Special thanks and acknowledgement to committee members responsible for planning the 2023 Showcase and GPSA Research Exposition events.

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**Volunteer Abstract Reviewers**

- Ajay Barman
- Samantha Edgerton
- Marwa Aly
- Arpita Sinha
Impacts of The Nitrogen Addition Time for Sequential Inoculation in Wine

**Primary Author:** Ipek Aktuna  
**Co-Author(s):** Jonathan Brumley, Charles Edwards  
**Faculty Sponsor:** Charles Edwards

**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s)** Medical & Life Sciences  
**Campus:** Pullman

**Abstract:**

While Saccharomyces cerevisiae can metabolize sugars of grape musts into ethanol and CO2 wine, other yeasts present (so-called non-Saccharomyces) can also do so but with less ethanol produced. This provides a potential advantage for winemakers who want to produce wines with lower alcohol contents. However, both non-Saccharomyces and S. cerevisiae yeasts require various nutrients such as amino acids and ammonia (collectively known as “yeast assimilable nitrogen”) which can be present in grape musts in limiting concentrations. This study aims to evaluate the impacts of the addition time of nitrogen sources with sequential inoculation of a non-Saccharomyces yeast (M. pulcherrima P01A016) with a commercial strain of S. cerevisiae (LalvinNBCTM). A completely random (nested) experimental design was applied with the different addition times of nitrogen as the variable (days 2, 3, or 5) using a commercially-prepared Chardonnay must. All Chardonnay wines except those without any added nitrogen reached dryness by day 27. The nitrogen addition time increased sugar utilization when it was added. Moreover, M. pulcherrima consumed 95.15 mg N/L or 100.93 mg N/L within 24 hours after YAN addition on day 2 or 3, respectively. In comparison, S. cerevisiae and M. pulcherrima together depleted 94.89 mgN/L in 24 hours when YAN was added on day 5. This result demonstrated that M. pulcherrima has a high demand for nitrogen. Preliminary studies suggest that adding nitrogen before inoculation of S. cerevisiae supported the growth of M. pulcherrima, thereby consuming sugar to by-products other than ethanol. Chemical composition of these wines will be determined.
The Impact of the COVID-19 Pandemic Lockdown on the Delayed Presentation of Patients with Musculoskeletal Trauma Injuries in Ethiopia: A Retrospective Analysis

Primary Author: Gabriel Alemayehu
Co-Author(s): Samuel Hailu, Naomi Chaytor
Faculty Sponsor: Naomi Chaytor
Primary College/Unit: Spokane
Associated College(s)/Unit(s): Medical & Life Sciences
Campus: Spokane

Abstract:

Introduction: Many countries enacted lockdown measures during the COVID-19 pandemic, delaying the presentation of patients with musculoskeletal injuries to hospitals. This study examined the impact of this period in Ethiopia, where preexisting determinants of inaccessible healthcare for patients with trauma injuries exist.

Methods: Using the trauma registry at Tikur Anbessa Specialized Hospital in Addis Ababa, Ethiopia, we identified patients with musculoskeletal trauma injuries. Patients were stratified into those who presented with injuries during the 365 days before and after April 8th, 2020, when a state of emergency was declared. Our retrospective analysis evaluated for differences in time to presentation after injury, delayed presentation frequencies as established by the current literature, and possible risk factors.

Results: 2,069 patients were included in our study, of whom 955 (46.2%) presented during the COVID-19 period. There were no significant differences in the number of presentations defined as delayed (p=0.175). However, the mean time to presentation during the COVID-19 period increased from 102.4 to 155.2 hours (p=0.041). This difference was greater for those residing outside of the capital city (p=0.025).

Conclusion: The COVID-19 lockdown period exacerbated preexisting determinants of inaccessible healthcare for patients with musculoskeletal trauma injuries in Ethiopia. While the high rates of delayed presentations persisted during this period, the actual time it took for patients to present to the hospital significantly increased. Policy implementation for future initiatives should take certain populations, such as those who live outside of the capital city, into account.
PRESPECTIVES OF INSTRUCTIONAL COACHES IN SAUDI ARABIA ABOUT THE CURRENT MODEL TO IDENTIFY STUDENTS WITH LEARNING DISABILITIES

Primary Author: Hassan Alwadei
Co-Author(s):

Faculty Sponsor: Michael Dunn

Primary College/Unit: Education
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

Topic:
Multi-Tiered Systems of Support (MTSS) is a framework to provide early intervention for students who are at risk for LD. Students with LD pose a number of challenges for many educational systems. This study is significant as it focuses on finding more efficient methods for identifying students with LD. There is a paucity of research about the experiences of instructional coaches about alternative methods for identifying learners with an LD in Saudi Arabia. This study helps to bridge that research gap by exploring the applicability of MTSS within the Saudi context. The instructional coaches' perspectives regarding the MTSS model will also facilitate decision-making about whether the new method of identifying students with LD is the most effective alternative to the IQ/Discrepancy model.

Method:
This study will use semi-structured interviews to investigate how current LD instructional coaches mentor LD teachers to identify students with disabilities. My study will also investigate instructional coaches’ understanding of and perspectives about MTSS as an alternative method. I chose the semi-structured interview method because I want to prepare questions for the interviewee to start with and ask follow-up questions during the interview if needed.

Results:
The study will show the extent of instructional coaches' satisfaction with the current model to identify students with LD in Saudi Arabia. The results may indicate that the current model is unsuitable and needs to be changed. The results may support the transition to using the MTSS for students with LD.
Edge-intelligence enabled crop physiology sensing system for automated heat stress mitigation in apple orchards

**Primary Author:** Basavaraj Amogi  
**Co-Author(s):** Nisit Pukrongta, Srikanth Gorthi, Lav Khot, Bernardita Sallato, Carolina Torres, Troy Peters  
**Faculty Sponsor:** Lav Khot  
**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s):** Agricultural & Natural Sciences  
**Campus:** Other

**Abstract:**

Frequent heat waves in the pacific northwest (PNW) have increased the risk of apple fruit sunburn, which causes up to 40% yield losses. Such weather uncertainties and heat stress events can further propagate issues related to irrigation management as growers try to balance optimal crop load for superior fruit quality. Therefore, this study aimed to realize an automated in-field sensing technology for season lon heat stress management. Pertinent to this, an IoT (Internet of Things) based crop physiology sensing system (CPSS) was developed and field tested. CPSS is capable of real-time computations using deep learning algorithms on edge. Eight such CPSS nodes were deployed in two apple cultivars (three in cv. WA38 and five in cv. Honeycrisp) from July to September of 2021 and 2022 seasons to evaluate the effectiveness of conventional evaporative cooling (EC), fogging, protective netting, and a combination of fogging and netting (fognet) treatments. CPSS monitored the orchard microclimate every minute and fruit surface temperature (FST) every five minutes. The control and netting treatments have shown higher FST and air temperature for both cultivars, leading to delayed fruit maturity and smaller fruit size. Per fruit weight in fognet was higher compared to other treatments. Although, with the lowest percent of sunburns, conventional treatment had higher soft scald incidence at storage compared to fogging, which had comparatively more sunburn damage. Additional data analysis and use cases of this technology are being explored for heat stress mitigation in grapevines and crop water stress monitoring in fruit crops.
Universal Cash-Transfers and Socioeconomic Disparities in Child Investments: A Qualitative Account

Primary Author: Mariana Amorim
Co-Author(s): 

Faculty Sponsor: 

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

 Whereas various Universal Basic Income plans have been promoted since the Great Depression, there has been renewed interest in this policy. The concept implies trust in the ability of parents to make the best decisions about how to use unconditional cash-transfers to promote well-being, health, and social mobility of their children. We know, however, little about the impacts of unconditional cash-transfers on parents’ financial decision-making. We study the Alaska Permanent Fund Dividend, the only long-standing universal and unconditional cash-transfer program in the western world, to investigate the social meaning, uses, and consequences of universal cash transfers across the socioeconomic spectrum. Through interviews with Alaskan parents, we identify how parents across the socioeconomic spectrum make decisions regarding the allocation of universal payouts. Overall, parents across the SES spectrum think the PFD has a positive impact on their children’s wellbeing, but for different reasons and in reference to distinct timeframes. High-SES families are the most likely to fully invest and save the payouts in ways that promote socioeconomic attainment (e.g., mortgages, college accounts) that will benefit children in the future. Through being invested in savings accounts for their children's future use, PFD payouts further bolster mobility for children in high-SES families. Low- and middle-SES families reported primarily using PFD payouts to keep up with bills and finance the present-day needs of their children. Findings suggest that the PFD’s social meanings and uses differ by socioeconomic status, but this primarily reflects structural constraints rather than differences in values or goals.
Exercise reverses high fat food induced changes in perineuronal nets

Primary Author: Lydia Bailey
Co-Authors: Georgia Kirkpatrick, Travis Brown

Faculty Sponsor: Travis Brown

Primary College/Unit: Veterinary Medicine
Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Pullman

Abstract:

Principal topic
Perineuronal nets (PNNs) are lattice-like structures that ensheathe subsets of neurons, mainly parvalbumin (PV) expressing inhibitory interneurons located in the cortices. PNNs influence cell properties by reducing plasticity and increasing excitability, making them important modulators of neuronal firing. Thus far, PNNs have been understudied for various reasons despite their important role in neuronal activity. This study aims to elucidate some of the functions of PNNs on neuronal activity, determine their involvement in diseases such as addiction and obesity, and identify manipulations that may reverse the effects induced by a high-fat diet.

Methods
This study uses various staining and electrophysiological methods to quantify the intensity of PNNs as well as the influence of PNNs on neuronal activity. Wisteria floribunda agglutinin staining and fluorescence microscopy are used to assess the number and intensity of PNNs in various brain regions. This study aims to be one of the first to utilize a novel adeno-associated virus, PHP.eB, in rats, which allows whole-brain labeling of PV-expressing interneurons. Electrophysiology coupled with this viral labeling method allows accurate assessment of the activity of PNN ensheathed cells. In the future, we aim to specify accurate labeling techniques to identify which components of PNNs are altered by exposure to a high-fat diet and/or exercise.

Results
Via Wisteria floribunda agglutinin staining, we have found that PNN intensity, but not number, is reduced by high-fat diet in the prelimbic (PL) and orbital frontal (OFC), but not the infralimbic (IL) cortices. Further, high-intensity exercise following exposure to a high-fat diet recovers this effect in the PL, but not the OFC. We have begun to assess the functional influence of PNNs on neuronal firing via the degradation of PNNs with chondroitinase ABC. Next, we plan to investigate the influence of a high-fat diet-induced reduction in PNN intensity on neuronal activity. Overall, this study will allow for a better understanding of PNNs with regard to high-fat diets and will shed light on how lifestyle changes, such as exercise, may act as a neurologically based therapeutic option.
Distribution System Situational Awareness

Primary Author: Surendra Bajagain  
Co-Authors: Anamika Dubey

Faculty Sponsor: Anamika Dubey

Primary College/Unit: Engineering and Architecture  
Associated College(s)/Unit(s): Engineering & Physical Sciences  
Campus: Pullman

Abstract:

Enhanced distribution system level situational awareness helps distribution system operators make the best operational decisions under disturbances. In this work, situational awareness means extending the distribution system’s visibility beyond the substation. The extensive rollout of advanced metering infrastructure (AMI: a combination of smart meters and communication networks) in the utilities allows utilities to collect unprecedented data and utilities can leverage the data to build new monitoring tools. This proposal uses AMI data to develop a distribution system monitoring tool.

