Interdisciplinary Research (IDR) Origination Awards

Cover Page

Project Title

Title: Reducing Musculoskeletal Injury Risk For High School Athletes—A Pilot Project

Principal Investigator(s) (full-time faculty)

Name (PI listed first)	Department	College
Matthew Seeley	Exercise Sciences	Life Sciences
Sarah Coyne	School of Family Life	FHSS
Christine Griffiths	Exercise Sciences	Life Sciences
Chad Hancock	Nutrition, Dietetics, and Food Science	Life Sciences
Michael Jones	Computer Science	CPMS
Michael Larson	Psychology	FHSS
Garritt Page	Statistics	CPMS

Track

Track one

Abstract

Eight million American adolescents participate in organized high school sport and enjoy associated benefits. They also experience increased musculoskeletal injury risk. Multiple risk factors are associated with musculoskeletal injury for adolescent athletes, yet interactive effects of these risk factors are unclear. The first objective of this pilot study is to collect data describing musculoskeletal injury risk factors and musculoskeletal injury rates for one group of adolescent athletes, to identify interactive relationship(s) of musculoskeletal injury risk factors and musculoskeletal injury for adolescent athletes. The second objective is to develop a digital tool to be used to collect real-time injury risk factor data and report those data to certified athletic trainers and coaches working directly with adolescent athletes. To accomplish the first purpose, we will collect injury risk factor data on adolescent athletes from 12 different local athletic teams during one competitive season. Data describing musculoskeletal injuries for the same athletes will also be collected, and we will explore the risk factor and injury data for previously unknown multivariate relationships between injury risk factors and musculoskeletal athletic injury. To accomplish the second purpose, we will use an iterative process and feedback from certified athletic trainers, coaches, athletes, and parents to create a digital platform than can be used to collect and report aggregate injury factor data to certified athletic trainers and coaches throughout a competitive athletic season. Certified athletic trainers and coaches can cooperatively use these aggregate risk factor data to inform training practices and reduce injury risk for adolescent athletes.

Summary of Plans for External Funding

2024: Intermountain Health Community Partner Fund, Build Dairy, and the AOSSM (Playmaker Grant)
2025: NIH R15 AREA grant (NIAMS, NIAAA, or NICHD) and the AOSSM (Return to Play Grant)
2026-2027: NIH R01 (NIAMS, NIAAA, or NICHD), Human-Centered Computing Program at NSF, and the William T. Grant Foundation

Project Narrative

Introduction. Adolescence is a time of formative physical, social, and emotional growth, and sport participation during adolescence can offer various benefits. Adolescent athletes can enjoy increased physical activity, improved mental and emotional health, enhanced academic performance, as well as decreased risk of depression, anxiety, and use of illicit drugs, alcohol, and smoking.[1, 2] Youth sport participation rates have recently and dramatically increased in America. Approximately 60 million children and adolescents now participate in organized youth sports programs each year.[3] Eight million adolescents participate in high school sports.[4]

Although youth sport participation offers many benefits, adolescent athletes are at increased risk for musculoskeletal injuries that are expensive and otherwise detrimental. For example, greater than 20% of injuries that occur to 15-year old individuals are due to sport.[5] Approximately $8 billion are spent annually treating adolescent athletic injuries in the US.[6] In addition to financial burden, sport-related musculoskeletal injuries can decrease the adolescent athlete's short-term and long-term physical and mental health. For example, more than 1% of all youth female soccer players will experience a serious anterior cruciate ligament (ACL—i.e., the knee) injury every soccer season, while nearly 1% of youth American football players will experience a serious ACL injury every season.[7] Surgical ACL repairs are expensive, approximately $35K per surgery, and challenge the adolescent with physical pain, missed practice time, and mental and emotional stress (decreased perceived quality of life, fear of reinjury, and increased depression and anxiety).[8, 9] Furthermore, adolescent athletes who rupture their ACL are at significantly greater risk for knee osteoarthritis, a debilitating and incurable disease. Up to 50% of ACL surgical repair patients will be diagnosed with knee osteoarthritis 10 to 20 years following the surgery.[10] The lower-extremities are the most commonly injured location for adolescent athletes, especially the knee and ankle joints.[11] For adolescent male athletes, the most common injury sites are the thigh and ankle, while the ankle and knee joints are most injured for females.[12] More research is needed to reduce musculoskeletal injury rates for adolescent athletes.

Multiple risk factors are associated with lower-extremity musculoskeletal injuries for adolescent athletes, including injury and sport participation history, movement biomechanics, mental health status, as well as characteristics of sleep and nutrition. History of previous injury is one of the most sure predictors of musculoskeletal injury in sport.[13] History of sport participation is also known to affect injury risk. For example, early sport specialization has been associated with overuse injury and burnout for young athletes, and is considered to be a current public health issue.[6, 7, 14] Increased training volume and decreased recovery time promote adolescent athletic injury. Overuse injury has been observed to occur following an increased number of practices and/games.[15] Movement biomechanics are also associated with musculoskeletal injury in youth athletes, with certain biomechanical patterns having been identified as more dangerous than others. For example, certain ground reaction force patterns are associated with increased risk of bone and joint injuries in running.[16, 17] Certain hip, knee, and ankle joint patterns are associated with lateral ankle sprains in a various young athletes.[18, 19] Relationships between sports injury and mental health/psychological factors are known, with mental health factors influencing rates of injury and the process of sports injury and rehabilitation linked to an extensive range of psychological and mental health issues.[20] For example, life stressors and emotional distress can decrease cognitive focus and increase injury risk.[21] Trait anxiety is associated with muscle tension and divided attention that can increase injury risk.[22] Sleep also influences injury risk for adolescent athletes. In a comprehensive meta-analysis, chronic sleep deficits were clearly shown to significantly increase risk of sports musculoskeletal injury, and acute sleep deficits appeared to increase injury rates.[23] Youth soccer players seem to experience more when competing after sleeping for six or less hours.[15] Finally, nutrition also likely affects musculoskeletal injury risk for adolescent athletes. Sugar sweetened beverage consumption is the greatest specific food group source of calories and added sugars for 12-18 year old children.[24] Excess energy consumption is a major health concern for adolescents, particularly related to high rates of

adolescent overweight and obesity.[25] Energy drink consumption by adolescents is common. Energy drinks are increasingly marketed to adolescents[26] and contribute to increased risk of many health concerns in adolescents, including decreased sleep quality, mental health, and school performance, and increased risky behaviors that may impact sport injury risk.[27-29] Finally, dairy products are the primary sources of calcium and Vitamin D intake in the United States and are nutrients of concern for avoiding bone fractures.[30]

There are two objectives of this pilot study. The **first objective** is to simultaneously measure (1) injury risk factors (i.e., injury and sport participation histories, biomechanics, mental health, sleep, and nutrition) and (2) musculoskeletal injuries in one sample of adolescent athletes, across one competitive athletic season; then, explore potential interactive relationships between injury risk factors and athletic injury. This will increase our ability to intervene and potentially reduce musculoskeletal risk for adolescent athletes. The **second objective** of this study is to create a digital tool that can provide certified athletic trainers (ATCs) and coaches who work directly with adolescent athletes with daily aggregate data that can be used to inform training practices and reduce musculoskeletal injury risk for adolescent athletes. Challenges associated with this purpose include determining what information to present to ATCs and coaches, based upon their background, capabilities, and goals. Previous work in this area has identified tension between athlete agency and team needs in the context of athlete data.[31] Similar tensions involving athlete well-being and team performance will need to be addressed. We will accomplish this purpose using an iterative design process in which we create a series of digital tools that are revised based on feedback from ATCs and coaches. This work builds on Dr. Jones' prior interview study of data sharing between coaches and adolescent athletes, from a coach perspective, in the context of figure skating.[32] Herein, Dr. Jones reported that coaches interpret some data as a proxy for effort, and that this interpretation is not always not supported by evidenced-based studies. We hope that the current work will support ATCs and coaches in more accurately interpreting data describing adolescent athletes. This purpose aligns with an emerging grand challenge in the design of human-computer interaction in sport, in which the athlete is treated as a multifaceted individual for the purposes of increasing athletic performance *and* life-long wellness benefits.[33]

