

2019 POTENTIAL INJURY SCIENCE REU SUMMER RESEARCH PROJECTS

(Please scroll down to view all projects #1 to #11.)

ENGINEERING CORE

All Engineering Core REU students will learn the design and conduct of laboratory-based and real-world engineering studies and the analysis and interpretation of the data collected. They may have opportunities to submit and present their work at conferences (e.g., the Ohio State University Impact Biomechanics Symposium and the Annual Meeting of the Human Factors and Ergonomics Society) with support from their mentors and to participate in the preparation of publications. They will be encouraged to work independently with appropriate mentorship and to generate enthusiasm and future career interest in engineering research that incorporates medicine and behavior for injury prevention.

ENGINEERING RESEARCH PROJECTS

Project 1: Data Engineering: Analysis of Crash Data

Mentor: Aditya Belwadi, MS, PhD, CPST

Research Description: Motor vehicle crashes are the leading cause of death and a leading cause of injury for children worldwide. As long as there are childhood injuries, there will be a need to apply the tools of science to prevent them. The Center for Injury Research and Prevention is a comprehensive pediatric trauma research facility at Children's Hospital of Philadelphia dedicated to addressing injury, the leading cause of death for children and adolescents. The center is seeking highly motivated and innovative undergraduate students majoring in Biomedical Engineering to participate in several exciting new projects focused on pediatric biomechanics, machine design and computational modeling. Candidates should have interest in data analysis with demonstrated capability in application of mechanical engineering concepts.

REU Project Description: The REU student will become a member of the Engineering Research Core at the Center for Injury Research and Prevention and will receive

mentorship from several of the lead investigators of the Core. The student will develop his/her skills with data analyses of a diverse set of data types. Previous experience using MATLAB is critical, and the student will have the opportunity to increase his/her skills in this area. The student will also gain experience in problem-solving, data analyses, interpreting findings, and developing new research ideas. There will also be opportunities to submit and present his/her work at conferences and to participate in the preparation of journal publications.

Project 2: Project: Understanding Factors Contributing to Crashes and Near Crashes Among Risky Drivers Using Naturalistic Driving Data

Mentor: Thomas Seacrist, MS

Research Description:

Motor vehicle crashes remain the leading cause of death in the United States and worldwide. Risky drivers, specifically young and older drivers, are disproportionately represented among motor vehicle crashes. Previous research has attempted to quantify driving behavior and factors contributing to crashes and near crashes among risky drivers. However, the majority of these studies are based on police-reports and post-crash survey, which do not contain detailed information about the crash events. Others have studied driver behavior using driving simulators, which may not accurately represent real-world (i.e. naturalistic) driving. Recently, the US Department of Transportation funded a large-scale US naturalistic driving study – the Strategic Highway Research Program 2 (SHRP2) Naturalistic Driving Study – which tracked day-to-day driving, crashes, and near crashes among 3,000 drivers over a two-year period. This large dataset offers a unique opportunity to study real-world driver behavior that contributes to crashes and near crashes.

At the Center for Injury Research and Prevention, we are interested in understanding how pre-crash factors, such as distraction or road conditions, contribute to crashes and near crashes. Additionally, we are interested in knowing how these factors differ among risky drivers, with a particular emphasis on young teen drivers. Finally, we would like to

make recommendations to vehicle manufacturers on which crash avoidance technologies can best address these contributing factors.

REU Project Description: The REU student will become a member of the Engineering Research Core at the Center for Injury Research and Prevention and will receive mentorship from several of the lead investigators of the Core. The student will be involved in the review and analysis of naturalistic crashes and near crashes among risky drivers from the SHRP2 dataset. The student will develop his/her skills with data analyses, statistical analysis, and team-based case reviews. Previous experience using MATLAB, SAS, SPSS or other programming language is critical, and the student will have the opportunity to increase his/her skills in this area. Prior experience with biostatistics and/or video coding is also beneficial. The student will also gain experience in problem-solving, data analyses, interpreting findings, and developing new research ideas. In addition, there will be opportunities to submit and present his/her work at conferences and to participate in the preparation of journal publications.

