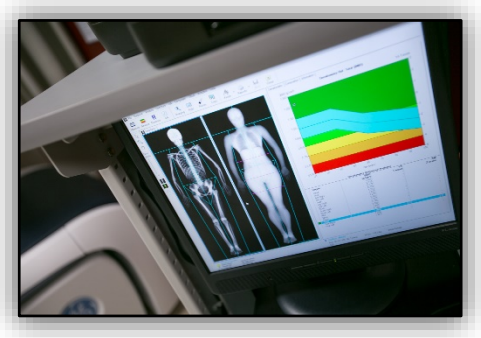
**Funding Agency:**
NIH awards UL1TR000427 and TL1TR000429; Department of Orthopedics and Rehabilitation

**Research Team:**
Colin Grove, Dr. Darryl Thelen (UW Mechanical Engineering),Dr. Bryan Heiderscheit

**Collaborators:**
Dr. Mark Pyle (UW Surgery), Dr. Ari Rosenberg (UW Neuroscience), Dr. Kevin Ponto (UW Design Studies), Dr. Susan Whitney (U. Pittsburgh)

**Abstract:**
Epidemiological evidence suggests vestibular disorders are common. Vestibular rehabilitation (VR) is the recommended standard of care. While VR facilitates the process of central vestibular compensation and leads to improvement in a large proportion of affected individuals, many individuals achieve only partial recovery through central vestibular compensation or fail to compensate. Whether or not improvement with VR is observed depends heavily on which patient-reported and performance-based outcome measures are utilized to assess changes due to interventions. Since the choice of outcome measures depends in part metrics such as reliability and validity, knowing these psychometric properties is critically important. Originally conceived more than 30 years ago, the Sensory Organization Test (SOT) is considered one of the gold-standard tests of postural balance. Recently, a modernized version of the SOT was developed. The psychometric properties of this next-generation SOT are not yet described in the literature. The proposed research will fill this gap and provide mentoring regarding investigation of outcome measures and dissemination of results. We believe that this next-generation SOT will have similar test-retest reliability and criterion validity as its predecessor. This central hypothesis will be tested in two separate investigations. Study A involves a single group, repeated measures design that will be used to assess stability of performance on the SOT over a five week period of time. Study B includes analysis of data collected at a single time point in which a parallel groups design will be used to compare performance on the traditional SOT to performance on the next-generation SOT. These two studies are trainee projects included in Dr. Grove's dissertation. In the short-term, the data collected will help determine which version of the SOT is used as a secondary outcome measure in a planned, phase I trial of a new intervention for visually-induced vertigo. We believe that, in the long-term, the data collected will lead to improved clinical management of persons living with vestibular dysfunction.





## Injury Risk among Distance Runners: Biomechanics, Morphology and Training

**Research Team:**
Mikel Joachim, Jen Sanfilippo, Christa Wille, Dr. Bryan Heiderscheit

**Collaborators**:
Alyson Kelsey (UW Athletics)

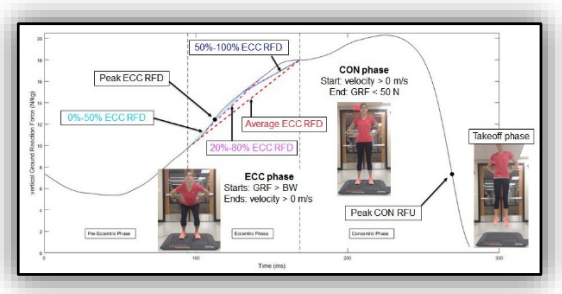
**Project Description:**
Monitoring fitness and performance of elite athletes before, during, and after a competitive season is important to ensure an athlete's health and success. This may be especially important for Division 1 distance runners who train at high volumes during the season, placing them at risk for running-related injuries. Pre-season measures of interest include Lunar iDXA (GE Healthcare, Madison, WI) scans to monitor physiological health and fitness of the athletes, while countermovement jump and 3D running gait analyses are used to monitor biomechanical performance. During the season, running volume and time-loss due to injury are recorded. Having an expansive set of data allows for the ability to establish normative data for healthy, elite athletes based on gender, speed, and other relevant variables for each measure of interest. Furthermore, having baseline data and prospectively following the athletes through a season or throughout their collegiate career may be helpful to detect predictors of injury. Specific topics of interest include: 1) Identifying the correlation between base of gait during running and injury; 2) Describing the relationship between tibial bone density and 3D running mechanics; 3) Identifying trends in common biomechanical measures across running speeds and across tasks; and 4) Developing normative performance values by gender for elite athletes.