Methods

Subjects. We will recruit varsity athletes from 12 different high school athletic teams at either Provo or Timpview High School: boys and girls lacrosse, boys and girls soccer, and boys and girls basketball. We expect to involve approximately 120-180 athletes (10-15 research subjects per athletic team). We have chosen these teams for two reasons: (1) these sports involve relatively high injury rates and will present opportunities to observe as many injuries as possible, and (2) we have identified several forward-thinking athletic coaches associated with these teams who are willing to participate in this study. Importantly, immediately after enrolling in this study, each research subject will be given an unidentifiable alphanumeric code that will be used to describe them throughout the entire study. Only researchers who interact with the research subjects in person, as described hereafter, will be able to personally identify any research subject. All data collected during this study will be digitized and saved using the aforementioned alphanumeric code; further, all data files will be saved on password protected computers accessible only to members of the research team. We are currently seeking IRB approval from the Intermountain Health IRB, with the assistance of Dr. Anthony Beutler, MD, an Intermountain Health board-certified sports medicine physician who is very supportive of this study and has collaborated in research endeavors with Dr. Seeley for several years.

Objective 1

Injury Factors. To accomplish the first objective of the study, we will collect the following injury risk factor data for all research subjects.

1. Injury History: a one-time comprehensive injury history will be collected under the supervision of Dr. Beutler. Dr. Beutler will supervise local Intermountain Sports Medicine fellows and Intermountain ATCs in recording comprehensive injury histories for each research subject. This will be done during their preseason physical and Intermountain Health has agreed to provide complementary preseason physical examinations for all research subjects. These injury history data will be collected only once, in person, at the school, at the beginning of the competitive season.
2. Pain and Soreness: current pain and soreness will be measured daily via self-report by research subjects from the time of enrollment to the end of the competitive season. Current pain and soreness will be evaluated using a Stanford Collaborative Health Outcomes Information Registry body map displayed on each research subject's smart phone.(Figure 1; [34]) This body map requires research subjects to indicate areas of and severity of musculoskeletal pain and/or soreness across the entire body and is a valid and reliable way to assess distribution of pain across the body for pediatric individuals[35] who are suffering from musculoskeletal pain.[36] The pain and soreness data will be collected under the supervision of Dr. Pexa, who has knowledge in the collection and interpretation of this sort of data.[37] Pain and soreness are thought to be predictive of some musculoskeletal injuries,[38, 39] and ATCs and coaches can use these data to inform training and practice protocols.
3. Sport participation history: a modified version of the Boston University Sport Participation History survey[40] will be completed by each research subject, via their smart phone, at a location of the research subject's choosing. This survey will require the research subjects to identify all sports they previously participated in, age at which the participation began, number of years of participation, and duration of participation at each level of competition. These data will be collected under the supervision of Drs. Seeley and Pexa. These data will be collected only once at the beginning of the competitive season.
4. Movement biomechanics: 3D hip, knee, and ankle joint angles, for both leges, will be quantified during three common athletic movements: (1) double-leg forward jump with a single-leg lateral land-and-cut, (2) double-leg broad jump for distance, and (3) drop-jump maximal height vertical jump. These data will be collected using OpenCap software,[41] a novel opensource markerless motion capture tool, and several iPhones in a gymnasium at the school. These data will be collected under the supervision of Dr. Seeley, only once at the beginning of the competitive season.
5. Mental health: mental health and psychological well-being will be measured via self-report. A survey link will be texted to each participant every Monday throughout the competitive season. Participants will be asked to complete the youth version of the public domain 21-item Depression, Anxiety, and Stress Scale (DASS-21). The DASS-21 youth version effectively detects symptoms of depression, anxiety, and stress in children and adolescents, mirroring the reliability seen in adult assessments.[42] Additionally, the research participants will receive a daily text message prompting them to complete a one-item mood check-in. This check-in will utilize a visual analogue scale (VAS) ranging from 0 to 100 to gauge their current mood and their readiness for practice. These data will be collected under the supervision of Dr. Larson who has numerous publications in the area sport psychology. Additionally, four questions will be asked, at the beginning of the study, concerning eating disorders, which are more prevalent in young athletic populations that non-athletic populations. These questions have been selected by Dr. Coyne.
6. Sleep: sleep will be measured via self-report, once each week throughout the competitive season. Every Monday the research subjects will complete Athlete Sleep Behavior Questionnaire, which is a reliable and valid instrument that can be used to test sleep patterns for athletes.[43] The research participants will also complete a daily visual analog scale, rating their sleep quality from 0 to 100

for the previous night, and report the time they went to bed and the time they woke up. These questions have been selected by Dr. Larson.

7. Nutrition: while it is not feasible to obtain a full assessment of nutritional factors that may impact injury risk in this study, some data related to a few aspects of nutrition that could impact physical performance, participation, and risk of injury will be collected. A limited number of questions designed to assess consumption of (1) sugar sweetened beverages, (2) calcium from milk products, (3) caffeine from energy drinks, and (4) hydration status will be asked on a daily basis. These questions have been selected by Dr. Hancock.

Musculoskeletal Injuries. All injuries will be documented for all research subjects from the time the subjects enroll in the study to the end of the competitive season. These injuries are typically documented, independent of this research study using well-established protocols that have been in place at Provo and Timpview High Schools for years. Immediately after a suspected injury occurs, the athlete is referred to the ATC for evaluation. At the discretion of the ATC, either a treatment plan is established by the ATC or the athlete is referred to a sports medicine physician for further evaluation. Regardless of whether the athlete is referred to a physician for further evaluation or not, the injury is eventually recorded by the ATC. The ATCs have agreed to support this research study and provide injury records for all research subjects; Provo School District is supportive of this cooperation between the current researchers and ATCs. The injury records will be collected under the cooperative supervision of Drs. Seeley, Beutler and Griffiths.

Statistical Analyses. Dr. Page will lead all statistical analyses for this study. The statistical analysis will consist of three phases: exploration, modeling, and validation. The first step in analyzing the data set, which will be copious and complex, will be to perform a thorough exploratory data analysis. Modern tools such as model-based clustering and principal components will be employed, in addition to common graphical and numerical summaries, to understand properties of the data and, if possible, discover hidden structures. Based upon results of the exploratory data analysis, statistical models will be formulated to determine which factors are predictive of injury. The main statistical tool that will be employed for the modeling component of the statistical analysis will be logistic or multinomial regression since the outcome of interest is injury (either a binary or a category). Determining how to include some of the injury factors (i.e., the predictor variables) will require care, however, as some are functional in nature (e.g., biomechanics); consequently, functional-on-scalar logistic or multinomial regression will also be considered. After a model has been formulated, it will be validated using simulation and other techniques (e.g., cross-validation and/or out-of-sample prediction performance). We fully anticipate that the size and complexity of data collected for this research project will require developing new statistical procedures.