Project 3: Biomechanical Response and Driver Reaction Time during Pre-Crash Maneuvers

Mentor: Valentina Graci, PhD

Research Description: Motor vehicle crashes remain the leading cause of death for children, youth, and young adults. Historically, automotive safety research and advancements have focused on mitigating injuries once the crash has occurred. However, more recent automotive safety research is shifting its focus to studying events prior to the crash. Previous research has shown that more than 60 percent of crashes involve some form of pre-crash maneuver (braking, swerving, skidding) prior to the crash. This number is likely to increase with the advent of early warning systems and autonomous vehicles. Such maneuvers, whether initiated by the driver or by an autonomous vehicle, may change the position of the occupants relative to the seat belt, thus altering their biomechanical response if a crash still occurs.

In addition, an unintentional consequence of autonomous safety features is that drivers may become more inattentive or distracted. Therefore, the reaction time required to take over the control of a vehicle in event of an emergency may be further delayed. This is particularly true for novice teen drivers, who may need time to understand and react to an emergency take-over situation given their inexperience. At the Center for Injury Research and Prevention, we are interested in understanding how pre-crash maneuvers affect child occupant position and motion prior to a crash. In addition, we are interested in developing warning systems that could decrease reaction time and lead to timely corrective driving actions, with a particular emphasis on young teen drivers.

REU Project Description: The REU student will become a member of the Engineering Research Core at the Center for Injury Research and Prevention and will receive mentorship from several of the lead investigators of the Core. The student will be involved in various aspects of the research process, including primary data collection on human volunteers, post-processing, data analysis, and interpretation of the results. The student will develop his/her skills with data analyses of a diverse set of data types including motion capture data of actual children and young adults in a laboratory and naturalistic motor vehicle environments, crash test dummy data, as well as naturalistic data from real world driving. Machine design and electronic circuitry knowledge would be beneficial for this research. Previous experience using MATLAB is critical, and the student will have the opportunity to increase his/her skills in this area. The student will also gain experience in problem-solving, data analyses, interpreting findings, and developing new research ideas. In addition, there will be opportunities to submit and present his/her work at conferences and to participate in the preparation of journal publications.

Project 4: Safe Mobility: A User-Based Approach to Transportation Safety

Mentor: Megan Ryerson, PhD

Research Description: From bike lanes to pedestrian plazas, the urban transportation systems of American cities – and Philadelphia specifically – are becoming more multimodal. Yet, the increasing number of cyclists and pedestrians has led to a rise in

conflicts and crashes. The research project proposed here is a collaboration between 1) The Center for Injury Research and Prevention, a comprehensive pediatric trauma research facility at Children's Hospital of Philadelphia dedicated to addressing injury, the leading cause of death for children and adolescents, and 2) Mobility21, the National University Transportation Research Center on Safety and Mobility housed at the University of Pennsylvania. The centers are seeking highly motivated and innovative undergraduate students majoring in Transportation Engineering/Planning and Public Health to participate in an exciting, innovative new project to measure safe mobility for vulnerable populations.

Understanding the safety and public health impact of infrastructure improvements requires understanding how vulnerable road users -- pedestrians and cyclists -- interact and respond to infrastructure. The REU student will assist with a project that will involve instrumenting pedestrians and cyclists while they are traveling along urban transportation infrastructure in Philadelphia. Eye tracking technology will capture their moment-by-moment glances, and physiology monitors will capture their physical responses. The combined qualitative and quantitative data will be used to develop and estimate metrics of value to road designers. Job responsibilities may include designing and conducting experiments and collecting data out in the field, image and data analysis using specialized software -- MATLAB and/or MS Excel. Previous coursework in Statistics, Engineering/Design, and Mathematics and experience with MATLAB is preferred.

REU Project Description: The REU student will become a member of the Engineering Research Core at the Center for Injury Research and Prevention and will receive mentorship from several of the lead investigators of the Core. The student will develop his/her skills with data analyses of a diverse set of data types. Previous experience using MATLAB is critical, and the student will have the opportunity to increase his/her skills in this area. The student will also gain experience in problem-solving, data analyses, interpreting findings, and developing new research ideas. There will also be

opportunities to submit and present his/her work at conferences and to participate in the preparation of journal publications.