State estimation is the monitoring tool used in the distribution system. Usually, the distribution network models do not include the LV side of the network. An incorrect secondary network or aggregated load model results in different voltages across the secondary network and incorrect power measurements. North American residential distribution system has a split-phase configuration which is not observable despite having the data from the customers’ smart meters. Generally, a single-phase circuit representation for the split-phase residential distribution system is used. However, the single-phase equivalent model could accurately reflect the split-phase model only under perfectly balanced conditions. The developed approach facilitates the integrated monitoring of primary and secondary networks that extend the visibility of the network to the customers’ house level in North American residential distribution systems. The unbalanced split-phase model of the secondary network is considered in the developed method.
COVID impact on the U.S. Poultry Trade

**Primary Author:** Dipanwita Barai  
**Co-Author(s):**

**Faculty Sponsor:** Thomas L. Marsh  
**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s)** Administrative & Information Systems  
**Campus:** Pullman

**Abstract:**

Principal topic

COVID-19 impacted the global food security by shocking demand, supply, and, consequently, international trade in the poultry industry. The United States is one of the largest poultry-producing and exporting countries in the world. Most of the developing countries’ primary source of protein is poultry, and they import poultry products from the United States. Lockdown of businesses and social distancing during COVID-19 impacted global poultry industry for its labor-intensive nature and highly inter-dependent distributional network requirements.

**Method**

We develop and econometrically estimate a structural gravity model to quantify the impact of the COVID-19 on the U.S. poultry trade precisely using detailed monthly data from 2015 to 2022 for each poultry products. We captured the multilateral resistance term by controlling for the remoteness indexes. We also account for the trade agreements and previous periods' impact on the U.S. poultry because economic variables take time to impact.

**Results/implications**

The results indicate that the increment of the COVID-19 death cases in partner countries increase exports and imports where the increment of the COVID-19 death cases in the United States decrease exports and imports of U.S. poultry items significantly, ceteris paribus. Hence, the United States poultry industry becomes relatively closed as the COVID-19 death cases increases in the United States than the partner countries.

This cutting-edge research provides unique insights into how the timing of pandemic restrictions impacts the U.S. poultry industry and aids policymakers in determining ways to minimize economic loss due to COVID-19 and secure global food security.
Chromium in gallium oxide under pressure

**Primary Author:** Lauren Barmore  
**Co-Author(s):**  
**Faculty Sponsor:** Matthew McCluskey  
**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s)** Engineering & Physical Sciences  
**Campus:** Pullman

**Abstract:**
Principal topic:
Gallium oxide is a semiconductor that has been a recent focus of research due to its material properties that are useful for high-power electronics. Crystals of gallium oxide are grown at WSU and can be modified or doped to intentionally include impurities to change the properties of the crystal. This work investigates the effects of high pressure on the optical properties of gallium oxide doped with chromium as well as aluminum-gallium oxide alloy (AGO). Understanding the role of stress and impurities in semiconductors is important to optimizing electronic device performance.

**Method:**
A diamond anvil cell (DAC) is a handheld high-pressure device that compresses a sample between two diamonds. In this work, a DAC was used to apply static pressure to gallium oxide or AGO crystals up to a maximum of 10 gigapascals. The photoluminescence spectrum of gallium oxide under pressure inside the cell was measured. Additionally, X-ray diffraction was used to study how the structure of the crystal changes as pressure is increased.

**Results:**
Under pressure, the red chromium emission peaks in gallium oxide shift linearly with increasing pressure. In contrast, in AGO, the chromium emission peaks shift nonlinearly with increasing pressure. This variation may be due to the different pressure responses of the two materials. X-ray diffraction reveals how the crystal lattice for gallium oxide and AGO compress as pressure is applied to the sample. This work allows a better understanding of the effects of stress and impurities in semiconductor crystals.
A Quality Improvement Project: Creating and Providing Web-Based Resources to Improve Confidence in Staff and Parents Interacting with Adolescents Experiencing Suicidal Ideation Utilizing Tools for Advancing Mental Health Awareness of Rural Adolescents and Children (Project TAMARACK)

Primary Author: Josilyn Baugher  
Co-Author(s): Barbara Bennett-Wolcott, Bevan Briggs

Faculty Sponsor: Bevan Briggs

Primary College/Unit: Nursing  
Associated College(s)/Unit(s): Medical & Life Sciences

Campus: Spokane

Abstract:

Background: Rural adolescents have an increased risk of suicide attempts and death. Rural Alliance (RA) parents and school staff need accurate education to gain confidence in discussing suicidal ideation with adolescents. Directly discussing suicide can save lives by decreasing suicide risk. This quality improvement (QI) project focused on developing and delivering accurate psychoeducational resources to meet this need.

Methods: The psychoeducational videos and resources created with evidence-based information are provided for parents and staff of RA middle and high school students via the Washington State University College of Nursing website. Before making the videos available to the target population, a convenience sample evaluated the videos through pre- and post-viewing questionnaires modified from the Literacy of Suicide Scale (LOSS) with permission. The questionnaire evaluates knowledge, the effectiveness of the educational intervention, the level of confidence in interacting with students experiencing suicidal ideation, and potential resource improvements.

Results: Parents and guardians within the convenience sample reported a higher confidence level than school staff in interacting with a teenager experiencing suicidal ideation before and after the intervention. School staff demonstrated greater improvement than parents and guardians in confidence and knowledge following the educational intervention.

Conclusions: Based on open-ended feedback, parents and staff believe suicide should be discussed more frequently, and education about available resources needs to increase. Both convenience sample groups of school staff and parents demonstrated improved confidence and knowledge after viewing the associated psychoeducational video. This indicates the educational intervention was effective.

Keywords: adolescent suicide, rural, psychoeducation
Northwest Public Broadcasting: 100 Years, 100 Stories

Primary Author: Ashley (Ash) Beard
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Faculty Sponsor:

Primary College/Unit: Communication
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

On December 10, 1922, Northwest Public Broadcasting, then KFAE, hit the airwaves for the first time on the campus of Washington State College (now WSU). To understand how this station has since informed the Northwest – shaping the lives of countless community members – Producer Ash Beard examined archives, dug through storage closets and interviewed past and present staff members. Ash traveled across the region asking supporters why they tune in. Unpacking this legacy became an important reminder to stay diligent, honest and dedicated to acknowledging our biases. Public media will always be subject to the politics of its time and the audience it serves: NWPB is not the exception. After months of in-depth discussions about how to celebrate 100 years of broadcasting with integrity and transparency, the staff drafted a live radio program that celebrated accomplishments, reminisced about changes that shaped the station and raised awareness about the past with tangible goals to improve. Staff and students, past and present, created a two-hour radio program that aired live on December 9th. The show consisted of seven investigative features, five live interviews, five pre-recorded interview segments, a game show with three listener contestants, and original compositions by Composer Greg Yasinitsky. A montage of listener testimonials wrapped up the program. According to hundreds of voices from communities across the Northwest: people support NWPB because it is a reliable source of information that educates, enlightens and informs.
Impact of improving the heat detection method on farm dietary costs, production, and profitability in Washington and Florida dairy operations

Primary Author: Giulia Berzoini Costa Leite
Co-Author(s):

Faculty Sponsor: Marcos Marcondes

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s): Agricultural & Natural Sciences
Campus: Pullman

Abstract:

The herd’s reproductive performance vastly impacts the dairy’s efficiency. Throughout the years, authors gathered data about the chosen heat detection method and economic/productive indexes of dairy farms, but they never linked those results with their consequences on diet costs. We aimed to evaluate the effects of the heat detection method on the productivity and feed expenses of Florida (FL) and Washington (WA) dairy operations. A discrete Markov Chain model was used, assessing the probabilistic performance of dairy cows and heifers over 10 years, aiming to reach a steady-state herd. We used the non-linear solver tool of Excel subjected to constraints of a minimum of 900 and a maximum of 1000 cows, and a voluntary culling rate from 0 to 40% of 3 or more lactation cows. The computed data of the last year was used to compare WA and FL scenarios, highlighting the breeding detection used by the farm: visual observation (VO), rump/tail markers (RM), or electronic detectors (ED, collars, or pedometers). Prices were obtained from the USDA website (12/2022). The milk yield/cow increased by 0.8% and 2.3% (RM or ED, respectively) compared to VO in FL. In WA, this increase was 1.6 and 4.7%, respectively. The calving interval decreased from 13.1 mo using VO to 12.8 and 12.5 using RM and ED in FL. The same trend is observed for WA, decreasing from 12.7 to 12.4 (VO vs. RM) and down to 12.4 with ED. When analyzing feeding expenses with forage, we observed that the more modern the heat identification method, the fewer expenses with forages, regardless of the region. However, this relationship is inverse when we analyze expenses with concentrates. Overall, farms increased feeding costs by 2.4% when changing from VO to RM; however, profit increased by 1.2%. When switching from VO to ED, feeding costs increased by 5.8 and 22% for WA and FL, respectively, but profit improved by 8 and 38.7%, respectively. We concluded that the more specialized the heat detection system, the higher the dietary costs. Still, these costs are followed by increased milk production, improved reproduction, and higher profit.
Transforming Digital Healthcare with Self-Powered Wearable Devices

Primary Author: Ganapati Bhat
Co-Author(s):

Faculty Sponsor:

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

Wearable sensors, along with smart home technologies, have the potential to transform healthcare by enabling cost-effective, reliable, continuous, and data-driven monitoring of users in a free-living environment. Despite the impressive potential of wearable technology, widespread adoption of wearable devices has been limited due to several technology and adaptation challenges, including form factor, incompatibility, and energy constraints. This has led to multiple health societies, including the Movement Disorders Society Task Force on Technology, stating that solving these challenges is crucial to improve the adoption of wearable devices. This proposal addresses the challenges by building a holistic hardware-software design flow for multi-modal wearable device design. The design flow uses a ground-up methodology that integrates user and doctor inputs, application specifications, energy harvesting, and thermal management to enable robust multi-modal wearable devices. A successful outcome in the project will lead to the widespread adoption of self-sustainable wearable devices that provide accurate early diagnosis and health monitoring.
Detection of Chinook Salmon Environmental DNA with CRISPR Technology

**Primary Author:** Tholen Blasko  
**Co-Author(s):**  
**Faculty Sponsor:** Michael Phelps  
**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s)** Agricultural & Natural Sciences  
**Campus:** Pullman

**Abstract:**

**Principal Topic**  
Detecting the presence of Pacific salmon in waterbodies using environmental DNA (eDNA) has emerged as a preferred monitoring method. Environmental DNA analysis is non-intrusive at the individual and ecosystem level, which is important for critical species such as Chinook salmon (Oncorhynchus tshawytscha). Currently, 10 distinct subpopulations of Chinook salmon are endangered, threatened, or candidates for listing under the United States Endangered Species Act (ESA). Restoration projects aiming to restore Chinook salmon populations to previously degraded habitat areas have been prioritized in recent years, requiring an accurate assessment of recolonization. Environmental DNA has great potential for monitoring Chinook recolonization or migration, but current methods require a quantitative polymerase chain reaction (qPCR) in a lab setting to identify the presence or absence of a target species. While streamside eDNA collection takes only minutes, sample processing time may take weeks to months. A rapid and field-deployable eDNA processing system would save researchers resources and time, increasing eDNA’s efficacy as a monitoring tool.

**Method**  
We developed a CRISPR Cas12a-based nucleic acid detection technology to detect the presence or absence of Chinook salmon mitochondrial DNA using the unique sequence of that species. An initial loop-mediated isothermal amplification method (LAMP) was developed to amplify a selective region of all salmon and trout mitochondrial DNA. Chinook salmon samples are then confirmed by using specific CRISPR “guide” RNA sequences engineered to only identify the target species. Field assays utilize a portable incubator to perform a one-tube LAMP amplification, followed by a CRISPR digest, with results analyzed on a lateral flow strip. The assay was piloted on eDNA samples collected from the Snake River and the South Fork Palouse River which have or do not have migratory Chinook salmon populations, respectively.