Objective 2

In support of the second purpose of this study, we will employ a user-driven iterative design process to create a digital tool to provide information to high school certified athletic trainers and coaches. This approach is grounded in a fieldwork-based approach to research through design (RtD) in which design practice is used to generate new knowledge about what future interactive technology might be or should be.[44] We chose RtD because it allows for open-ended exploration of interactive technology in a new area such as the display of wellness information for athletic trainers and coaches in youth sports. In accordance with RtD methodology, we will design functioning prototypes that display relevant information to athletic trainers and coaches. This design phase will be guided by a prior of data literacy among Division I college athletes[31] and our own prior study of coach perspectives on data sharing with adolescent athletes in the context of sub-elite figure skating as mentioned above.[32] We will then evaluate functioning prototypes in the field with athletic trainers and coaches using inductive methods to collect in-depth qualitative descriptions of use. Evaluation in the field will be followed by careful reflection on the outcomes of those evaluations. Guided by our reflections, we will repeat the process by

identifying new problems, designing new prototypes, conducting new field evaluations and again reflecting on observations. This process is repeated as the design evolves and new problems are identified. RtD results in new insights about the design of interactive systems that can applied in related settings. RtD can also reveal gaps in theories from the behavioral sciences that inform design. Our multi-disciplinary team includes behavioral science researchers who will be a critical part of collaboratively identifying and addressing these gaps. All work associated with Objective 2 will be led by Dr. Jones, who has successfully used RtD in prior work which led to a successful technology transfer to real-world use as often happens in fieldwork-based RtD.[45]

Relevant to both study objectives, but especially the second objective, we have already built a prototype digital tool we will use to collect preliminary data for three local high school athletic teams this spring (2024), beginning in two weeks. These teams include a track and field, soccer, and lacrosse team. These tests will help us refine the digital tool that will be used to support the work we are proposing herein. The funds requested in this proposal will be used to (1) further refine our digital tool and (2) collect injury risk factor data and injury records for 12 local high school athletic teams (120-180 athletes) during the 2024-25 school year. We now have approval for this data collection from the Provo School District and Provo and Timpview High Schools, and we are close to obtaining IRB approval from the Intermountain Health IRB. In studying three teams, this spring, and 12 more teams next school year, we will test the feasibility of our data collection and distribution methods, and then improve where needed. During the 2025-2026 school year, we plan to use external funding to support an substantially larger study that will involve up to 75 high schools throughout Utah and Idaho, any high school utilizing a certified athletic trainer who is employed by Intermountain Health. We already have received verbal support from the Intermountain Health Sports Medicine physicians for this larger project.

Injury Risk Factor	Data Collection Instrument	Collection Frequency	Anticipated Completion Time
Injury History	Interview with physician or ATC	Once, beginning of study	10 min
Pain and Soreness	Stanford Body CHOIR Map Survey	Daily, throughout study	1-3 min
Sport Participation History	Modified Boston University Sport Participation Survey	Once, beginning of study	30 min
Biomechanics	OpenCap 3D Motion Capture	Once, beginning of study	20 min
Mental Health	DASS-21 Youth Survey	Weekly, throughout study	15 min
Mental Health	VAS Mood Check-in Survey	Daily, throughout study	< 1 min
Mental Health	VAS Readiness to Practice Survey	Daily, throughout study	< 1 min
Mental Health	4-Question Eating Disorder Survey	Once, beginning of study	2 min
Sleep	Athlete Sleep Behavior Survey	Weekly, throughout study	10 min
Sleep	VAS Sleep Quality Survey & Questions Concerning Sleep and Awake Times	Daily, throughout study	< 1 min
Nutrition: sugar, calcium, caffeine	3-item Survey Re # of Consumed Sodas, Milk, and Energy Drinks	Daily, throughout study	< 1 min
Nutrition: hydration	Urine Color Analysis Question	Daily, throughout study	< 1 min

Table 1. All of the injury risk factors that will be collected during the proposed study. Data describing each factor will be collected for each research subject (adolescent athlete) at the frequency and time described in Column C and require the duration described in Column D.

Budget and Budget Narrative

Item	Cost
2 MAT Student Wages Years 1 and 2	36,000.00
1 Psychology UG Student Wages Years 1 and 2	18,000.00
1 Computer Sciences UG Student Years 1 and 2	21,600.00
1 Statistics UG Student Wages Year 1	6,000.00
1 Statistics UG Student Wages Year 2	12,000.00
3 Laptop Computers & 3 iPhones	5,500.00
Subject Compensation	18,000.00
Total	117,100.00

1. **Two Masters of Athletic Training (MAT) students** will work for 15 hours per week, at $15 per hour, for 40 weeks (from July 1 to May 31) during both Years 1 and 2. They will work primarily under the supervision of Drs. Seeley and Griffiths and be involved in most study components, with an emphasis on data collection in Year 1. During Year 2, these students will assist with data analysis, interpretation, and presentation (academic and community presentations, and preparation of scientific manuscripts for publication). It is expected that all students involved in this project will earn coauthorship on academic presentations and publications.
2. **One undergraduate (UG) student in psychology** will work for 15 hours per week, at $15 per hour, for 40 weeks (from July 1 to May 31) during both Years 1 and 2. This student will work primarily under the supervision of Drs. Larson and Coyne and be involved primarily in the collection, analysis, and interpretation of the mental health data, although the student will interact with all other student researchers and faculty on the research team. This student will also assist in the preparation and delivery of academic and community presentations, and publication of scientific manuscripts.
3. **One UG student in computer science** will work for 15 hours per week, at $18 per hour, for 40 weeks (from July 1 to May 31) during both Years 1 and 2. This student will work primarily under the supervision of Dr. Jones and be involved primarily in human-computer interaction part of the study; of necessity, the student will also interact with the other student researchers and faculty on the research team. This student will also assist in the preparation and delivery of academic and community presentations, and publication of scientific manuscripts.
4. **One UG student in statistics** will work for 10 hours per week, at $15 per hour, for 40 weeks during Year 1 and for 20 hours per week, for 40 weeks, during Year 2. This student will work primarily under the supervision of Dr. Page and be involved primarily in the statistical analysis of the collected data. Like the other students, this student will interact with the other student researchers and faculty on the research team. This student will also assist in the preparation and delivery of academic and community presentations, and publication of scientific manuscripts.
5. **Three laptops and three iPhones** will be purchased and dedicated to this study.
6. **Subject Compensation.** We will recruit up to 180 subjects for this pilot study, from 12 different athletic teams. We will compensate each subject $100 if they complete all of the study tasks.

Plans for External Funding

With assistance from the BYU Office of Research Development, we have created a three-stage plan for securing external funding required to completely support this line of research. This plan consists of short-, mid-, and long-term funding goals. Most members of our research team (Beutler, Coyne, Larson, Jones, Page, Seeley) have substantial experience obtaining and maintaining external funding, and therefore understand the level of determination and commitment that is required to obtain external funds.

All of the short-term proposals described in this paragraph will be submitted in 2024. Dr. Seeley has already communicated with Intermountain regarding the Community Health Care Foundation and Community Partner Fund. We expect to receive a small ($5K) grant via the community partner fund before July 1, 2024. Additionally, Dr. Beutler has excellent connections with the American Orthopaedic Society for Sports Medicine (AOSSM), and the current topic is tailor-made for an AOSSM Playmaker grant (up to $25K). IDR funds are also considered to be short-term and would be a substantial assist in collecting the needed pilot data to secure larger mid-term funds. Another short-term source of funding that will be targeted is Build Dairy. We will submit a proposal focusing on the idea that calcium intake is being supplemented by energy drinks, for adolescent athletes, to Build Dairy. The BYU Food Science program now funds numerous graduate students via Build Dairy, and Dr. Hancock has connections there.