BEHAVIORAL SCIENCE CORE

All Behavioral Science Core REU students will be exposed to core behavioral science research methods – quantitative and qualitative – and will apply them in settings involving human subjects. They may have opportunities to submit and present their work at conferences (e.g., the International Study for Traumatic Stress Society Annual Conference, the CHOP LEND Research Day) with support from their mentors and to participate in the preparation of journal publications. They will be encouraged to work independently with appropriate mentorship and to generate enthusiasm and future career interest in behavioral science research that links behavior to medicine and engineering for injury prevention and prevention of traumatic stress among injured children.

BEHAVIORAL SCIENCE RESEARCH PROJECTS

Project 5: Translational Research to Develop & Evaluate Aggression and Bullying Prevention Programs for Urban Youth

Mentors: Stephen Leff, PhD; Tracy Waasdorp, PhD

Research Description: Peer aggression and bullying occur frequently in schools and have a harmful impact at the student, classroom, and school-wide level. Further, aggression and bullying are associated with poor psychosocial adjustment, feelings of being unsafe at school, lower levels of academic achievement, and school dropout as students reach adolescence. These issues are especially concerning for minority youth living in inner-city, under-resourced communities who are also exposed to stressors, including poverty, single-parent home, drug use, and community violence.

Dr. Leff and colleagues have developed several aggression and bullying prevention programs, many of which were designed in partnership with key stakeholders through a community-based participatory research approach to specifically address the aforementioned concerns for urban minority youth. In addition, the programs are unique

in their focus on multiple forms of bullying/aggression (including relational and cyber-bullying), attention to broader classroom and school climate factors, focus on unstructured school settings, such as the lunchroom and playground, and examination of intervention integrity (i.e., assessment of content & process variables and whether the program was implemented as intended).

Specifically, we have 1) a small-group pull-out program for relationally aggressive third through fifth grade girls, 2) a classroom-based program for third through fifth grade boys and girls, and 3) a 90-minute 3D interventional assembly (and accompanying app) designed to improve knowledge of bullying and to promote positive bystander behaviors among middle school students. Our newest lines of research include transitioning our small-group intervention to a coaching and training model (training the school counselor and classroom teachers to run the program), developing virtual simulations for youth to practice strategies outside of sessions, and the development of a relational aggression prevention program for first and second grade students.

REU Project Description: The REU student will be able to explore our current datasets (topics such as self-report of bullying, aggression, problem-solving skills, victimization, and cyberbullying, as well as teacher report and parent data) to choose his/her own research question to be answered. The student must have basic statistical knowledge and be comfortable using SPSS or STATA. The student will also learn how to formulate a research question using extant literature and secondary data, run basic statistical analyses, utilize literature to support findings, and learn to present the research project.

Project 6: Examining the Neural and Neuropsychological Factors Underlying Risky Driving Behavior and Crashes in Developing Teen Drivers.

Mentor: Elizabeth A. Walshe, PhD

Research Description: Compared to adults, young novice drivers are three times more likely to be involved in a motor vehicle collision, which remains the leading cause of death and injury among adolescents. While inexperience certainly plays a role, the ongoing neurocognitive development of the frontal lobe of the brain during the

adolescent years (and into young adulthood) may also contribute to the disproportionate number of crashes among young drivers. The ability to direct and maintain attention, make decisions and control behavior (related to distractibility, impulsivity, risk-taking) all continue to develop with maturation of the frontal lobe, and each of these cognitive abilities are important for the complex skill of driving. We are currently conducting a number of studies examining the relationship between crashes and the development of the neural and cognitive processes necessary for safe driving in adolescents and young drivers.

REU Project Description: The REU student will join a research team that uses neuroscience, neuropsychology and cognitive science approaches to understand risky driving behavior and the increased crash risk among young novice drivers. As part of this quantitative research team, the student will have the opportunity to gain skills and experience with a wide range of measures and different types of data including: neuroimaging data, neuropsychological tests of brain function, neurophysiological measures (e.g. eye-tracking), simulated/virtual driving assessment and self-report measures of driving behavior and individual characteristics (e.g. personality).