**Results & Implications**  
Our technology provides researchers with a rapid eDNA detection method that can be used by biologists in the field. Streamside results give researchers real-time data, increasing the range of insights into Chinook salmon population dynamics and movements. Further work on this project will include optimization of specific assays for the salmon, trout, and char species found in Washington State.
Survival of agricultural enterprises in Ecuador after COVID 19 pandemic

Primary Author: Hector Botello
Co-Author(s):

Faculty Sponsor: Michael Brady

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s) Agricultural & Natural Sciences
Campus: Pullman

Abstract:

Companies use resources to channel them into production chains that generate goods and services. However, some of these plans are not profitable in certain economic scenarios; therefore, economic units must reorganize, either by closing production chains or changing their organization. Consequently, the levels of mortality and survival of firms are related to the expectations of future profits, barriers to entry and territorial factors that shape the environment where a new firm is born. The relevance of this phenomenon lies in the fact that older firms can develop better technological capabilities, contributing to increase the competitiveness of firms in foreign markets (Chetty and Hamilton 1993).

In Latin America, the survival of firms is low. In Mexico, 75% of new companies last up to a maximum of 2 years; in Argentina, 93% do not reach the second year of life. Comparatively, in the United States the average life span is 6 years and almost 40% reach the third year. In this sense, there is no literature that explains this phenomenon in Ecuador. Therefore, this paper wishes to contribute to the existing literature by studying the survival of agricultural enterprises in Ecuador through survival models between 2012 and 2021. Among the preliminary results is that the average survival time of agricultural SMEs (less than 9 employees) is only 3 years while the rest are 13 years. Aspects such as exporting Agricultural exporting companies have an average age of about 9 years compared to 4 years for the rest of the companies.
Archean to Paleoproterozoic Magmatic and Metamorphic Evolution of Lofoten – Vesterålen area in northern Norway through zircon U-Pb and Hf isotopic analysis

**Primary Author:** Manuela Botero  
**Co-Author(s):** Jeffrey Vervoort, Fernando Corfu  
**Faculty Sponsor:** Jeffrey Vervoort  
**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s)** Agricultural & Natural Sciences  
**Campus:** Pullman

**Abstract:**

The Lofoten–Vesterålen area in Norway records a tectono-magmatic history that span from the Neoarchean to the Paleoproterozoic. This study focuses on the 2.7-2.6 Ga and 1.9-1.8 Ga crust preserved in the region and, how this fits in with Earth’s crustal evolution more broadly. We present new U-Pb and Lu-Hf data from three sample groups: 1) The granulite facies zone (GFZ); 2) the amphibolite facies zone (AFZ) and; 3) the anorthosite-mangerite-charnockite-granite (AMCG) suite. Solution Hf isotope compositions were obtained for zircons previously dated by ID-TIMS [1,2]. In-situ LASS–MS-ICPMS analyses were conducted to simultaneously determine U-Pb ages and Hf isotope compositions. Neoarchean populations in the GFZ and AFZ yield $\varepsilon$ Hf(i) from +0.9 to -0.3 at ~2.7 Ga. Paleoproterozoic population (~1.8 Ga) yield $\varepsilon$ Hf(i) around -16 and -7 for the GFZ and AFZ, respectively. All AMCG samples yield in-situ U-Pb ages between 1.87 and 1.79 Ga and Hf isotope compositions varying from -4.0 and -15.0 $\varepsilon$ Hf(i). In general, there is a good agreement between solution and in-situ data. Metamorphic overprinting is recorded within the GFZ and the AMCG at ca. 108 Ga. The absent of metamorphic overprint in the AFZ supports the hypothesis of a tectonic boundary between the GFZ and AFZ. Paleoproterozoic magmatism has Hf isotope composition that suggest incorporation of both, recycled ancient crust, and juvenile material. Sub-chondritic Hf isotope compositions from Neoarchean rocks suggest no significant presence of older crust within the source regions of these rocks. The AMCG suite was likely emplaced during the Columbia supercontinent assembly.
Maternal and Neonatal Morbidity Across Race, Ethnicity and Birth Location in Washington State, 2010-2016

Primary Author: Christina Brumley
Co-Authors: Haley McRae, Olandunni Oluwaye, Janessa Graves, Sterling McPherson, Celestina Barbosa-Leiker, Ekaterina Burduli

Faculty Sponsor: Ekaterina Bruduli

Primary College/Unit: Nursing
Associated College(s)/Unit(s): Medical & Life Sciences
Campus: Spokane

Abstract:

Background: The United States continues to experience increases in maternal-neonatal mortality and morbidity, particularly among minoritized racial and ethnic groups. Community (e.g., home or birth center) births have become more prevalent, with some studies showing that planned community births may be a safe option for low-risk pregnancies.

Objective: To examine differences in maternal-neonatal morbidity across race, ethnicity, and birth location in Washington State.

Methods: We analyzed n=360,086 Washington State birth records between 2010-2016. We examined maternal and neonatal morbidity within and across birth location, and by race and ethnicity in healthy, term, singleton pregnancies.

Results: Compared to hospital births, home births had lower odds of adverse maternal outcomes (OR: 0.52; 95% CI: 0.41, 0.66; p=0.000) and adverse infant outcomes (OR: 0.66; 95% CI: 0.58, 0.77; p=0.000), birth center births had lower odds of adverse maternal outcomes (OR: 0.61; 95% CI: 0.48, 0.78; p=0.000) and adverse infant outcomes (OR: 0.62; 95% CI: 0.53, 0.73; p=0.000). When examining hospital births alone, neonates of non-Hispanic Black women had 30% higher odds of adverse outcomes compared to neonates of non-Hispanic White women (OR: 1.30; 95% CI: 1.22, 1.39; p=0.000), neonates of non-Hispanic American Indian/Alaska Native women had lower odds of adverse outcomes compared to neonates of non-Hispanic Black women (OR: 0.74; 95% CI: 0.64, 0.86; p=0.000), and neonates of Hispanic women had lower odds of adverse outcomes when compared to neonates of all other racial/ethnic groups.

Conclusion: While acknowledging limitations of vital records data, these results highlight racial and ethnic disparities in hospital births.
Validating the TASTT to Enhance Teachers’ Use of Transition Practices

**Primary Author:** Lauren Bruno
**Co-Author(s):**

**Faculty Sponsor:**

**Primary College/Unit:** Education  
**Associated College(s)/Unit(s):** Social Sciences  
**Campus:** Pullman

**Abstract:**

The Teacher Activity Survey – Transition and Technology (TASTT) is a survey developed to identify secondary special educators’ knowledge and self-efficacy surrounding the use of transition evidence-based practices in their classrooms. The TASTT also evaluates the types of professional development (PD) received in these areas by practitioners. The use of transition evidence-based practices are imperative to preparing students with disabilities for successful outcomes in postsecondary education, employment, and/or independent living. The validation of the new measure, TASTT, is critical as questions were modified or added to include language designed to measure teacher self-efficacy within transition, as identified by Rowe and colleagues (2021). The TASTT identifies how PD impacts teachers perceived self-efficacy in implementing evidence-based practices to enhance student outcomes. The final version of the TASTT has then be distributed to a national population to further identify needs of secondary-special educators and inform professional development and teacher-preparation programming. This study supports continued research focused on teachers’ use of evidence-based transition practices to enhance student transition outcomes.
Characterizing the social and caregiving environments of infants: the MIMBES Study

Primary Author: Beatrice Caffe
Co-Author(s): Janet Williams, Michelle McGuire, Courtney Meehan

Faculty Sponsor: Courtney Meehan

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s): Social Sciences
Campus: Pullman

Abstract:

Throughout our history and in most of the world today, mothers relied on allomaternal (non-maternal) caregivers to successfully rear children. However, studies documenting childcare in natural settings in Western industrialized societies, where mother-infant dyads are more isolated from allomothers than in other parts of the world, are limited. Utilizing infant focal observations, we characterized the social and caregiving experiences of infants (N=51) from a NW region in the United States and investigated the relationship between nonmaternal caregiver support and maternal investment. We hypothesized that allomaternal investment would result in a reduction of maternal investment in infant care. We fit linear models, including maternal investment and nonmaternal care, and included infant age, maternal age, and infant sex and maternal work status as fixed effects. Results indicated that mothers provided over 89% of all infant care, and allomaternal physical contact with infants (11%) was not associated with the amount of time mothers were in contact with their infants across the day. We also found that non-household allomaternal investment was not associated with changes in maternal, paternal, or sibling investment. Our findings are in contrast to numerous studies conducted in non-Western settings and suggest the WEIRD (Western, Educated, Industrial, Rich, and Developed) household structure and ecology may dampen the role and impact of allomothers on maternal behavior. Our study provides a unique look into early infant care in naturalistic settings in a Western sample and contributes to our understanding of ecology, social structure, culture, and behavior on childcare and maternal and allomaternal investment.
Improving student success and equity with growth mindset interventions

Primary Author: Elizabeth Canning
Co-Author(s):

Faculty Sponsor:

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

Despite efforts to diversify science, students who are the first in their family to attend college and Persons Excluded due to Ethnicity or Race (PEERs) continue to experience worse academic outcomes and leave science at higher rates than their classmates. One promising solution is growth mindset interventions, which teach students that ability is malleable, rather than fixed. Although successful growth mindset interventions have yielded impressive outcomes (e.g., increasing persistence and closing achievement gaps), there has been considerable variability in their success. This indicates that encouraging students to adopt a growth mindset might not be enough on its own if the environment does not support or reinforce this mindset. In an experiment with Introductory Biology students enrolled at a large Historically Black University, we tested how mindset messages from instructors enhance the effectiveness of interventions directed at students. Mindset interventions have shown great potential to address large-scale educational inequities in logistically simple, cost-effective ways. This project capitalized on this potential by investigating an important moderator of their success for stigmatized groups: instructors’ growth mindset messages.
On-farm identification of subclinical mastitis in dairy herds using the California Mastitis Test (CMT)

Primary Author: Icaro Castro
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Faculty Sponsor:

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s) Agricultural & Natural Sciences
Campus: Pullman

Abstract:

Mastitis is the most common endemic disease affecting dairy cattle worldwide, with a ~15% of prevalence of both forms. Subclinical mastitis is characterized by physical, chemical, and bacteriological changes in milk and pathological changes in the mammary gland. It has multiple causes, such as virus, fungi, and algae infections, but is most frequently caused by bacteria. This disease affects milk production and quality and depresses dairy cows’ fertility, causing significant economic losses to the dairy industry because of costs associated with discarded milk, treatments, long-term damage to the udder, and culling and replacement costs. Further, mastitis can be challenging to prevent and control in dairy herds, resulting in adverse effects on animal welfare, health, and productivity. In the United States, the annual economic loss from mastitis was estimated at between $1.7 and $2.0 billion. The best way to diminish the incidence of cases is to work on better management practices and animal-level factors such as breed, post-milking teat disinfection, free-stall bedding material and quality, antimicrobial treatments, and fast diagnostics. The California Mastitis Test (CMT) has been used for many years as a practical and economic on-farm screening test for mastitis detection. A four-compartment paddle and the CMT reagent are the only necessary supplies to conduct the test. It measures the inflammation within a quarter and can be scored based on the degree of gel formation (Negative, T, 1, 2, or 3), along with a purple color that is generally more intense in samples from infected quarters.
Constructing Journalism in the Digital Age: A Case Study of Metajournalistic Discourse at a Local Wyoming Newspaper

Primary Author: Elizabeth Chambers
Co-Author(s):

Faculty Sponsor: Jennifer Henrichsen

Primary College/Unit: Communication
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

PRINCIPAL TOPIC
Rhetoric about journalism is increasingly antagonistic and politicized, especially on social media platforms that offer a more direct and public avenue for criticizing the press. This rhetoric is part of metajournalistic discourse, or public expressions that evaluate news and the newsmaking process. Metajournalistic discourse not only reflects shared understandings about journalism, but also shapes it, which makes this discourse key to understanding the public’s relationship with and trust in journalism.