The primary target for mid-term (applications submitted in 2025; $200K-300K) funding is the NIH AREA (R15) grant, which is an excellent fit for BYU researchers generally. Dr. Seeley has applied twice for AREA funds, unsuccessfully, but is determined to try again. This line of research fits well for an AREA grant because it is a project that can easily involve numerous undergraduate research assistants. Most members of this research team have stellar records of involving numerous undergraduate students in their research. Dr. Coyne has successfully obtained an AREA grant. The current research topic could fit multiple NIH institutes. For example, by focusing on reducing risk for a specific musculoskeletal injury (ACL or Achilles Tendon), the present and novel research approach would be fundable through the National Institute of Arthritis and Musculoskeletal and Skin Diseases (an R15 titled, “Sex Differences In ACL Risk Factors Emerge During Adolescent Growth” was recently funded via this institute). Or, with a focus on eating disorders, a mental health focus of the present study, a proposal could be crafted for the National Institute of Mental Health (an R15 titled, “Reducing Eating Disorder Risk Factors in Female College Athletes—A Pilot Study” was recently funded within this institute). Similarly, we could focus on physical activity, or energy drinks, and target other institutes such as the National Institute of Child Health and Human Development or National Institute on Alcohol Abuse and Alcoholism, respectively. Two other mid-term funding targets for this line of research will be: (1) Return to Play Grant from the AOSSM, and (2) Community Care Foundation Grant from Intermountain Health. Dr. Beutler is well connected to both of these funding sources.

Long-term funding targets (submitted in 2026 and beyond; >$1M) for this research agenda will include an R01 grant submitted to any of the aforementioned NIH institutes. We will also target one or more of the following organizations: Keck Foundation, Pew Charitable Trust, or William T. Grant Foundation. These organizations support research agendas like the present that offer vast societal improvement such as increasing overall health and well-being of children and adolescents. Finally, another promising long-term target is the Human-Centered Computing Program at the National Science Foundation, which funds projects involving cross-disciplinary design-based research that results in new technologies in response to human needs and intentions. Projects funded by the Human-Centered Computing Program often include collaboration between behavioral scientists and computer scientists. Awards in this program range from $600K to $1.2M, depending on duration and number of investigators.

Biographical Sketches

BIOGRAPHICAL SKETCH

NAME: Coyne, Sarah

eRA COMMONS USER NAME (credential, e.g., agency login): sarahcoyne

POSITION TITLE: Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Utah State University	B.S.	04/2001	Psychology
University of Central Lancashire	PhD	05/2004	Psychology

A. Personal Statement

I have studied the impact of media on children, adolescents, and families for the past 20 years. Traditionally, much of my research has examined media effects on adolescents and emerging adulthood. For example, I was a co-PI for Flourishing Families: a 10-year longitudinal study examining the reasons why families with adolescents flourish or fail (with a major component being media). This study has resulted in multiple publications on the link between social media and mental health during adolescence. More recently, I have been focusing on the impact of media on minority populations, including LGBTQ+ individuals. I have supervised hundreds of students over the course of my career and have a great deal of experience in conducting survey, experimental, qualitative, and longitudinal research. These experiences have taught me what is needed to conduct high quality research, how to mentor and inspire students in the research process, and how to effectively recruit and retain a sample (for example, Flourishing families maintained an 85% retention rate over a decade of data collection). I have currently been at BYU for around 17 years. Before that, I worked at the University of Central Lancashire (in Preston, England) for 3 years. During this time, I have maintained a strong and consistent publication record (numbering 200+ publications), with many being published in the very top outlets in my field (including Child Development, Developmental Psychology, Pediatrics, etc). Additionally, I have a great deal of experience mentoring students. I typically work with upwards of 20 undergraduate and 1-3 graduate students each semester, with around 75% of my publications including a student co-author. I generally teach two undergraduate courses each year at BYU and truly love teaching and mentoring undergraduate students.

B. Positions and Employment

2007 - Professor, Brigham Young University, Provo, UT
2004 - 2007 Lecturer, University of Central Lancashire, Preston

Honors and Awards
2022 - 2022 Top paper, ICA (CAM division)
2020 - 2021 Career Champion, Brigham Young University
2017 - 2018 Extraordinary Research Achievement, Brigham Young University
2016 - 2017 Mentoring Award, Faculty Women's Association - BYU
2016 - 2017 Teaching Award, Brigham Young University
2013 - 2016 Mary Lou Fulton Young Scholar Award, Brigham Young University
2004 - 2004 Young Investigator's Award, International Society for Research on Aggression

C. Contributions to Science
The vast majority of research focuses on short-term effects of using media during childhood or adolescence. However, the cumulative effects of media likely shape attitudes and behavior across development. As a developmental psychologist, I have conducted multiple studies examining the impact of different types of media on child and adolescent behavior across multiple developmental periods. Many of my studies are some of the longest running studies conducted on certain types of media (e.g., violent video games). This research shows the importance of studying media across development as opposed to taking a snapshot in time, with a hope to reduce negative child health outcomes as a result of media.I have conducted multiple studies on the impact of media the development of body image and related constructs. This research includes longitudinal, experimental, cross-sectional, and qualitative (interviews and focus groups) methods. I have focused specifically on early childhood media, and effects on adolescents and emerging adults.

Coyne SM, Rogers A, Holmgren HG, Booth MA, Van Alfen M, Harris H, Barr R, Padilla-Walker LM, Sheppard JA, Shawcroft J, Ober M. Masters of Media: A longitudinal study of parental media efficacy, media monitoring, and child problematic media use across early childhood in the United States. J Child Media. 2023;17(3):318-335. PubMed Central PMCID: PMC10575305.

Coyne SM, Warburton W, Swit C, Stockdale L, Dyer WJ. Who is Most at Risk for Developing Physical Aggression After Playing Violent Video Games? An Individual Differences Perspective From Early Adolescence to Emerging Adulthood. J Youth Adolesc. 2023 Apr;52(4):719-733. PubMed PMID: 36763317.

Coyne SM, Stockdale L. Growing Up with Grand Theft Auto: A 10-Year Study of Longitudinal Growth of Violent Video Game Play in Adolescents. Cyberpsychol Behav Soc Netw. 2021 Jan;24(1):11-16. PubMed PMID: 33337262.

Coyne SM, Padilla-Walker LM, Holmgren HG, Stockdale LA. Instagrowth: A Longitudinal Growth Mixture Model of Social Media Time Use Across Adolescence. J Res Adolesc. 2019 Dec;29(4):897-907. PubMed PMID: 29953692.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Christine Multer Griffiths

POSITION TITLE: Associate Teaching Professor, Department of Exercise Sciences, BYU

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Brigham Young University, Provo, Utah	PhD	12/2001	Exercise Science/Wellness
Miami University, Oxford, Ohio	MS	08/1993	Exercise Science
Miami University, Oxford, Ohio	BS	08/1990	Exercise Science
Miami University, Oxford, Ohio	BS	05/1990	Education
Board of Certification for Athletic Trainers		06/1992	Certified Athletic Trainer

A. Personal Statement: I will serve as a Co-investigator on this study. I am a certified athletic trainer (ATC) and have been an ATC for 33 years and have supervised athletic training for students for the same number of years. I have expertise in sports injury and youth sports injury. I also have 31 years of working with clinical athletic trainers. The data collection portion of this study will require coordination with the onsite athletic trainers and the BYU students who are with them. There is nuance in understanding the relationship of the athletic trainer to the athletes and the hierarchy within which they operate that will need to be considered to successfully execute data collection and to ultimately interpret the data that is collected. I currently supervise our 35 graduate athletic training students who are completing their clinical experiences. Additionally, I was employed as a project manager with a contract research organization (CRO) that managed large scale clinical trials on medical devices that were being tested for FDA approval. During that time, I managed over 50 sites collecting data with a $10 million dollar budget. I was responsible for insuring that the trial was in compliance with all FDA regulations and patient safety was assured.