# Development of the University of Wisconsin Running Injury & Recovery Index

**Research Team:**
Evan Nelson, Dr. Bryan Heiderscheit

**Collaborators:**
Benjamin Maschke (TRIA Orthopedic Center), Dr. Terri Chmielewski (TRIA Orthopedic Center), Jason Lobb (Mountain Land Physical Therapy), Josh Fischer (Advanced PT and Sports Medicine), Erik Bies (Movement Systems Physical Therapy)

**Project Description:**
Patient-reported outcome measures integrate the patient's perspective into decisions regarding the effectiveness of physical therapy care. Runners commonly report variability following a running-related injury because the injury may not demonstrate an equal rate of recovery in all types of running training. The recovery process is further complicated by external pressures to return to running, internal pressures, self-identification as a runner, or the psychologic response to running injuries. The University of Wisconsin Running Injury and Recovery Index (UWRI) is the only patient-reported outcome measure specific to the activity of running and may help separate functional change from symptom variability during the rehabilitation process. The purpose of this study is to evaluate the validity the UWRI in a large sample of patients receiving care for a diverse set of running-related injuries and determine the responsiveness of the UWRI to quantify meaningful clinical change. Additionally, this study will provide an assessment of how running-related injuries impact an individual's health-related quality of life. A planned secondary analysis will evaluate pain-related psychological factors occurring with running-related injuries.




# Countermovement Jump Analysis in D1 Athletes

## Research Team:

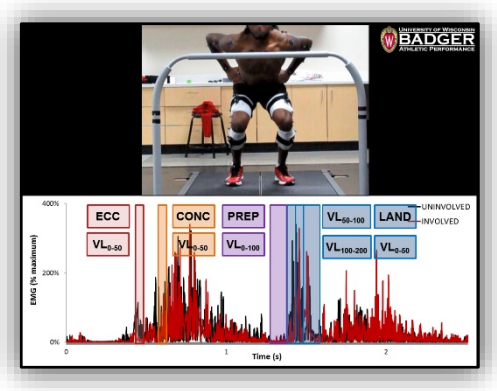
Dr. Dan Cobian, Demitra Philosophos, Jen Sanfilippo, Dr. Bryan Heiderscheit

## Collaborators:

Dr. Joseph Weir (KU), Jake Siedlik (Creighton)

## Project Description:

Countermovement jump (CMJ) performance is an important indicator of lower extremity explosiveness and can differentiate elite athletes from their novice counterparts. Greater CMJ eccentric (ECC) phase rate of force development (RFD) may enhance the stretch-shortening cycle kinetics and maximize CMJ performance. CMJ ECC RFD is inconsistently quantified, poorly defined, and has not been comprehensively investigated. The primary focus of collegiate strength and conditioning programs is to maximize athleticism which leads to improved sports performance. Previous research indicates that vertical jump height and power improves throughout a collegiate athlete's career, but it is unclear what constituents of the CMJ moderate these performance improvements. The objectives of this project are to: 1) Comprehensively define ground reaction force-time curve ECC and concentric (CON) phase variables, and determine which variables are significant predictors of CMJ height in collegiate athletes; 2) Evaluate changes in CMJ performance and force-time curve variables throughout the collegiate career of individual athletes; 3) Determine the influence of anterior cruciate ligament reconstruction on CMJ performance and force-time curve profiles of collegiate athletes.