METHOD
Past research has mainly focused on metajournalistic discourse from public figures and national news outlets, with few studies considering local journalism or audience-generated discourse. This study in progress aims to fill this gap in the literature by conducting a qualitative analysis of metajournalistic discourse from journalists and their audiences at a local Wyoming newspaper, the Jackson Hole News&Guide. Using 10 semi-structured interviews with newsroom staff and a textual analysis of online material, including approximately 50 articles, 80 Facebook posts, and 300 comments, this paper will reveal how the newspaper’s journalists and their audiences construct meaning around journalism.

RESULTS/IMPLICATIONS
Preliminary findings show journalists tend to reference traditional journalistic ideals including truth, objectivity, fairness, and balance. While most journalists cited traditional roles of journalism in society, such as disseminating information, serving as a government watchdog, and fostering a sense of local identity and community, many also advanced a more activist role for themselves in uplifting underrepresented voices and advocating for social change. In contrast to this mission-mindedness, the newspaper’s online readers often repeated national anti-press rhetoric, accusing the newspaper of being “fake news,” having a political bias, and censoring alternative viewpoints. Notably, however, both journalists and many online commenters expressed a desire for civil, constructive discussions about the news, discussions which changing media structures, such as the immediate and often argumentative forum of Facebook comments, make more challenging. Final results will likely reveal further complexities in the metajournalistic discourse of local journalists and their audiences. These findings have practical implications for improving the relationship between journalists and their local communities and, by extension, repairing public trust in journalism as an institution central to a functioning democracy.
The Santiago Metro since 1990: State-Building, Social Conflict, and the Search for Profit

Primary Author: Andra Chastain
Co-Author(s):

Faculty Sponsor:

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Liberal Arts & Humanities
Campus: Vancouver

Abstract:

This project examines the recent history of the Santiago metro system, which is the largest in South America and serves a metropolis of six million people. It is part of a monograph, under contract with Yale University Press, about the political, social, and cultural history of the Santiago metro system in the twentieth century. This chapter investigates a puzzle: since Chile’s return to democracy in 1990, experts have lauded the Santiago metro as a success, yet a fare hike in 2019 sparked popular protests, $350 million in damage to the metro system, and a plebiscite to rewrite Chile’s constitution. What explains the contradiction between the metro’s positive public image and the social upheaval that followed the fare hike? I argue that the metro’s expansion and fiscal efficiency relied on policies that disproportionately burdened low-wage workers, passengers, and low-income residents. I use qualitative methods, reading the company’s annual reports, the local press, and government archives, and drawing on oral histories that I conducted with metro workers. This project is significant because it shows the difficult trade-offs behind the construction of a modern infrastructure system. Chile is often heralded as a neoliberal success story due to its rapid economic growth, reductions in poverty, and stability for foreign investors. Yet the recent protests have shown that this is not the whole story. The metro is a case study of broader patterns in Chile and elsewhere in the Americas where efficiency is achieved through often-unseen human costs.
Gender Mainstreaming in Taiwan: A case study

Primary Author: Yin-Ru Chen
Co-Author(s):

Faculty Sponsor: Tricia Glazebrook

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Public Policy and Gender Studies
Campus: Pullman

Abstract:

Gender mainstreaming (GM) is an international initiative that aims to install gender perspectives into all levels of organizations with sets of strategies. Gender studies consider that organizations and institutions are gendered for being long infused with male domination. Therefore, GM has been developed to build a gender-sensitive government for providing better services and public policies.

Taiwan declared to include the idea of GM as a part of the government's re-innovation program in 2003 and put the GM program into implementation in 2005. Until 2023, the GM program has been implemented in Taiwan for more than 15 years. However, the GM program was only evaluated once in 2015 with funding from the Taiwan government. This research aims to examine the program design and the implementation outcomes of the GM program in Taiwan for providing substantive policy direction to the Taiwan government. In addition, this research also provides a meaningful case study for gender policy studies in Asia.

The program theories, which explain the relationships between targeted issues, measures, and outcomes of programs, will be the theoretical base for evaluating the GM program design and measuring outcomes. In addition, multiple methods, such as content analysis, face-to-face interviews, and qualitative comparative analysis (QCA), will be utilized to analyze the program’s policy tools.

The findings show that the GM program was adopted without a clear pre-evaluation. The program design failed to construct a functional rationale for implementation, and the policy tools were not designed and implemented effectively.
Clinicopathologic Comparison of Basal Cell Carcinoma between Hispanics and Non-Hispanic White Patients in Los Angeles County

Primary Author: Esther Choi  
Co-Author(s): Martha Oberg, John Roll

Faculty Sponsor:

Primary College/Unit: Elson S. Floyd College of Medicine  
Associated College(s)/Unit(s): Medical & Life Sciences  
Campus: Spokane

Abstract:

Basal cell carcinomas (BCC) are the most common malignancy in the United States (US). Majority of cases are identified in Non-Hispanic Whites (NHW) and are far less demonstrated in patients of color (POC). However, the Hispanic population represents a large proportion of the US population, and skin cancer diagnoses in Hispanics are rising. Despite the discrepancy of incidence seen, there are reports explaining racial differences in various other aspects of skin cancer, such as the delay in diagnosis, advanced stages, and clinical presentations that deviate from the hallmark features of BCC. Thus, the goal of this study is to examine the difference between clinicopathologic and clinical presentation of BCC in Hispanics versus NHW.

A retrospective chart review of all patients with a biopsy-proven diagnosis of BCC at Los Angeles County + USC Medical Center from January 2018 to March 2020 was performed. Patient characteristics, like age and sex, and tumor characteristics, like location, subtype, tumor depth, and perineural invasion were analyzed using chi square of independence and t-test (p<=.05).

In total, 152 specimens were collected amongst 124 subjects (79 Hispanics and 45 NHW patients). We found statistically significant differences in gender disparity, age, location, subtype, and pigmentation between Hispanics and Non-Hispanic White groups. Our study supports deviations from epidemiological data and clinical presentation of BCC from the well-studied phenotypic attributes on NHW skin. Further research should be conducted to identify additional differences in skin cancer presentation in POC to reduce the gaps in skin cancer knowledge and care.
Digital Manipulation of Molecular Ion Populations for Cryogenic Infrared Spectroscopy: New Paradigms for Chemical Analysis

**Primary Author:** Brian Clowers  
**Co-Author(s):** Vasyl Yatsyna, Thomas Rizzo

**Faculty Sponsor:**

**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s) Engineering & Physical Sciences**  
**Campus:** Pullman

**Abstract:**

The innovative arrangement of digitally manipulated ion traps enables an extraordinary degree of separation power for molecular ion clouds. The precision and accuracy of printed circuit board technology enables the construction of cyclic ion manipulation chambers that yield separation factors that are not possible using traditional techniques. Combining this functionality with the capacity to isolate and store ion provides researchers with a new tool for the characterization of molecular species. Impacting product quality control, drug design, medical diagnostics and fundamental science, this separation modality is ideally suited to additional domains of molecular characterization. Using the metabolites of a common anesthetic (midazolam), we demonstrate the capacity to separate isomers (i.e. molecules with the same mass but different atomic configurations) with subsequent verification using cryogenic infrared spectroscopy. Not only does this new analysis platform conclusively identify individual compounds within complex samples, but the spectral invariance observed in the infrared domain provides a tractable metric to assign confidence in identification. To demonstrate the broad reaching capacity of this new platform, we also highlight a feature of the technique that allows for the kinetic characterization of ion populations using reactive gas species. Instead of simply asserting a particular degree of chemical transformation occurs, the new cryogenic spectroscopy approach provides a mechanism to quantitatively monitor the location and degree of chemical reactivity throughout a molecular population. Collectively, this new analysis platform impacts chemical fundamentals that inform salient applications across disciplines with an increased levels of speed, selectivity, and accuracy.
We’re all in this together: A tenant engagement program to combat campus-wide energy consumption

Primary Author: Zachary Colligan  
Co-Author(s): Anna Post, Shelby Ruiz  
Faculty Sponsor: Shelby Ruiz  
Primary College/Unit: Engineering and Architecture  
Associated College(s)/Unit(s): Visual Arts & Design  
Campus: Pullman

Abstract:

The purpose of this study was to assess the scalability, energy reduction, and cost savings potential of a tenant engagement program and Smart Power Strips (SPS) in commercial office settings. The Energy and Comfort at WSU program is supported by three pillars: energy efficiency in buildings, full-time staff and faculty comfort and well-being, and creating a community of sustainable building occupants. This program included the installation of 200 SPS throughout targeted buildings on WSU’s Pullman campus. The goal is to broaden the scope of focus to include additional target buildings and thousands of additional staff and faculty, while maintaining the effectiveness of the procedure. This tenant engagement program is a social intervention campaign driven by routine in-person and remote communication to build relationships and encourage positive behaviors in university building occupants. The approach enables us to offer energy-focused interventions, including SPS installations, to address common comfort issues that building occupants experience and to conserve energy by eliminating plug loads. Campus-wide engagement, while maintaining established relationships with thousands of individuals, is impossible without the proper organization and infrastructure. This organization depends on volunteer representatives across campus. “Energy Champions” are volunteers who serve to disseminate our energy efficient solutions and materials to their coworkers in the various departments of our targeted buildings. These friendly faces are advocates for sustainable behavior, a resource for guidance, and support our program through recruitment and engagement. We have recruited 35 energy champions to participate and support this program leading to 200 installed SPS across campus. Departmental adoption and IT support of the installations are crucial next steps to completing hundreds of additional SPS installs and for conserving more energy. The SPS installation alone eliminates 41% of pre-strip plug loads. In addition to our other engagement efforts, it is estimated that annual building energy savings are between 1.5 and 10% depending on environmental conditions and user behaviors. This presentation will focus on the existing findings of the feasibility study conducted in years past, outcomes of smart power strip implementation to date, and plans for expanding the project to more of the WSU Pullman campus.
Keeping it a Ms.-tery: how widespread is the use of Ms.?

Primary Author: Emily Cukier
Co-Author(s):

Faculty Sponsor:

Primary College/Unit: Libraries
Associated College(s)/Unit(s) Liberal Arts & Humanities
Campus: Pullman

Abstract:

Choice of gendered honorifics (Mrs., Miss, or Ms.) offers a glimpse of how women represent themselves (or are represented by society) in relation to their marital status. In the U.S., starting in about the 1960s, cultural adoption of the term "Ms." offered women the choice of a marriage-status-agnostic term analogous to "Mr." for men. However, over time it has also acquired pejorative connotations that parallel linguistic diminutions of female-gendered terms.