B. Positions, Scientific Appointments, and Honors

Associate Teaching Professor	2023-present	Brigham Young University
Associate Project Manager	2022-2023	Avania (Contract Research Organization)
Chair, Department of Sport Sciences	2018-2022	Thomas More University

Adjunct Instructor	2016-2017	Thomas More University
Online Course Developer and Instructor	2009-2017	Jackson State Community College
Associate Lecturer	2004-2019	Nova Southeastern University
Assistant Professor	2002-2004	The University of Toledo
Adjunct Assistant Professor	2002-2004	Medical College of Ohio
Faculty Instructor	1999-2001	Brigham Young University
Research Assistant	1998-1999	Brigham Young University
Graduate Teaching Assistant	1997-1999	Brigham Young University
Research Technician	Summer, 1997	The Procter & Gamble Company
Director of Aquatic Rehabilitation	Summer, 1996	The Orthopedic Specialty Hospital (Murray, Utah)
Assistant Athletic Trainer	1993-1996	Miami University
Instructor	1993-1996	Miami University

C. Contributions to Science

Kuntz, AR, **Griffiths, CM**, Rankin, JM, Armstrong, CW, and McLoughlin, TJ. Cortisol concentrations in human skeletal muscle tissue after phonophoresis with 10% hydrocortisone gel. *Journal of Athletic Training*, 2006; 41(3): 321–324.

Woolstenhulme, MT, **Griffiths, CM**, Woolstenhulme, EM, and Parcell, AC. Ballistic stretching increases flexibility and acute vertical jump height when combined with basketball activity. *The Journal of Strength and Conditioning Research*, 2006, 20(4); 799-803.

Masterson, MM, Morgan, AL, **Multer, CE**, and Cipriani, DJ. The role of lower leg muscle activity in blood pressure maintenance of older adults. *Clinical Kinesiology* 60(2); Summer, 2006.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.

Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Hancock, Chad R.

eRA COMMONS USER NAME (credential, e.g., agency login): CHANCOCK

POSITION TITLE: Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	START DATE MM/YYYY	END DATE MM/YYYY	FIELD OF STUDY
Brigham Young University	B.S.		04/1998	Physical Education (Exercise Physiology)
University of Missouri, Columbia, MO	Ph.D.		05/2005	Physiology/Muscle Physiology
Washington University in St. Louis, MO	Postdoctoral Fellow	05/2005	07/2008	Exercise/Nutrition Metabolism

A. Personal Statement. A primary focus of this project is aimed at assessing relationships between risk factors for injury in adolescent athletes and to provide school certified athletic trainers and athletic coaches with daily information that can be used to adjust practice intensity, to reduce injuries experienced by high school athletes. My research interest has been in the area of cellular energy metabolism and muscle function, and I have published over 40 original research manuscripts in this area. In addition, I have taught upper division and graduate courses in Sports Nutrition and Energy Metabolism since 2006 at St. Louis University and at Brigham Young University. I am assisting with this research proposal by providing assessment tools and questions to help determine nutritional aspects of adolescent behavior that are risk factors for injury. My specific contributions include the following: assist with experimental design and writing, provide survey questions for assessment of nutritional risk for injury, data analysis and interpretation.

B. Positions and Honors

Positions and Employment

2023- present Professor, BRIGHAM YOUNG UNIVERSITY
2008 - 2014 Assistant Professor, BRIGHAM YOUNG UNIVERSITY
2014 - Associate Professor, Brigham Young University, Provo, UT

Other Experience and Professional Memberships

2000 - Member, American Physiological Society
2000 - Member, American College of Sports Medicine
2007 - Member, Editorial Board-American Journal of Physiology-Endocrinology and Metabolism
2008 - Member, American Diabetes Association

Relevant course instruction:
NDFS 100. – Essentials of Human Nutrition
NDFS 635R – Sports Nutrition
NDFS 310 – Nutrition and Metabolism in Sports and Exercise

DIET-550 Nutrition and Physical Performance. Adjunct Instructor in the Department of Nutrition and Dietetics of Saint Louis University. Masters level course

Honors

Sam and Aline Skaggs Distinguished Mentoring Fellowship, BYU College of Life Sciences, 2022

C. Contribution to Science. My research focus has largely been more on a basic and applied focus on aspects of energy metabolism. I have published over 40 manuscripts in this area.

1. Hyldahl RD, Gifford JR, Davidson LE, Hancock CR, Hafen PS, Parcell AC, Mack GW. Physiological assessment of a 16 day, 4385 km ultra-endurance mountain bike race: A case study. *Exp Physiol.* 2024 Jan 8. doi: 10.1113/EP091260.
2. Marchant ED, Nelson WB, Hyldahl RD, Gifford JR, Hancock CR: Passive heat stress induces mitochondrial adaptations in skeletal muscle. *Int J Hyperthermia* 2023, 40(1):2205066.
3. Jacobson MM, Gardner AM, Handley CE, Smith MW, Christensen WF, Hancock CR, Joseph PV, Larson MJ, Martin CK, LeCheminant JD: Body shape perception in men and women without obesity during caloric restriction: a secondary analysis from the CALERIE study. *Eat Weight Disord* 2023, 28(1):20.
4. Marchant ED, Kaluhiokalani JP, Wallace TE, Ahmadi M, Dorff A, Linde JJ, Leach OK, Hyldahl RD, Gifford JR, Hancock CR: Localized Heat Therapy Improves Mitochondrial Respiratory Capacity but Not Fatty Acid Oxidation. *Int J Mol Sci* 2022, 23(15).
5. Marchant ED, Marchant ND, Hyldahl RD, Gifford JR, Smith MW, and Hancock CR. Skeletal Muscle Mitochondrial Function after a 100-km Ultramarathon: A Case Study in Monozygotic Twins. *Med Sci Sports Exerc* 53: 2363-2373, 2021.
6. Deyhle MR, Carlisle M, Sorensen JR, Hafen PS, Jesperson K, Ahmadi M, Hancock CR, and Hyldahl RD. Accumulation of Skeletal Muscle T-cells and the Repeated Bout Effect in Rats. *Med Sci Sports Exerc* 2019.
7. Hafen PS, Abbott K, Bowden J, Lopiano R, Hancock CR, and Hyldahl RD. Daily heat treatment maintains mitochondrial function and attenuates atrophy in human skeletal muscle subjected to immobilization. *J Appl Physiol (1985)* 127: 47-57, 2019.

A more complete list of publications can be found here:
https://www.ncbi.nlm.nih.gov/myncbi/1VCwb51aEVrQh/bibliography/public/

D. Research Support

Skylark Biosciences research project: Investigating prodrug-39 as an AMP mimetic for regulation of energy metabolism and muscle growth. $30,000 David Thomson and Chad Hancock 2020-2023.

BYU Interdisciplinary Research Origination Award (Track 1) $120,000 for 2021-2023. The Impact of Repeated Exposure to Heat Stress on Muscle Energetics, Vascular Dynamics and Function in Aging. Robert Hyldahl, Co-investigators: Chad Hancock, Jayson Gifford, John Price.