The student will also have an opportunity to develop a number of valuable skills for a career in research by joining research team meetings and scientific discussions and assisting with a number of stages of the scientific research process, such as: participant recruitment, data management and analyses, literature reviews, and manuscript preparation. We are looking for a student interested in quantitative research who wants to expand his/her research experience and who is motivated and excited to work on this team's projects examining the brain and behavior of young drivers

EPIDEMIOLOGY CORE

All Epidemiology Core REU students will be exposed to survey design and administration and data analysis and interpretation. They may have opportunities to submit and present their work at conferences (e.g., the American Public Health Association's annual conference) with support from their mentors and to participate in

the preparation of journal publications. Students will be encouraged to work independently with appropriate mentorship, to generate enthusiasm and future career interest in epidemiology, statistics, demography, and ethnography research that links the fields of medicine and behavior to injury prevention.

EPIDEMIOLOGY RESEARCH PROJECTS

Project 7: Objective Diagnostic Tools for Youth Concussions

Mentors: Catherine McDonald, PhD, RN, FAAN; Ronni Kessler, MS

Research Description: Concussion in youth has received heightened attention owing to emerging evidence that this common injury can affect academics and cause behavioral changes and neurocognitive deficits in working memory, concentration, processing speed, and eye and motor function. As the incidence and awareness of sports-related concussions and multiple sub-concussive loads raises concern about long-term effects of repeated exposures, scientific approaches to injury prevention and treatment are hampered by the subjective, non-specific, symptom-based aspects of concussion diagnosis and a lack of knowledge about the role that age, sex and biomechanics have in exacerbating outcomes. We are addressing this gap by collecting data using an objective suite of diagnostic measurements, both pre- and post-season for high school age athletes, as well as for adolescents with concussion seen at Children's Hospital of Philadelphia Sports Medicine clinics.

REU Project Description: The REU student will become a member of our research team based at the Center for Injury Research and Prevention at Children's Hospital of Philadelphia. The student will help analyze baseline neurofunctional data collected pre- and post-season during the previous school year through a partnership with a local high school. Activities will include data management, query resolution, data cleaning, and data analyses focused on specific research questions. Additionally, they will assist in developing an annual progress report that will be presented to the school administration. The ideal candidate will be interested in learning how to use statistical software and developing the skills need to conduct the various elements of data

analysis. We are looking for a motivated, detail-oriented, confident, and enthusiastic student that is looking to expand his/her research experience.

Project 8: Understanding the Needs of Teen Drivers with Developmental Disabilities

Mentors: Rachel Myers, PhD; Allison Curry, PhD

Research Description: Motor vehicle crashes are the leading cause of death and injury for teens. Investigators at the Center for Injury Research and Prevention (CIRP) are conducting a variety of research studies to examine driving outcomes among teen drivers with developmental disabilities. Presently, these studies include: (1) qualitative research examining healthcare providers' attitudes and behaviors related to safe transportation and driving for youth with developmental disabilities, such as autism spectrum disorder and (2) qualitative research with parent-youth dyads regarding safe transportation and driving among youth with development disabilities.

REU Project Description: This student will participate in many aspects of a scientific research study and will have the opportunity to gain experience in applying various skills valuable to a future career in public health, health sciences, policy, epidemiology, or scientific research. The student may be involved in and responsible for tasks related to: literature reviews; data collection and management; qualitative coding; medical records abstraction, and developing project databases. In addition, the student will be able to participate in team research meetings, scientific discussions, and CIRP-wide research meetings. The student should be motivated, enthusiastic, dependable, and detail-oriented. Prior coursework in public health, psychology, social work, health policy, behavioral health, nursing, or health sciences and experience working with policy, scientific data or in a scientific research setting is preferred, but not required.