There is little scholarship demonstrating the prevalence of the honorific "Ms." compared to the marriage-explicit terms "Mrs." or "Miss". This hypothesis-generating research attempts to map their usage over time in the U.S. using two large text resources that represent the general population (Google Books Ngrams) and scholarly literature (the General Index). Broadly, usage of the term "Ms." rises in both, however it peaks in the mid-90s in Google Books; in the General Index it becomes predominant. These results may reflect greater acceptance for nontraditional identification in the culture of academia, and/or a greater desire for a consistent identifier regardless of marital status within the more limited demographic of female-identifying academics.
Vaccine candidates to sheep-associated malignant catarrhal fever: safety and efficacy in a laboratory model

Primary Author: Cristina Cunha  
Co-Author(s): Katherine Baker, Donal O'Toole, Emily Cole, Smriti Shringi, Daniela More, Hong Li

Faculty Sponsor: Cristina Cunha

Primary College/Unit: Veterinary Medicine  
Associated College(s)/Unit(s) Medical & Life Sciences  
Campus: Pullman

Abstract:

Sheep-associated malignant catarrhal fever (SA-MCF) is an often-fatal syndrome of ungulates caused by ovine herpesvirus-2 (OvHV-2). OvHV-2 is adapted to sheep, which serve as carriers, but can cause disease when transmitted to non-adapted species, including cattle, bison, and deer. SA-MCF is particularly important to the bison industry due to the high susceptibility of bison to the disease, with devastating outbreaks occurring when bison and sheep are kept in proximity. A vaccine to protect disease in susceptible species is necessary to avoid animal losses and the negative impact of the disease on agriculture. The goal of this study was to evaluate the safety and protection efficacy of chimeric viruses that serve as vectors to OvHV-2 glycoprotein B (gB), which is known to induce protective immune responses. Three non-pathogenic chimeric viruses, based on bovine herpesvirus 4 and a recombinant alcelaphine herpesvirus-1-ORF73-null, that express OvHV-2 gB were tested in immunization/challenge experiments using a laboratory rabbit model. Seven animals per group were immunized with the vaccine candidates using various vaccination regimes and delivery routes and then challenged with a lethal dose of OvHV-2. All vaccine candidates were deemed safe, as no local or systemic clinical signs were observed in any trial. Anti-OvHV-2 gB antibodies were detected in all vaccinated animals. Following challenge, protection rates in immunized animals ranged from 28.5 to 71.4%. The safety and high protection efficacy of some vaccine candidates in the laboratory model were very promising and prompt us to perform vaccine trials in relevant target species, including cattle and bison.
Elections and Interventions: Examining their Influence on Sexual Violence in Armed Conflict

Primary Author: Cortney Dalton
Co-Author(s):

Faculty Sponsor: David Makin

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

Principal topic:
Past research has found a relationship between elections and violence. There is a curiosity about whether this holds true for sexual violence and elections. This study looks to see if there is a correlation between sexual violence prevalence, severity, and elections.

Methods:
This utilizes data on sexual violence in armed conflict collected by Cohen and Nordås (2014), as well as data on elections compiled by the author, and is analyzed using Chi-squared and other appropriate tests.

Results/Implications:
Associations are found to be statistically significant. This provides a baseline for future study. While sexual violence research is difficult to do on an international scale and there are limitations to these findings, they are worth considering for future research.
Online and In-Person Programming Camps’ Effectiveness in Generating Interest in Learning Computing within Rural Communities

**Primary Author:** Carla De Lira  
**Co-Author(s):** Rachel Wong, Olusola Adesope  
**Faculty Sponsor:** Olusola Adesope

**Primary College/Unit:** Engineering and Architecture  
**Associated College(s)/Unit(s):** Administrative & Information Systems  
**Campus:** Pullman

**Abstract:**

For middle school students who have not been exposed to computing, generating interest prior to high school is important to help inform their career choices. Middle school students from rural locations may also face the disadvantage of extremely limited computing opportunities within their communities. With computing occupations growing in demand 13% between 2020-2030, computer science (CS) outreach programs play an important role in supporting students’ interest in computing as a potential career, especially in K-12 school years. A programming camp is a CS outreach opportunity that lasts several days outside of regular classroom time and is organized for students to engage in computing in an informal setting. With the recent shifts between online and in-person learning experiences due to COVID-19, online CS outreach opportunities increased in presence also. The purpose of this study is to evaluate and compare the effectiveness of our online and in-person programming camps in generating interest/motivation in computing and increasing programming knowledge among middle school students.

In summer 2022, online and in-person programming camps for middle school students were hosted by CS educators from Washington State University. The online camp was conducted via Zoom whereas the in-person camp took place on the WSU Pullman campus. Each camp consisted of about 55 participants from rural communities within the Inland Northwest and nationwide. This presentation will robustly discuss details of logistical and teaching decisions made at each camp. Our results show that both programming camps were effective in generating interest/motivation in computing, as well as increasing programming knowledge.
Sleep Deprivation Dampens Salivary Cortisol Response to Repeated Stressors

**Primary Author:** Sara Delane  
**Co-Author(s):** Kirstie R. Lundholm, Stephen M. James, Kimberly A. Honn, Devon A. Hansen, Hans P.A. Van Dongen, Brieann C. Satterfield

**Faculty Sponsor:**

**Primary College/Unit:** Spokane  
**Associated College(s)/Unit(s):** Medical & Life Sciences  
**Campus:** Spokane

**Abstract:**

Cortisol is part of the hypothalamic-pituitary-adrenal (HPA) stress pathway and helps regulate physiological responses to stressors. Total sleep deprivation (TSD) elevates next-day cortisol and may affect acute stressor response. Here we investigated the salivary cortisol concentration (SCC) change after repeated stressor exposure, under TSD and well-rested conditions.

N=10 healthy adults (ages 22-37; 5 females) completed a laboratory-based study involving 38h TSD, preceded and followed by 10h sleep opportunities. On day 2 (baseline) and day 3 (TSD), participants completed two sessions with 30min rest between, in a high-fidelity shooting simulator. Participants (civilians) acted as law enforcement in a deadly-force decision-making task in which they verbally engaged with video scenarios and chose whether to use simulated deadly force. Saliva samples were collected daily pre-stressor and 0min, 15min, and 30min after each stressor.

SCC in the post-simulation samples, normalized to pre-stressor, was analyzed using mixed-effects ANOVA, with fixed effects for day, sample time, and their interaction. Planned comparisons revealed a significantly blunted SCC peak during TSD compared to baseline ($t_{[99]}=2.84$, $p=0.006$) following the first session. No SCC peak was observed following the second session, regardless of day.

In both TSD and well-rested conditions, SCC peaked after the first stressor but not the second stressor. However, TSD dampened the SCC response to the first stressor. Our findings suggest that TSD does not change the pattern of SCC responses to repeated stressors but dampens the magnitude of initial peaking. Further analysis will explore if desensitization played a role in dampening this SCC response.

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Cell type-specific patterns of adolescent spine pruning within the mouse medial prefrontal cortex

**Primary Author:** Kristen Delevich  
**Co-Author(s):** Courtney Klappenbach, Qing Wang, Kylee Lenkersdorfer, Jason Acuna, Theodora Gill, Alexis Daniels

**Faculty Sponsor:**

**Primary College/Unit:** Veterinary Medicine  
**Associated College(s)/Unit(s):** Medical & Life Sciences  
**Campus:** Pullman

**Abstract:**

Adolescence is widely recognized as a developmental period when cognitive and affective processing matures and there is heightened risk for psychiatric disease. Adolescence is accompanied by significant synaptic reorganization in the frontal cortex, including the elimination of synapses, referred to as spine pruning. It is unclear whether specific cell types within the frontal cortex exhibit distinct temporal profiles of spine pruning, which may provide mechanistic insight into adolescent onset psychiatric disease. In this study, we combined pathway-specific neuroanatomical labeling and confocal imaging to directly compare dendritic spines on two major frontal cortical pyramidal neuron types, intratelencephalic (IT) and extratelencephalic (ET) neurons, across the adolescent transition [postnatal day (P)29, 44, and 60]. We hypothesized that IT neurons, which mediate cortico-cortical and interhemispheric communication, would exhibit more extensive dendritic spine pruning compared to ET neurons. Across ages, we observed that IT neurons had significantly higher apical spine density compared to ET neurons. Spine density on both cell types was dynamic across time points, increasing from P29 to P44 and then decreasing at P60. Finally, we tested whether microglia participate in spine pruning between P44 and P60 by injecting the drug clodronate disodium salt (CDS), which induces selective apoptosis of microglia, or phosphate buffered saline (PBS) unilaterally into the frontal cortex at P44. We then compared IT and ET apical dendritic spine density and morphological features in the injected hemisphere at P52. Analysis is currently ongoing, but these studies will identify promising cellular targets for future investigation of adolescent onset psychiatric disease.
When virtual reality meets Washington-based wine experience: the role of mental imagery on visit intention

Primary Author: Demi Deng
Co-Author(s):

Faculty Sponsor: Bob Harrington

Primary College/Unit: Business
Associated College(s)/Unit(s): Administrative & Information Systems
Campus: Pullman

Abstract:

Introduction
Washington is the second-largest wine-producing state in the US. Nevertheless, the economic impact of Washington State (WA) wines is far behind wine-renowned states such as California. Consequently, effective marketing strategies are desperately desired. With the burgeoning of virtual reality (VR) applications in fostering immersive tourism experiences and eliciting destination visits, we are inspired to leverage the advantage of VR technology in promoting Washington as an unparalleled wine region, thus attracting more attention and boosting wine-related revenues. To develop our research rigorously, we utilized the mental imagery model as an overarching theoretical framework, exploring the interaction roles of virtual social presence (with vs. without) and consumption cues (nature-based vs. social-based) on WA-based winery visit intention.

Method
Two consecutive studies were designed to test and validate the proposed hypotheses. Specifically, for study 1, an online panel with VR experience was required to watch one randomly assigned VR-endorsed video featuring a WA-based winery experience and then answer questions. Study 2 further validates the result of Study 1 using a lab-based experimental design. The subjects were requested to use VR gear to watch a randomly assigned marketing material and answer questions by completing a survey.

Results/Implications
221 participants attended study 1, and the data collection for Study 2 is still going. The results confirmed the prominence of using dissimilar consumption cues and virtual social presence when using VR technology in promoting WA wine tourism. Destination marketers thus have a clearer picture of leveraging the tested signals to promote WA wine businesses.
CO-HYDROTREATMENT of BIO-OIL and WASTE COOKING OIL for HYDROCARBON PRODUCTION

Primary Author: Melba Denson
Co-Author(s):

Faculty Sponsor: Manuel Garcia-Perez

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s): Engineering & Physical Sciences
Campus: Pullman

Abstract:

The continuous increases in global population growth, industrialization, and depletion of fossil fuel reserves demand the diversification of our energy portfolio. Bio-oil, generated from lignocellulosic biomass, contains a significant amount of oxygenated compounds that lead to undesirable properties, therefore, limiting its direct usability as a fuel source. This study practically aimed to upgrade bio-oil into biofuels and other hydrocarbons. BTG bio-oil mixed with 1-butanol was co-hydrotreated with waste cooking oil (WCO) using NiMo catalyst. Co-hydrotreatment was done in two phases: stabilization and deoxygenation. The yield, composition, and properties of the upgraded oil as affected by different bio-oil concentrations blended with WCO were reported.

The resulting hydrotreated oil was distilled at <150°C, 150-250°C, and 250-350°C to obtain gasoline, kerosene, and diesel, respectively. The yield of the hydrotreated oil showed that increasing the bio-oil concentration resulted in increased amounts of coke (0.7-2.4%) and water (2-10%) and decreased amount of organic layer (80-63%). The yield of distillation cuts showed that increasing the bio-oil concentration leads to a slight increase in gasoline yield and a decrease in kerosene and diesel yields. The UV-fluorescence analysis on the hydrotreated oil showed that increasing the bio-oil concentration resulted in the formation of more polycondensed and conjugated ring system compounds. FTIR results showed that most of the raw materials were converted to biofuels after the hydrotreatment. Further characterization results such as FT-ICR MS, GC/MS, HV, density, viscosity, surface tension, elemental analysis, etc. are also reported. The recommended bio-oil blend in WCO is 20 wt.% accounting for 0.8% coke.
Balance: Designing Solutions to address Patient Needs without Increasing Clinic Workload

**Primary Author:** Brianna Diaz  
**Co-Author(s):**

**Faculty Sponsor:** Jaime Bowman

**Primary College/Unit:** Tri-Cities  
**Associated College(s)/Unit(s)** Medical & Life Sciences  
**Campus:** Tri-Cities

**Abstract:**

The Yakama Indian Health Services Clinic (IHS) in Toppenish, WA serves as a medical home to over 13,000 Native Americans / Alaskan Natives. Like in many healthcare settings, the COVID-19 pandemic exacerbated staff shortages which led to decreased scheduling capacity and, in turn, increased inappropriate utilization of the walk-in clinic for chronic and preventative care services. Ideally, these services would be managed by a primary care provider in a continuous care model, which improves patient outcomes through the development of a therapeutic patient-provider relationship over time.