BYU Gerontology Research Award – 2020 ($9,000) Heat Therapy: a Intervention to Improve Skeletal Muscle Bioenergetics and Vascular Function in Aged Adults (Robert Hyldahl, Jayson Gifford, Chad Hancock)
Co-investigator- 2021 - Repeated Exposure to Heat Stress (REHS): A Novel Therapeutic Strategy for Age-Related Skeletal Muscle and Vascular Dysfunction-1 R01 AG076632-01. (Not Funded)

Co-investigator- 2019 - Heat-Induced Skeletal Muscle Mitochondrial Biogenesis: A Countermeasure For Human Disuse Atrophy - 1 R01 AR073838-01A1 (Revision, scored at the 26th Percentile; Not Funded)

BIOGRAPHICAL SKETCH

NAME: Jones, Michael David

eRA COMMONS USER NAME (credential, e.g., agency login): n/a

POSITION TITLE: Professor of Computer Science

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Brigham Young University	B.S.	04/1995	Computer Science/Math
Brigham Young university	M.S.	04/1997	Computer Science
The University of Utah	Ph.D.	07/2001	Computer Science

A. Personal Statement

I will serve as a Co-Investigator on the study and assist with human-computer interaction (HCI) aspects of the study. Specifically, I will assist with data visualization, studies involving how people interact with data in this context and manuscript/external funding application writing. I am skilled at completing design-based HCI research in specific contexts with interdisciplinary teams. I currently lead a team of 5 graduate and undergraduate students involved in the study of sports and outdoor recreation.

B. Positions and Employment

2023 to present—Associate Dept Chair, Department of Computer Science, Brigham Young University
2021 to present—Professor, Department of Computer Science, Brigham Young University
2007 to 2021—Associate Professor, Department of Computer Science, Brigham Young University
2001 to 2007--Assistant Professor, Department of Computer Science, Brigham Young University

Honors and Awards

2021 Technology Transfer Award, Brigham Young University

C. Contributions to Science

Relevant to this proposal, my work in sports and HCI has focused on the role of data in coaching for youth sports. That works focused on the dynamics of data sharing in the context of sub-elite figure skating. Other relevant work includes analysis of motion data in volleyball and figure skating, the study of interactive systems in outdoor recreation, and the invention of new techniques for prototyping a class of physical interactive devices. Five representative publications are:

Don Elvitigala, Armagan Karahanoglu, Andrii Matviienko, Laia Turmo Vidal, Dees Potsma, **Michael Jones**, Maria Montoya, Daniel Harrison, Lars Elbaek, Florian Daiber, Lisa Burr, Rakesh Patibanda, Perttu Hamalainen, Robby Van Delden, Regina Bernhaupt, Xipei Ren, Vincent Van Rheden, Fabio Zambetta, Elize Van Den Hoven, Carine Lallemand, Dennis Reidsma, Florian Mueller, "Grand Challenges in SportsHCI" to appear in *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems*. Honolulu, Hawaii, April 2024 (to appear).

Michael Jones, Mia Caminita, Elizabeth Klemm, Dustin Bruening, Sarah Ridge. "Training, children, and parents: Coach perspectives on wearable sensor data in sub-elite figure skating in the United States", *International Journal of Human-Computer Studies*, Academic Press. March 2024.

Zann Anderson and **Michael Jones** "Experience Shaping, Social Cues and Safety: Headphone Use and Non-Use While Hiking in the United States"**,** *International Journal of Human-Computer Interaction,* Taylor and Francis, online. August 2023.

Miki Jauhiainen and **Michael Jones**. "Using Machine Learning to Classify Volleyball Jumps" in *NTSPORT'22: New Trends in HCI and Sports Workshop at MobileHCI'22, October 1, 2022*.

Scott McCrickard, **Michael Jones** and Timothy Stelter, eds. *HCI Outdoors: Theory, Design, Methods and Applications*, Springer. December 2020.

Complete List of Published Work in Google Scholar at:
https://scholar.google.com/citations?hl=en&user=Qpmq3ZQAAAAJ

D. Research Support

Dr. Michael Jones has served as Principal Investigator on $1.8M in external funding including two grants from the National Science Foundation to investigate design tools for physical computing objects ($1.1M) and another to investigate head mounted displays in Deaf education ($302k). His research has also been supported by Sorenson Impact Foundation ($302k) and Google ($90k). Additionally, his research is also supported by Signglasses, Inc. through patent licensing and royalty fees. He has successfully advised 15 graduate students and more than 70 undergraduate research assistants at BYU.

BIOGRAPHICAL SKETCH

NAME: Larson, Michael James

eRA COMMONS USER NAME (credential, e.g., agency login): MICHAEL.LARSON

POSITION TITLE: Professor of Psychology and the Neuroscience Center

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Brigham Young University	B.S.	08/2002	Psychology & Sociology
University of Florida	M.S.	05/2004	Clinical Psychology
University of Florida	Ph.D.	08/2008	Clinical Psychology—Neuropsychology

A. Personal Statement

I will assist with the mental health side of the study. Specifically, I will assist with determining measurement, measurement quality, data collection, data analysis, and manuscript/external funding application write up. I am a licensed clinical neuropsychologist with assessment and treatment experience and a primary expertise in traumatic brain injury and concussion. I am a Level 3 MRI scanner operator, have administered and interpreted hundreds of neuropsychological evaluations (including measuring and interpreting the cognitive and mood measures to be used in the current study), and am skilled at working in an interdisciplinary team. I currently lead a team of 18 graduate and undergraduate students that are productive and consistent in publication of cognitive neuroscience/neuropsychology research. I have published over 145 manuscripts and book chapters, including over 120 since my arrival at BYU in 2008.

B. Positions and Employment

2018 to present—Professor, Department of Psychology and Neuroscience Center, BYU
2016 to present—Editor-in-Chief, *International Journal of Psychophysiology*
2016 to present—Associate Department Chair, Department of Psychology, BYU
2014 to present--Associate Professor, Department of Psychology and Neuroscience Center, BYU
2014 to 2016--Associate Director of Clinical Training, Clinical Psychology Program, BYU
2014 to 2018—Associate Professor, Department of Psychology and Neuroscience Center, BYU
2008 to 2014--Assistant Professor, Department of Psychology and Neuroscience Center, BYU
-Licensed Clinical Psychologist--Utah Obtained 04/2010
License Number: 7229338-2501

Honors and Awards

2018 Martin B. Hickman Innovation in Teaching Award, College of Family, Home, and Social Sciences
2015 Young Scholar Award, Brigham Young University
2014 Outstanding College Young Alumnus, Public Health & Health Professions, University of Florida
2013 Outstanding Department Young Alumnus, Clinical & Health Psychology, University of Florida
2012 Program Committee Chair 40th Annual Meeting of the International Neuropsychological Society
2009 Psi Chi Psychology Teacher of the Year, Brigham Young University
2007 Levitt Neuropsychology Research Award, University of Florida

C. Contributions to Science

My work in psychopathology, mental health, concussion and traumatic brain injury has focused on cognitive control/executive function changes and cognitive control dysfunction. I have published over 140 manuscripts across a range of neuropsychological and psychiatric disorders, including healthy aging, traumatic brain injury, obsessive-compulsive disorder, anxiety, and depression. Five representative publications (from 145 total journal articles and book chapters) include:

Larson, M.J., Muir, A. M.**, Reid, R.O.**, Carbine, K.A., Marsh, H.*, LaCouture, H.*, McCutcheon, C.*, & Bailey, B. W. (in press). Does intensity matter? A randomized crossover study of the role of acute exercise intensity on cognitive performance and motor speed and accuracy. *Progress in Brain Research*

Clayson, P.E., Shuford, J.L., Rast, P., Baldwin, S.A., Weissman, D.H., & **Larson, M.J.** (2023). Normal congruency sequence effects in psychopathology: A behavioral and electrophysiological examination using a confound-minimized design. *Psychophysiology*, e14426. Doi: 10.1111/psyp.14426.