Project 9: Motor Function and Behavior in Young Children with Cerebral Palsy

Mentor: Laura Prosser, PT, PhD

Research Description: Brain injury is the leading cause of disability in childhood. Cerebral palsy (CP) is caused by a brain injury that occurs near the time of birth and interferes with motor development. It affects about 3 babies per 1000 and 17 million

people worldwide. There is wide variability in the degree of physical disability caused by CP. While motor impairment during school-age children with CP has been fairly well characterized, the trajectory of motor impairment from infancy to early school-age has not. This makes it difficult to predict the degree of future disability in young children and difficult to identify which treatments are the most effective. However, this is important to understand because treatments delivered in the first few years of life have the most potential to cause neuroplastic changes that will reduce the degree of disability across the lifespan.

We are addressing this knowledge gap by quantifying motor impairment in the early years of life and studying how young children with CP respond to rehabilitation therapy. It is difficult to study young children because behavioral and cognitive limitations make rigorous research challenging. We have years of experience testing various protocols in this population.

REU Project Description: The REU student will become a member of our research team based at the Center for Injury Research and Prevention and in the Division of Rehabilitation Medicine at Children’s Hospital of Philadelphia. The student will contribute to two projects: 1. the design and feasibility testing of a novel, custom-designed, child-friendly device(s) to measure muscle strength in toddlers with and without CP. Strength measures from the new device(s) will be collected with musculoskeletal ultrasound imaging and clinical measures of motor function to determine the best battery of tests for this age group 2. video coding behavior during rehabilitation therapy sessions. Our lab extensively codes video sessions from our intervention research studies to determine the most important “ingredients” that are related to improvements in motor function. The student should have some technical background to contribute to the design and construction of the strength testing device(s). Attention to detail is critical for reliable video coding. Good communication skills are also expected in order to effectively coordinate activities in both labs.

**** ONLY STUDENTS FROM CHEYNEY UNIVERSITY OF PENNSYLVANIA AND LINCOLN UNIVERSITY, PA ARE ELIGIBLE TO APPLY FOR THE FOLLOWING PROJECTS: # 10 AND #11.**

Project 10: Video Analysis of Head Impact Sensor Data

Mentor: Declan Patton, PhD

Research Description: We are aiming to better understand the biomechanics of head impacts as they relate to concussion events. Recent advances in technology have enabled the development of instrumented equipment, which facilitate the study of concussion biomechanics by estimating the head impact kinematics of human subjects, predominantly athletes, in vivo. The current study uses headband-mounted sensors to investigate the biomechanical loading of the head over a season of high school competitive sport.

REU Project Description: The REU student will analyze video and sensor data collected during school sporting matches. Video and sensor data will be time-aligned using visual and coded time-stamping, respectively. Sensor-recorded events will be observed on video, and the details of each event will be coded appropriately. Descriptive statistics will be run to provide a summary of sensor-recorded events and head impact kinematics. This project would ideally suit a student majoring in Engineering who is familiar with Microsoft Excel and interested in sports and injury biomechanics.

Project 11: Urinary Biomarker in Mild Traumatic Brain Injury

Mentors: Akiva Cohen, PhD; Gary Beauchamp, PhD

Research Description: Traumatic brain injury (TBI) is the leading cause of death and disability in children and young adults. A TBI occurs on average every 21 seconds and afflicts approximately two million people annually in the United States. No effective therapy currently exists to treat TBI. A profound obstacle to the diagnosis and treatment

of TBI is the absence of an objective, quantitative test for TBI. The difficulty in diagnosing TBI is due in large part to the overlap in symptoms between TBI and other conditions (e.g., stroke, migraine, post-traumatic stress disorder (PTSD), depression and non-convulsive seizures), as well as variability in the initial injury and clinical presentation. Therefore, we are determining the nature of a biomarker in mice that have received a mild TBI.

REU Project Description: The REU student will become a member of the Cohen lab at the Center for Injury Research and Prevention at Children's Hospital of Philadelphia and the Beauchamp Lab at the Monell Center for Chemical Senses. The student will receive mentorship from the lead investigators, as well as from members of their laboratories. The student will learn how to collect urine from mild brain injured mice and conduct olfactory tests in the Y-maze. The student will also gain experience in problem-solving, data analyses, interpreting findings, and developing new research ideas. In addition, there will be opportunities to submit and present his/her work at conferences and to participate in the preparation of journal publications.