In discussions with key stakeholders such as patients, community leaders, clinicians, and administration, a shared goal was developed to encourage appropriate usage of primary care and urgent care services without increasing the administrative staff's already burdensome workload. To this end, I created a visually appealing, comprehensive, and educational poster to serve as a patient guide to navigate the triage question: “When is it better to immediately walk in to see a provider versus schedule a future appointment?”

In the development of the poster, I asked patients what information they would need to make informed medical decisions and then elicited feedback from staff. Additionally, I considered how the IHS serves as a western model of healthcare applied in the setting of an independent nation with a strong culture of community. To preserve this sense of welcome within the clinic, I prioritized representation and inclusion of community values, and avoided the use of unnecessary medical jargon and discouraging language (e.g. “DON’T walk-in” versus “consider scheduling when”).
Crossroads

**Primary Author:** Chris Dickey  
**Co-Author(s):**

**Faculty Sponsor:**

**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s)** Liberal Arts & Humanities  
**Campus:** Pullman

**Abstract:**

The tuba is among the youngest instruments in classical music. Since it was patented on September 12, 1835, the tuba has evolved into an instrument with a home in the last row of an orchestra, as the foundation of a brass quintet, or in the spotlight as as a soloist. If one examines the canonical tuba literature—the pieces that commonly appear on recitals and on required competition lists—one will notice a few glaring omissions. Where are the pieces written by women, people of color, or LGBTQ+ individuals? Intentionally diversifying the tuba repertoire is a necessary action item for the music profession to be relevant while responding to the needs of today’s ever-evolving world. With generous support from a New Faculty Seed Grant, Dr. Chris Dickey commissioned three dynamic pieces for tuba and piano written by composers holding a marginalized identity. The results include Katahj Copley’s Crossroads, Juantio Becenti’s Fantasy for Tuba and Piano, and Rhapsody for Tuba and Piano by Wayne Lu. These three works, in addition to other original repertoire for tuba and piano, appear on Crossroads, an album released under the Centaur Records label. Pianists Fabio Menchetti and Michael Seregow are featured on the recording project. Dickey performed these works in a national recital tour to generate interest in the new works and led discussions about intentional programming.
Investigation Of A Novel Insulation Foam Made From Gypsum Drywall Waste

Primary Author: David Drake
Co-Authors: Taiji Miyasaka

Faculty Sponsor:

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s): Engineering & Physical Sciences
Campus: Pullman

Abstract:

Foamed plastic rigid insulation panels are effective for reducing building heating and cooling loads, with consequent reductions in energy use and associated greenhouse gas (GHG) emissions. However, plastic foam manufacturing and in-service use result in significant GHG emissions. In addition, plastic foams are flammable, and have been implicated in recent building fires. This paper describes proprietary mixtures and methods for producing drywall waste foam (DWF) panels, a carbon-neutral, fire-protective insulation made from gypsum drywall waste and other construction and demolition (C&D) waste materials. Gypsum drywall waste is inherently fire-protective and has relatively low thermal conductivity, but is a low-value commodity with few current reuse and recycling applications. DWF panels address two pressing issues in the built environment: decarbonization of building materials, and diversion of problematic C&D waste from landfills. Investigation of DWF panel engineering properties, including density, hardness, friability, burnthrough time, and thermal conductivity are reported, with results compared to analogous commercially-available materials. Potential applications and areas for future investigation are also discussed.
Project STEM WRITE: Writing excellence through Review, Initiative, Thought, and Expression

Primary Author: Michael Dunn  
Co-Author(s): Wendy Olson, Adenike Otoikhian, Jon Anderson, Weili Yuan, Kyrin Gregory

Faculty Sponsor:

Primary College/Unit: Education  
Associated College(s)/Unit(s) Social Sciences  
Campus: Vancouver

Abstract:

Many U.S. public school students (75%+) struggle significantly with writing skills (NCES, 2017) and can continue into their first years of undergraduate education. This completed study offered writing webtools (e.g., 5-7 videos about a writing assignment’s rubric, low/high-quality exemplars; how to attend to the genre of lab reports) to lower-division STEM (Chemistry) students at WSU Vancouver to improve their skills through strategy instruction that supported writing transfer and genre awareness. The research questions for this study were: what are participants’ perspectives about writing? Do participants’ writing content and quality improve with use of WRITE? What were the instructor(s) and students’ thoughts about WRITE? Participants were asked to complete a short online survey (N=40) about writing and then indicate if they would share their chemistry lab report texts (N=25; three prior to Week 8, and three assignments after, when the webtools were opened in Canvas for them to see). Ten students agreed to be interviewed about their writing skills and their feedback about the webtools in Canvas. The results indicated that participants: found writing to be challenging, liked the webtools, and improved their writing based on the pre/post analysis (/5.00) of their use of the webtools (prewriting quality was 3.79, post was 3.91; pre quality was 3.51, post was 3.58). Kerry commented in the interview that she is, “good at writing papers. Lab reports are more challenging. I am not sure where to put information? What I should be including in each section? How much information is enough per section?”
Brain region-specific bacterial peptidoglycan levels change after ischemic stroke.

Primary Author: Cheryl Dykstra-Aiello  
Co-Author(s): Erika English, Marina Savenkova, James Krueger  
Faculty Sponsor:  
Primary College/Unit: Veterinary Medicine  
Associated College(s)/Unit(s) Medical & Life Sciences  
Campus: Spokane  

Abstract:  

Peptidoglycans are integral bacterial cell wall products found in developing and healthy adult and in diseased and sleep-deprived brains. However, although microbiota influence multiple pathophysiologies, including ischemic stroke, they have not yet been characterized in post-stroke brain. Using a surgical model to mimic human large vessel stroke, the left middle cerebral arteries of aged (63 weeks) male wildtype mice (n=5) were occluded permanently at the beginning of the dark cycle when they are typically most active. Animals recovered 2-2.5 hours before euthanization at ZT15. Brain stem (BS), hippocampus (HC), somatosensory and prefrontal cortical (Sctx; PFC) tissues were dissected and prepared for use in a standardized peptidoglycan ELISA for peptidoglycan quantification. Area-specific mean peptidoglycan values (ng/mg tissue wet weight ± SEM) were compared between the injured left and uninjured right hemispheres by two-way ANOVA and post-hoc tests with significant p-value<0.05. In Sctx and HC, peptidoglycan differed significantly between the left (Sctx-4.28±0.48; HC-5.05±0.57) and right (Sctx-5.66±0.29; HC-3.97±0.54) hemispheres. As expected, there were no hemispheric differences in either BS or PFC. In both hemispheres, peptidoglycan values were highest in BS (left-7.59±0.40; right-8.26±0.53) and lowest in PFC (3.82±0.21 3.56±0.56). This study partially confirms our parallel study demonstrating unique peptidoglycan regulation within brain areas and reports similar values in control Sctx and BS. Additionally, these results suggest cerebral blood flow changes induced by stroke affect peptidoglycan in the injury-associated brain areas and peptidoglycan may be affecting in stroke injury and recovery. 

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Electrochemical Deposition with Redox Replacement of Lanthanum with Uranium in Molten LiCl-KCl

Primary Author: Jeffrey Eakin
Co-Author(s):

Faculty Sponsor: Cornelius Ivory

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

Electrochemical recovery of dilute concentrations of actinides from spent nuclear fuel would reduce the longevity of storing high-level nuclear waste in underground waste repositories. Electrochemical deposition with redox replacement (EDRR) is used in a molten salt medium for the selective electrochemical recovery of uranium in the presence of excess concentrations of lanthanum. In each EDRR cycle, after a short electrodeposition pulse, the deposited lanthanum is spontaneously replaced by uranium at the open circuit potential. After repeated cycles, uranium metal was obtained on a tungsten electrode immersed in a LiCl-KCl melt that contained 1 wt.% lanthanum chloride – 0.15 wt.% uranium (IV) chloride. Scanning electron microscopy and energy dispersive X-ray spectroscopy (SEM-EDS) analysis revealed uranium particles approximately 0.5 - 1 um with well-defined rectangular shapes; and with 20 – 60 times more uranium recovered on the surface of the electrode than lanthanum. This work may be incorporated into proposed process flow diagrams describing the recycling of spent nuclear fuel.
Household ecology and infants’ fecal microbiome (IFM): the MIMBES study

Primary Author: Maryam Edrisi
Co-Author(s): 

Faculty Sponsor: Aaron Blackwell

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

The “old friends” hypothesis proposes that exposure to co-evolving microbial species in infancy and childhood may impact later life health and immune function, including allergies. Here, we sought to identify whether the holistic household ecology and individual household factors are associated with variation in infant fecal microbiome (IFM) alpha diversity. However, previous studies have not largely considered household ecology holistically, looking only at individual factors. We analyzed fecal samples from 48 healthy, exclusively breastfed infants from Eastern Washington and Northern Idaho. The V1-V3 region of the bacterial 16S rRNA gene was sequenced to characterize and analyze the role of household ecology on the IFM. Household ecological factors were reported by mothers of infants (via survey and naturalistic observations). Principal component analysis (PCA) scores summarized the household ecology (number of caregivers, non-household visitors, animals in house, household size, etc.). Regression models using main predictors of the individual household ecology, controlling for infant sex and delivery mode, were also conducted to identify whether there were independent effects of these household ecology factors. Results indicate that PCA scores predicted variance in infant’s fecal bacterial alpha diversity (Shannon index, Observed richness, Pielou’s, and Simpson Evenness), accounting for covariates of infant sex and delivery mode. Non-household visitors were negatively associated with Observed bacterial richness. However, no other household ecological variables were associated with infant fecal bacterial alpha diversity measures. These results suggest that more non-household sources of bacterial exposure should be considered when identifying possible factors that affect the gastrointestinal microbiome of exclusively breastfed infants.
Teaching Phonemic Awareness to Pre-service Teachers Through Remote Learning with a Digital Escape Room for Education

Primary Author: Jendra Elbek  
Co-Author(s): Jane Kelley

Faculty Sponsor: Jane Kelley

Primary College/Unit: Education  
Associated College(s)/Unit(s) Social Sciences  
Campus: Pullman

Abstract:

Principal Topic  
Pre-service teachers lack phonemic awareness (identifying and manipulating letter sounds) needed to effectively teach literacy/reading skills (Joshi et al., 2009). The COVID-19 pandemic further complicated literacy instruction by forcing educators into emergency remote (online) teaching for which they were ill-equipped (Hodges et al., 2020). One instructional tool, the educational escape room, allows players to participate in learning activities to gather clues, solve puzzles, and unlock the room before time runs out (Nicholson, 2015). By developing and testing a digital escape room for education (DERE), this study examines a novel teaching approach that captures education students’ attention and envelops them in literacy instruction online.

Methods  
We designed and built a 360° digital escape room to teach phonemic awareness (PA) to 142 pre-service teachers over 4 semesters through Zoom. The students were given pre- and post-tests on PA knowledge, and we observed their interactions with the DERE technology and cooperation with each other. Pre- and post-surveys measured students’ perceptions of their knowledge of PA and their confidence and likelihood of teaching PA in the future.