Christensen, B.A.**, Clark, B.**, Muir, A.M.**, Allen, W.D.*, Corbin, E.M.**, Jaggi, T.**, Alder, N.**, Clawson, A., Farrer, T.J., Bigler, E.D., & **Larson, M.J.** (2023). Interhemispheric transfer time (IHTT) and concussion in adolescents: A longitudinal study using response time and event-related potential (ERP) measures. *Frontiers in Human Neuroscience, 17,* 1161156 (pages 1 to 15). Doi: 10.3389/fnhum.2023.1161156

Larson, M.J. (2020). Improving the rigor and replicability of applied psychophysiology research: Sample size, standardization, transparency, and preregistration. *Biofeedback, 48*, 2-6.

Larson, M.J., Clayson, P.E.**, & Farrer, T.J.* (2012). Performance monitoring and cognitive control in individuals with mild traumatic brain injury. *Journal of the International Neuropsychological Society, 18,* 323-333.

Complete List of Published Work in Google Scholar at: https://scholar.google.com/citations?user=-ECDuuAAAAAJ&hl=en

D. Research Support

Dr. Michael Larson has applied for and received a combined total of grants and awards that exceeds $900,000, including six extramurally-funded proposals and over 25 intramural grants. Dr. Larson recently completed projects as a PI on a BYU College of Family, Home, and Social Sciences MEG grant ($20,000), and as a co-I on a Marjorie Pay Hinckley Research Award ($22,500). He also completed a second donor-funded mentoring experience where he and a team provide training on simultaneous EEG and fMRI (192,000). He previously completed a separate boot camp called “A Mentored-Learning Experience and Computational Training in Human Electrophysiology” ($161,020). Thus, Dr. Larson has a long history of funded awards that he has completed in a timely fashion with many undergraduate and graduate student collaborators.

BIOGRAPHICAL SKETCH

NAME: Page, Garritt L.

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Associate Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Iowa State University, Ames Iowa, USA	PhD	12/2009	Statistics
Brigham Young University, Provo Utah, USA	MS	08/2005	Statistics
Southern Utah University, Cedary City Utah, USA	BS	05/2002	Statistics

A. Personal Statement

I am the creator and maintainer of four R-packages. Among them is "ppmSuite" which is a collection of computer codes that permits users to fit models that are are connected to the methodological development in the proposed research program. I delivered a talk in a recently invited scientific symposium concerning several of the ideas discussed in the current proposal: Seeley, M.K., Evans-Pickett, A., Page, G., & Hopkins, J.T. (2021). Modern statistical approaches for improved analysis of neuromechanical data: applications and fundamental principles. Symposium at the Annual Meeting of the American College of Sports Medicine. Importantly, Dr. Seeley organized and chaired the session. I was a Fulbright scholar at the University of Bologna during the Spring of 2022. While there, the collaboration with Massimo Ventrucci (a consultant for this project and expert in penalized complexity priors) was begun.

B. Positions and Employment

2019-Present. Associate Professor, Brigham Young University, Provo Utah
2022. Fullbright Scholar, University of Bologna, Bologna Italy
2015-2019. Assistant Professor, Brigham Young University, Provo Utah
2011-2015. Assistant Professor, Pontificia Universidad Catolica de Chile, Santiago Chile
2009-2011. Visiting Assistant Professor, Duke University, Durham North Carolina

C. Relevant Publications

Page, Garritt L.; Quintana, Fernando A.; Dahl, David B. (2022) "Dependent Modeling of Temporal Sequences of Random Partitions" Journal of Computational and Graphical Statistics, 32(2) 614-627

Horton, W. Zachary; Page, Garritt L.; Reese, C. Shane; Lepley, Lindsay; White, McKenzie (2021) "Template Priors in Bayesian Curve Registration" Technometrics 63(4) 487-499

Hopkins, Ty J.; Son, Jun S.; Hyunsoo, Kim; Page, Garritt L.; Seeley, Matthew K. (2019) "Characterization of Multiple Movement Strategies in Participants with Chronic Ankle Instability" Journal of Athletic Training 54(6) 698-707

Page, Garritt L.; Quintana, Fernando A. (2015) "Predictions Based on Clustering of Hetergenous Functions via Shape and Subject-Specific Covariates" Bayesian Analysis, 10(2) 379-410

Page, Garritt L,; Dunson, David B.; (2011) "Bayesian Local Contamination Models for Multivariate Outliers," Technometrics 53(2) 152-162

Page, Garritt L.; Quintana, Fernando A.; Müller, Peter (2022) "Clustering and Prediction With Variable Dimension Covariates" Journal of Computational and Graphical Statistics 31(2) 466-476

Quinlan, José J.; Quintana, Fernando A.; Page, Garritt L. (2021) "On a Class of Repulsive Mixture Models" Test 30(2) 445-461

Page, Garritt L.; Rodríguez Álvarez, María Xosé; Lee, Dae-Jin (2020) "Bayesian Hierarchical Modeling of Growth Curve Derivatives via Sequences of Quotient Differences" Journal of the Royal Statistical Society: Series C 69(2) 459-481

Page, Garritt L.; Quintana, Fernando A. (2018) "Calibrating Covariate Informed Product Partition Models" Statistics and Computing 28(5) 1009-1031

Page, Garritt L.; Quintana, Fernando A. (2016) "Spatial Product Partition Models" Bayesian Analysis, 11(1) 265-298 (Discussion paper with rejoinder)

BIOGRAPHICAL SKETCH

NAME: Seeley, Matthew K.

eRA COMMONS USER NAME (credential, e.g., agency login): mseeley3

POSITION TITLE: Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Kentucky, Lexington, KY, USA	PhD	08/2006	Exercise Science
Utah State University	MS	05/2002	Exercise Science
Utah State University, Logan, UT, USA	BS	05/2000	Exercise Science

A. Personal Statement

I have the expertise and experience necessary to contribute to the proposed project in the ways that are described in the accompanying grant proposal; i.e., assist with the collection, analysis, and interpretation of data describing movement biomechanics, and injury records. My academic expertise/background is in human neuromechanics, and I also have valuable experience in the measurement and interpretation of joint biochemistry associated with articular cartilage health. For the past several years, I have been working closely with Dr. Garritt Page to better understand joint biomechanics, in the specific context of knee joint articular cartilage health. Further, much of my research surrounding knee pathologies and articular cartilage health involves measurement of human movement mechanics, and the interpretation of these measurements. Additionally, before beginning my PhD program, I worked as a certified athletic trainer at Utah State University, where I was responsible for assisting in the prevention, diagnosis and treatment of injuries for collegiate athletes. I have the conceptual knowledge, technical skills, and leadership ability to lead the proposed project, in cooperation with my co-investigators. I have a broad conceptual background in biomechanics, with specific training and skills in the measurement of lower-extremity neuromechanics, patient-reported outcomes, and joint biomechanics. I have demonstrated my knowledge and skills in publishing numerous articles related to biomechanics and athletic injury within various contexts.

B. Positions and Employment

1997-2002	Certified Athletic Trainer, Utah State University, Logan, UT
2002-2006	Research Assistant, University of Kentucky, Lexington, KY
2006-2013	Assistant Professor, Exercise Sciences Dept, BYU, Provo, UT
2013-2018	Associate Professor, Exercise Sciences Dept, BYU, Provo, UT
2018	Visiting Scholar, Exercise and Sport Sciences Dept, UNC, Chapel Hill, NC
2018-present	Professor, Exercise Sciences Dept, BYU, Provo, UT

C. Honors
Kenneth L. Knight Award for the Outstanding Research Manuscript, *Journal of Athletic Training*, 2019 (Characterization of multiple movement strategies in participants with chronic ankle instability)

Outstanding Researcher Award, College of Life Sciences, Brigham Young University, 2019

Visiting Scholar Award, American College of Sports Medicine (ACSM), 2017

D. Relevant Contributions to Science
Lee, H., et al. (2023). Decreased rate of torque development in ankle evertors for individuals with chronic ankle instability. *Clinical Biomechanics*, 109, 106096.