## Movement Biomechanics, Neuromuscular Performance, and Functional Recovery after ACLR

**Research Team:**
Dr. Daniel Cobian, Mikel Joachim, Keith Knurr, Jen Sanfilippo, Dr. Bryan Heiderscheit

**Collaborators**:
Mitch Toda (UW Athletics), Kyle Gibson (UW Athletics), Dr. Geoff Baer (UW Orthopedics and Rehabilitation), Dr. Tamara Scerpella (UW Orthopedics and Rehabilitation)

**Project Description:**
Abnormal lower extremity movement biomechanics and neuromuscular performance are a barrier to successful return to sport in people post-anterior cruciate ligament injury and reconstruction (ACLR). Our laboratory maintains ongoing investigations to 1) evaluate common clinical measures of recovery such as muscle mass and strength, single-leg hops, and patient-reported outcome surveys, 2) lower-extremity joint kinetics and kinematics during running and jumping in elite collegiate athletes throughout recovery post-ACLR, 3) assess leg muscle activation patterns during running and jumping in collegiate athletes post-ACLR, 4) compare movement biomechanics and muscle activation between post-ACLR athletes and control subjects. This research has important clinical implications, as athletes are often allowed to return to sport within one year of ACLR, but may be at increased risk for re-injury (and decrements in sports performance) due to persistent lower extremity biomechanical abnormalities and reduced muscle activation capacity.

## An Innovative Tool for the Assessment of Gait Dysfunction in the Clinical Setting

**Funding Agency:**
NIH: Eunice Kennedy Shriver National Institute of Child Health & Human Development

**Research Team:**
Mikel Stiffler-Joachim, Dr. Bryan Heiderscheit

**Collaborators:**
Dr. Kris O'Connor (Metria Innovations), Dr. Brian Armstrong (Metria Innovations), Dr. Chris Powers (USC)

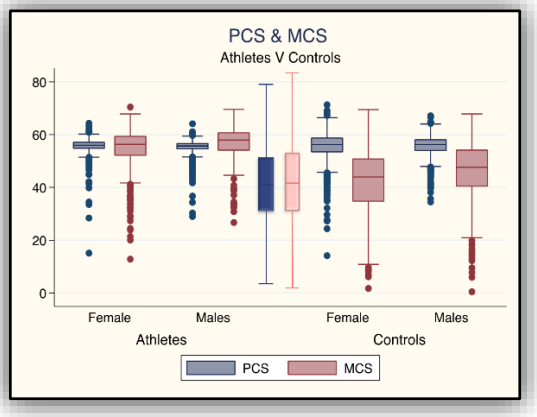
Research Abstract


## Evaluation of the Star Excursion Balance Test in D1 Athletes

**Research Team:**
Mikel Stiffler-Joachim, Dr. Bryan Heiderscheit

**Collaborators:**
Dr. David Bell (UW Kinesiology)

Research Abstract
Research Abstract




## Health Related Quality of Life Among D1 Athletes

**Research Team:**
Liga Blyholder, John Scerpella, Jen Sanfilippo, Dr. Bryan Heiderscheit

**Collaborators:**
Dr. Stephanie Kliethermes (UW Orthopedics & Rehabilitation), Dr. Traci Snedden (UW School of Nursing), Dr. Tim McGuine (UW Orthopedics & Rehabilitation)

**Project Description:**
The active promotion of health and well-being, understood as health-related quality of life (HRQOL), among collegiate students is integral to counteracting adverse health outcomes during college and beyond. The college years are seen as instrumental in building a foundation of positive health-related behaviors that support well-being far into adulthood. Well-being, as a subjective concept, is a global representation of both physical and mental health. It provides a broad lens for the assessment and development of customized health promotion, and disease prevention strategies. The need to assess and support health and well-being in college students is supported by a number of high profile initiatives. The National Collegiate Athletic Association has stressed the importance of well-being and the application of evidence-based best practices for understanding and supporting mental health issues among student-athletes. For many athletes, sport-related musculoskeletal injuries result in significant time loss from activity and declines in athletic performance. These events may negatively impact health-related quality of life. This project seeks to better understand HRQoL among Division I collegiate athletes: 1) as it relates to their general undergraduate peers, 2) relative to year in school; and 3) how it changes after a sports-related injury.