Results/Implications  
Teaching literacy strategies online to pre-service teachers is challenging. The adversities of the pandemic revealed a critical need for educators to incorporate technology into their curriculums in captivating ways. Preliminary results of our DERE study show significant evidence of increases in student engagement and PA learning. The culminating results of this study will guide the formation of DERE design principles that teachers can use for many classroom contexts, including for emergency remote teaching.
Communication about COVID-19 and vaccinations among Nimipuu

Primary Author: Rachel Ellenwood  
Co-Author(s): Zoe Higheagle Strong, Amanda Boyd  
Faculty Sponsor: Amanda Boyd  
Primary College/Unit: Communication  
Associated College(s)/Unit(s): Social Sciences  
Campus: Pullman

Abstract:

COVID-19 incidence rates were higher for American Indians compared to other racial groups in the United States. Despite barriers and unequal losses during the pandemic, American Indians have high vaccination rates. We provide insight into perceptions of COVID-19 and vaccinations through in-depth interviews with American Indians residing on the Nez Perce Indian Reservation in the United States. This study provides a holistic view of how American Indians perceive vaccines by bringing together Indigenous perspectives of risk and the Health Belief Model. The results demonstrate the importance of tribal sovereignty in developing health communication strategies, and the need for messaging that is trusted and culturally appropriate. Our study will provide insight into the factors that influenced successful health communication strategies among American Indians, and how the Health Belief Model may be enhanced by including cultural and traditional perspectives of the priority population. We conclude with recommendations for further research and health communication strategies that resonate with Indigenous populations.
Expression of sex-specific molecular markers by Babesia bovis gametes

Primary Author: Hala Elsayed  
Co-Author(s): Wendell Johnson

Faculty Sponsor: Massaro Ueti

Primary College/Unit: Veterinary Medicine  
Associated College(s)/Unit(s) Medical & Life Sciences  
Campus: Pullman

Abstract:

Bovine babesiosis caused by Babesia bovis is one of the most important tick-borne diseases of cattle in tropical and subtropical regions. B. bovis parasites have a complex lifecycle, including development within the mammalian host and tick vector. In the tick midgut, extracellular Babesia parasites transform into gametes that fuse to form zygotes. Understanding the biology of extracellular B. bovis tick stages is an important step towards developing control strategies for preventing parasite transmission. We developed a chemoattraction-based method to separate male gametes from in vitro induced B. bovis culture. Separation enables the validation of sex-specific markers. Collected male gametocytes were observed by Giemsa-stained smear and live-cell fluorescence microscopy and used to confirm sex-specific markers by quantitative real-time PCR. Some genes were found to be male gamete specific genes including hap2, major sperm protein (msp), 6-cysteine (B), histone H2B and zinc finger C3H1 protein2 (ZNFP2). However, ABC transporter G, ccp1-ccp3, Signal recognition particle subunit (SRP72) and RNA helicase genes were found to be upregulated in female gametes (culture depleted males). These results revealed strong markers for B. bovis male and female gametes. Herein we describe the identification of sex-specific markers essential for sexual reproduction. These tools will enhance our understanding the biology of sexual stages and, consequently, the development of additional strategies to control bovine babesiosis.
Peptidoglycan Levels in Healthy Murine Brain Fluctuate with Sleep, Sleep Loss, and Activity Cycles

Primary Author: Erika English  
Co-Authors: Cheryl Dykstra-Aiello

Faculty Sponsor: James Krueger

Primary College/Unit: Veterinary Medicine  
Associated College(s)/Unit(s) Medical & Life Sciences  
Campus: Spokane

Abstract:

Microbe-host interactions influence host physiology. Aberrant host behavior, including altered sleep, can perturb the microbiome and its products. Bacterial cell wall products peptidoglycan (PG) and its muramyl peptide (MP) constituents are extensively characterized sleep promoting substances and are found in healthy murine brain. Detection of bacterial products via host pattern recognition receptors induces inflammatory and sleep regulatory cytokines. A quantitative description of brain PG/MPs is lacking as is whether brain PG changes with sleep duration. WT mice acclimated to standard lab conditions were euthanized at times corresponding to light-dark transitions, peak rest and activity, and mid-way through the rest period, i.e., at Zeitgeber time (ZT) 3, ZT6, ZT12, and ZT15. Additional groups were euthanized at ZT3 and ZT15 following 3h of sleep deprivation (SD). A non-invasive PiezoSleep system recorded sleep. Sleep did not increase significantly following SD. Brain stem (BS), hypothalamus (HT), somatosensory cortex (Sctx), and olfactory bulb (OB) PG levels were determined (as ng PG per mg tissue) using a commercial ELISA. In all brain areas PG levels varied with time of day and were lowest at ZT12. Control values for BS (8.6), HT (3.6), and Sctx (3.7) were altered with SD from ZT0-3. BS and HT PG (7.5 and 3.0) decreased significantly (p< 0.05) while Sctx PG (4.8) increased significantly (p< 0.01). We conclude, PG is present in healthy murine brain, fluctuates with rest and activity, and is altered with SD. These data suggest symbiotic microbe-host interactions influence host neurobiology.
The Emergence of Classical Hydrodynamics from Quantum Turbulence

**Primary Author:** Edward Eskew  
**Co-Author(s):** Michael Forbes  
**Faculty Sponsor:** Michael Forbes  
**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s):** Engineering & Physical Sciences  
**Campus:** Pullman

**Abstract:**

Quantum turbulence is characterized by quantized vortices which tangle and interact in a "turbulent" manner. It may hold the key to poorly understood phenomena such as pulsar glitches, where the rate of rotation of a spinning neutron star suddenly and inexplicably increases. We hypothesize that, on macroscopic scales, the neutron superfluid is described by a hydrodynamic model. The mechanism behind glitches should appear as an instability in the hydrodynamic model, and this hydrodynamic formulation should in term arise from a microscopic quantum theory. Such a model would enable simulations of the neutron superfluid at volumes relevant to glitches.

In this work, we carry out numerical simulation of quantum hydrodynamics, and find that on a macroscopic scale, the dynamics are best matched by viscous classical hydrodynamics. We additionally investigate the role that chaos in the microscopic theory plays in the emergent hydrodynamics.
Asset Redeployability and Corporate Liquidity

Primary Author: Douglas Fairhurst
Co-Author(s): S M Zahid

Faculty Sponsor: Douglas Fairhurst

Primary College/Unit: Business
Associated College(s)/Unit(s) Administrative & Information Systems
Campus: Pullman

Abstract:

Principal Topic:
This paper investigates the effects of asset redeployability, the extent assets have usage across industries, on corporate cash holdings. Firms hold cash to be able to meet investment needs. However, firms may use the proceeds from the sale of redeployable assets to finance their investments as these assets are traded more actively. Further, redeployable assets, being great collateral, provide firms with easier access to and favorable terms for external financing. Thus, redeployable assets, being an alternative source of liquidity, may reduce firms’ holding of cash. This study is important because it highlights the interplay between short-term and long-term assets, which are typically considered separately.

Method:
We propose (1) asset redeployability may negatively influence cash holdings and (2) this influence is due to redeployable assets’ effect on (a) external financing and (b) asset sales. We use the asset redeployability measure developed by Kim and Kung (2017) and COMPUSTAT and a proprietary database for other variables. We implement an OLS regression with multiple fixed effects. We also implement propensity score matching, entropy balancing, and difference-in-differences approach to address endogeneity concerns and to infer causal evidence.

Results/Implication:
We find a significantly negative relationship between cash holdings and asset redeployability. This finding holds for matching analyses and a difference-in-differences approach. Firms with redeployable assets have easier access to credit lines. Further, firms with redeployable assets are more likely to fund investment via asset sales, especially during industry downturns. Collectively, the evidence highlights the interplay between the liquidity of short-term and long-term assets.
Engagement with a Tailored Sleep Guide Reduces Variability in Sleep Efficiency in Chronic Insomnia

Primary Author: Freya Fanson  
Co-Author(s): Devon Hansen, Elie Gottlieb, Roy Raymann, Sharon Danoff-Burg, Dedra Buchwald, Hans Van Dongen, Nathaniel Watson  
Faculty Sponsor:  
Primary College/Unit: Spokane  
Associated College(s)/Unit(s): Medical & Life Sciences  
Campus: Spokane  

Abstract:  
Insomnia is difficult to diagnose due to night-to-night sleep variability, and difficult to treat due to a lack of trained providers in behavioral therapy for insomnia. Consumer sleep technology (CST) may help to address this by enabling longitudinal sleep monitoring in a natural environment. One CST device, the SleepScore Max, combines non-contact sleep tracking with a tailored sleep guide, providing individualized recommendations to improve sleep. Here we examined whether level of engagement (defined as percentage of days interacted with the guide) with the sleep guide correlates with sleep efficiency in people with chronic insomnia.  
N=30 individuals with chronic insomnia (8 males, ages 18-65y) completed an at-home sleep monitoring study. Participants tracked their sleep with the CST device, engaging with the sleep guide daily for 8 consecutive weeks. Within-participant means and standard deviations of sleep efficiency were assessed by week, and change scores over the study duration were correlated with percentage of days interacting with the sleep guide.  
Mean sleep efficiency did not change significantly (t[23]=0.83, p=0.42), but night-to-night variability decreased over the study duration (t[23]=-2.16, p=0.041). There was a significant correlation between change in night-to-night variability and level of engagement with the sleep guide (r=-0.48, p=0.018), such that night-to-night variability decreased more in those with greater engagement.  
Research suggests that reduced night-to-night variability in sleep efficiency may be associated with overall improvement in chronic insomnia. As such, engagement with a tailored sleep guide incorporated in a CST device may help individuals with chronic insomnia improve their sleep.
Highly engineerable and recyclable resin for carbon fiber composites

**Primary Author:** Mingen Fei  
**Co-Author(s):** Baoming Zhao, Jinwen Zhang

**Faculty Sponsor:** Jinwen Zhang

**Primary College/Unit:** Engineering and Architecture  
**Associated College(s)/Unit(s):** Engineering & Physical Sciences  
**Campus:** Pullman

**Abstract:**

Our society faces a serious challenge in use of polymer composite and their disposal after use. Polymer composite products, especially carbon fiber reinforced composites (CFRP), are ubiquitous and critical to our everyday life. Researchers have attempted to use Schiff base dynamic chemistry to produce recyclable matrix resin for new CFRP. However, current Schiff base vitrimer resin have high viscosity or are in solid state, which is inconvenient in product fabrication. In this work, a low viscosity and recyclable Schiff base vitrimer resin is prepared from commercially available diamine, dialdehyde, and bisphenol A epoxy in a one-pot synthesis. The obtained resin presents a tensile strength up to 59.6 MPa and an elongation at break up to 8.4 %. Moreover, this Schiff base vitrimer has excellent chemical resistance toward various solvents. Due to the imine bond exchange reaction, the obtained CFRPs can be degraded in 0.2 M HCl solution at 200 °C in 4 h using a pressure reactor. Moreover, the prepared CFRP shows unique welding and shape changing properties. The findings from the study will help to bring Schiff base vitrimer resins from research stage to practical composite applications and have the potential to solve the problems of waste management of polymer composite.
ADA Functional Polymorphism Modulates REM Sleep Following Total Sleep Deprivation

Primary Author: Sofia Fluke  
Co-Author(s): Hans Van Dongen, Devon Hansen, Brieann Satterfeild

Faculty Sponsor: Brieann Satterfeild

Primary College/Unit: Spokane  
Associated College(s)/Unit(s): Medical & Life Sciences  
Campus: Spokane

Abstract:

Adenosine Deaminase (ADA) regulates extracellular levels of adenosine, a brain correlate of sleep homeostasis. A single nucleotide polymorphism (SNP) of the ADA gene increases homeostatic pressure for non-REM sleep after total sleep deprivation (TSD). Whether this genotype also impacts REM sleep after TSD has not been investigated. Here we examine the influence of an ADA SNP on REM sleep at baseline and following TSD.