Hanson, R.A., et al. (2023). Dual-sensing piezoresponsive foam for dynamic and static loading. *Sensors*, 23(7), 3719.

Lee, H., et al. (2023). Disrupted vision impairs force steadiness and accuracy in chronic ankle instability patients. *Journal of Orthopaedic Research,* 41(8), 1729-1737.

White, M.S., et al. (2021). The utility of functional data analyses to reveal between-limb asymmetries in those with a history of ACLR. Journal of Athletic Training, 56(3), 272-279.

Evans-Pickett, A., et al. (2020). Biomechanical Effects of Manipulating Peak Vertical Ground Reaction Force During Gait in Individuals with Anterior Cruciate Ligament Reconstruction. Clinical Biomechanics, 76.

Davis-Wilson, H.C., et al. (2020). Bilateral gait 6 and 12 months post-anterior cruciate ligament reconstruction compared with controls. Medicine and Science in Sports and Exercise, 52(4), 785-794.

Pietrosimone, B., et al. (2019). Walking ground reaction force post-ACL reconstruction: analysis of time and symptoms. Medicine and Science in Sports and Exercise, 51(2).

Novel functional clustering methods to study effects of biomechanics on knee joint health. A grant submitted in September 2022. NSF, PD 22-7334. Not Funded. Role: Co-PI.

Seeley, M.K., et al. (2021). Anterior knee pain independently alters landing and jumping biomechanics. Clinical Biomechanics, 89, 105458.

Seeley, M.K., et al. (2021). A review of the Relationships Between Knee Pain and Movement Neuromechanics. Journal of Sport Rehabilitation, 31(6).

Seeley, M.K., et al. (2020). Predicting running ground reaction forces using novel piezoelectric foam sensors. Journal of Sports Sciences, 38(16), 1844-1858.

Smart nanocomposite bio-sensing wearables for enhanced out-of-clinic rehabilitation. Submitted in October 2018. Funded from July 1 2019 to July 1 2022. NSF, PD 17-53442. Funded, $386,961. Role: Co-PI.

Mobile Gait Analysis Using Wearable Piezoresponsive Nano-Composite Sensors. Submitted in February 2015. NSF PD 14-7569. Funded, $376,053. Role: Co-PI.

Sarah Coyne, Current and Pending Support

Current Support:
A Growing up in a digital world: A synergistic approach to understanding media use in children ages 1-8 years

Time Commitment: 25%
Supporting Agency: NIH
Funding Agency's Procuring Contracting/Grants Officer: Jim Griffin
Performance Period: 2022-2025
Level of Funding: $1,451,484
Project Description: This Research Program proposal aims to address this scientific gap by creating an evidence base that uses standardized, scalable, comprehensive measures of early media exposure using the Comprehensive Assessment of Family Media Exposure (CAFE; Barr et al., 2020; Radesky et al., 2020a). Our approach, coordinated across sites, uses a modified Differential Susceptibility to Media Effects Model (DSMM; Valkenburg & Peter, 2013) to test multiple hypotheses about media use and child social-emotional development.

Pending Support:
The impact of the Utah Social Media Regulation Act on adolescent mental health, wellbeing, and digital technology use: A Natural Experiment

Time Commitment: 10%
Supporting Agency: NIH
Funding Agency's Procuring Contracting/Grants Officer: Jim Griffin
Performance Period: 2024-2026
Level of Funding: $275,000
Project Description:
The proposed aims will allow us to investigate the roll-out of the Utah Social Media Regulation Act using a natural experimental mixed-methods study. Our goal is to elucidate the effectiveness of the Utah Social Media Regulation Act on mental health, social relationships, and social media practices and learn who may be harmed by the act in order to provide support for these youth as necessary. The results of this study can further be used by other states and policymakers to create and adjust social media regulations to support child and adolescent wellbeing.

Christine Griffiths, Current and Pending Support

Current Support:
None

Pending:
None

Chad Hancock, Current and Pending Support

Current Support:
Skylark Biosciences research project: Investigating prodrug-39 as an AMP mimetic for regulation of energy metabolism and muscle growth. $30K David Thomson and Chad Hancock 2020-2023.

Pending:
None

Michael Larson, Current and Pending Support

Current:
A Mentored Environment Learning Skills During a Randomized Controlled Trial of Heart Rate Variability Biofeedback Following Traumatic Brain Injury; Brigham Young University College of Family, Home, and Social Sciences; $20K

Pending:
None

Michael Jones, Current and Pending Support

Pending

"HCC: SMALL: Rethinking Engagement with Interactive Technology in Nature Recreation" in the amount of $599,908 submitted to the National Science Foundation with a proposed start date of July 2024. 1.0 Person months committed.

Current

None

Garritt Page, Current/Pending Support

Pending

“XTRIPODS: Robust Data Science by Clustering Curves using Phase Variability” in the amount of $200,000 submitted to the National Science Foundation with a proposed start date of March 2024. Amount Requested: $200K. 0.3 Person months committed. Role: PI.

Current

None

Matthew Seeley, Current/Pending Support

Pending

"XTRIPODS: Robust Data Science by Clustering Curves using Phase Variability" in the amount of $200,000 submitted to the National Science Foundation with a proposed start date of March 2024. Amount Requested: $200K. 0.3 Person months committed. Role: Co-PI.

Current

Elucidating Non-contact Lower-extremity Injury Etiology In Collegiate American Football (2023). Athletics-Academic Collaboration Initiative. $21K. Primary Investigator.

References

1. Guddal, M.H., et al., *Physical activity and sport participation among adolescents: associations with mental health in different age groups. Results from the Young-HUNT study: a cross-sectional survey.* BMJ open, 2019. **9**(9): p. e028555.
2. Taliaferro, L.A., et al., *High school youth and suicide risk: exploring protection afforded through physical activity and sport participation.* Journal of school health, 2008. **78**(10): p. 545-553.
3. Sports, N.C.o.Y. *NCYS: Advocate of Youth Sports*. 2023 [cited 2023 December 14 2023]; Available from: ncys.org.
4. News, N.F.o.H.S.S. *Participation in High School Sports Reigsters First Decline in 30 Years*. 2019; Available from: https://www.nfhs.org/articles/participation-in-high-school-sports-registers-first-decline-in-30-years/.
5. Molcho, M., et al., *The epidemiology of non-fatal injuries among 11-, 13- and 15-year old youth in 11 countries: findings from the 1998 WHO-HBSC cross national survey.* Int J Inj Contr Saf Promot, 2006. **13**(4): p. 205-11.
6. Bell, D.R., et al., *The Public Health Consequences of Sport Specialization.* J Athl Train, 2019. **54**(10): p. 1013-1020.
7. Bram, J.T., et al., *Anterior Cruciate Ligament Injury Incidence in Adolescent Athletes: A Systematic Review and Meta-analysis.* Am J Sports Med, 2021. **49**(7): p. 1962-1972.
8. Choi, W.S., et al., *Cigarette smoking predicts development of depressive symptoms among US adolescents.* Annals of behavioral medicine, 1997. **19**(1): p. 42-50.
9. Lam, K.C., et al., *A unique patient population? Health-related quality of life in adolescent athletes versus general, healthy adolescent individuals.* Journal of athletic training, 2013. **48**(2): p. 233-241.
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