48 healthy adults (ages 27.7±5.3, 23 females) participated in one of three in-laboratory TSD studies. Following 10h baseline sleep (22:00–08:00), participants underwent 38h of TSD, with 10h recovery sleep (22:00–08:00). Sleep periods were recorded polysomnographically. The ADA SNP was determined using real-time PCR assay. Sleep stages were analyzed using mixed-effects ANOVA with fixed effects of ADA genotype, sleep period, and their interaction, controlling for study, with a random effect over subject on the intercept.

The sample included 42 G/G homozygotes and 6 A/G heterozygotes. The A/G heterozygotes spent less time in non-REM sleep during baseline and more during recovery compared to G/G homozygotes, albeit not significantly (p>0.01). However, A allele carriers spent significantly more time in REM sleep during baseline and less during recovery compared to G/G homozygotes (F1,46=8.13,p=0.007).

ADA genotype was associated with a shift in balance between REM and non-REM at baseline, as well as changes therein after TSD. This suggests a possibly homeostatic role for adenosine in mediating brainstem reciprocal interaction mechanisms known to be involved in REM sleep regulation.

Supported by CDMRP W81XWH-05-1-0099; ONR N00014-13-C-0063; NIH R21CA16769; ARO W911NF2210223.
Mind the Gap: Paramedian Approach for Coccygectomy

Primary Author: David Frolov
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Faculty Sponsor:

Primary College/Unit: Spokane
Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Spokane

Abstract:

Introduction: Coccydynia is often self-limiting, however, persistent pain can be treated with offloading, NSAIDs, physical therapy, and steroid injections. When all conservative management options fail, a growing body of evidence supports a coccygectomy for symptomatic relief. The standard approach involves a midline incision cephalad to the anus along the gluteal cleft. Historically, this method has had high rates of infection. We propose the paramedian approach to coccygectomy, using a 6 cm incision roughly 1.5 cm lateral to the midline. This has the benefit of distancing the surgical site from the anus, diminishing the crevice effect of the incision, and increasing the dermal thickness for improved surgical closure.

Methods: We present a case series of 41 patients who had a paramedian approach coccygectomy between 2011 and 2022. Collected data includes demographic information, comorbidities, etiology of symptoms, previous treatments, surgical metrics, complications, and follow-up evaluations. Data was analyzed in Microsoft Excel, including unpaired two-tailed T-tests.

Results: The patients’ average age was 45.8 years. Out of the 41 patients, five of the presented with post-operative complications (12.1%). One patient required an I&D and four others were treated with antibiotics for wound erythema. Post-operative evaluations showed continual improvement, greatest after one-year post-operative. VAS pain scale dropped from a 7.1 to 2.3 (P<0.001) and the Oswestry Disability Index (ODI) improved from 30.1 to 9.6 (P<0.001). 86.7% percent of patients reported either a good or excellent result.

Conclusion: Coccygectomies via the paramedian approach are an effective option to treat refractory coccydynia.
Elderberry juice and its effect on sperm in mice on a high-fat diet

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**Co-Author(s):** Patrick Solverson, Alfian Tonggano, Theodore Chauvin  
**Faculty Sponsor:**  
**Primary College/Unit:** Elson S. Floyd College of Medicine  
**Associated College(s)/Unit(s):** Medical & Life Sciences  
**Campus:** Spokane

**Abstract:**

Intro: High-fat (HF) diets and obesity have been known to cause a chronic inflammatory state of the human body that has been shown to impact spermatogenesis negatively. It is believed that oxidative stress and endocrine dysfunction are potential contributors to causing decreased sperm counts. Anthocyanin-rich diets (berries) have become increasingly studied based on their ability to protect against obesity by increasing insulin sensitivity and reducing lipid droplets. However, to our knowledge, there have yet to be studies analyzing the effects of elderberry extract in high-fat diet mice on testis and the genetic changes that occur.

Hypothesis: We hypothesize that Elderberry juice will alter the adverse effects seen in an HF diet in the murine testis resulting in increased sperm parameters.

Methods: Mice were fed an HF diet or HF diet with elderberry juice extract for 12 weeks. At 12 weeks, mice were euthanized, and body weight, fat pad weight, sperm, and testes were collected for analysis.

Results: We found reduced fat-pad weight in the elderberry juice extract-supplemented mice and reduced overall body weight. However, mice treated with elderberry extract were found to have reduced sperm count compared to the control. Overall, there were significant gene expression changes in the HF diet versus the HF diet fed with elderberry extract.

Conclusion: Elderberry extract mitigates some of the adverse effects of an HF diet in male mouse reproductive organs, including genetic differences. However, more work needs to be performed to determine the molecular mechanisms of how this occurs.
Your dietary habits matter to your babies

**Primary Author:** Yao Gao  
**Co-Author(s):**  
**Faculty Sponsor:** Min Du  
**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s):** Medical & Life Sciences  
**Campus:** Pullman  

**Abstract:**

Principal topic: Parents’ eating pattern affects their children’s health, which has been proved by increasing evidence through research during the past decade. Children born from mothers who are obese or addicted to unhealthy food (high fat/calorie composition) are more likely to have metabolic syndromes. But the specific reasons behind this cross-generational effect remains poorly defined. Thus, the goal of this study is to seek out mechanisms explaining it at molecular levels.

Imprint markers are inherited from parents which are not due to changes in genetics itself, but associated changes that can pass to their babies. We hypothesized that maternal obesity could alter the expression of H19, a maternal imprint gene, which alters the muscle development of fetuses.

**Method:** A high-fat diet (HFD) mice model was used to mimic the unhealthy eating pattern in mothers. Embryos of these HFD mice were collected, analyzed, and compared with the control group. Single cell sequencing, Western Blotting, Quantitative polymerase chain reaction, Lentiviral dCas9 transfection, and Immunocytochemical staining were conducted to screen, manipulate, and measure the expression levels of genes and proteins. The muscle cell line was further cultured to manipulate H19 gene expression and analyzed its biological effects in vitro.

**Results/implications:** Mice treated by HFD were 23% heavier than the control group. Embryos from those HFD maternal mice displayed suppressed muscle development. The imprinting pattern of H19 gene was disrupted and showed a higher level in HFD embryos. To establish causal relationship, we used genetic methods to increase H19 expression in cells which strongly inhibited muscle cell formation.

This is the first discovery that maternal HFD impedes their children’s muscle development early during the embryonic stage, by disturbing imprinting gene expression. Our data clearly demonstrate what parents eat can impact their babies’ muscle growth with long-term consequences. Therefore, a healthier lifestyle and diet are critically important for your own and children’s health.
Orchard-specific weather data driven automated frost mitigation system

**Primary Author:** Srikanth Gorthi  
**Co-Author(s):** Karisma Yumnam, Basavaraj Amogi, Gwen Hoheisel  
**Faculty Sponsor:** Lav Khot  
**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s)** Agricultural & Natural Sciences  
**Campus:** Prosser  

**Abstract:**

Washington State is the top producer of fresh market sweet cherries (61%) in the U.S. and early spring frost can cause up to 70% yield reduction. Post dormancy, sweet cherry buds are vulnerable to freeze/frost damage when exposed to critical temperature (-7 to 0 °C) based on the growth stage. To protect the buds from frost damage, growers operate active frost mitigation measures like wind-machine, under-tree sprinklers, and propane heaters based on air temperature thresholds. However, operation of these active methods is based on a point measurement of air temperature and lacks consideration on spatial variability typical in the central WA orchards established on varied terrains. Thus, this study was aimed to develop a wireless sensor network (WSN) distributed throughout the orchard block to continuously monitor frost events to help decisions on activation of mitigation techniques. As a precursor, drone sonde (integrated with thermal-infrared imager) based orchard site mapping was performed to understand cold spots as potential mote locations. For the selection of suitable sensors in the mote, we deployed radiative frost (RF) sensor and thermocouple (E-Type) for monitoring bud temperature along with an air temperature and relative humidity sensor at 1.5 m above ground level. Results showed that the bud temperature was lower (0.5 - 2.5 °C) than the air temperature and are significantly different (p < 0.05) but with high correlation (R2 = 0.98). Moreover, it was also observed that the RF sensor is more sensitive to frost conditions than the air temperature sensor. With the above understanding, our team has developed motes for WSN encompassing air temperature and relative humidity, RF sensors and we plan to evaluate the effectiveness of this network in three commercial sweet cherry orchards in the 2023 field season.
Assessing the Role of Intra-Cluster Floral Position on Apple Fruit Quality

Primary Author: Sarah Gruntmeir
Co-Author(s): Matthew Whiting, Manoj Karkee, Michelle Moyer

Faculty Sponsor: Matthew Whiting

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s) Agricultural & Natural Sciences
Campus: IAREC (Prosser)

Abstract:

Principal Topic
Crop load management is an essential process for maximizing profitability in the apple production system. The balance between excessive or insufficient fruit set may result in increased disorder presence, decreased fruit size, or inadequate floral numbers in subsequent years. However, crop load methods practiced by farmers today can be imprecise with the target pollination location within the tree canopy or the number of flowers that are pollinated. They can also be costly and time-consuming for producers. Scientists have been studying robotic pollination machines to optimize this process and decrease the need for post-pollination fruit thinning. This experiment explores the potential fruit quality potential within floral clusters to further determine the ideal blossoms to pollinate with upcoming robotic systems.

Method
Trees were selected in a randomized design and hand thinned in an open pollination setting to simulate pollination of the king bloom (the flower in the center of the floral cluster) or a lateral bloom (a flower on the perimeter of the cluster). Fruit diameter, cluster count, and shoot length were measured throughout the season. Post-harvest measurements included diameter, percent color, weight, disorder presence, firmness, Brix, and starch content.

Results
Results concluded that Gala showed marginal benefits to pollinating king blooms, while Honeycrisp showed few quality differences with pollination of a specific flower. Gala fruit from king blooms were on average 1.892 mm (p < 0.001) larger than side blooms and had 10.393 percent (p < 0.001) more color—attributes that could increase profitability for producers.
Investigating the development and evolution of mathematics teacher identity

Primary Author: Will Hall  
Co-Author(s): Molly Sutter

Faculty Sponsor:

Primary College/Unit: Arts and Sciences  
Associated College(s)/Unit(s) Social Sciences  
Campus: Vancouver

Abstract:

The first years of teaching are challenging and if teachers do not feel confident in who they are as a teacher, they are at risk for experiencing burn out (e.g., Beauchamp & Thomas, 2009; Hodges & Hodge, 2017; Lutovac & Kaasila, 2014; Molfino & Ochoviet, 2019; Taylor, 2017). Identity is a key component in teachers feeling confident in their role of teaching mathematics. Identity is socially formed, constantly changing, and is not singular (Akkerman & Meijer, 2011; Beauchamp & Thomas, 2009; Chung-Parsons & Bailey, 2019). Thus, it is imperative that teacher education programs investigate how to engage preservice teachers in activities that allow them to explore their own identities and prepare to engage their own students in similar activity. In this poster, we present results from an ongoing study in which students (n=34) in a mathematics teacher education program attended a professional conference for mathematics teachers and wrote autoethnographies regarding what it means to be a mathematics teacher. We utilize Bronfenbrenner’s Ecological System (Cross & Hong, 2012) and Gee’s views of identity (Carrier et al., 2017; Tsybulsky & Muchnik-Rozanov, 2019) to investigate the ways PMTs wrote about their personal experiences in their autoethnographies. Bronfenbrenner’s Ecological System breaks down environments in which people are situated while Gee illustrates different parts of identity (Carrier et al., 2017; Cross & Hong, 2012; Tsybulsky & Muchnik-Rozanov, 2019). Our purpose is to illustrate our theoretical framework that situates autoethnography within these two existing frameworks based on the results of our analytical work.
Separation of Terbium and Gadolinium by Isotachophoresis

Primary Author: Hannah Hallikainen
Co-Author(s): Corneilius Ivory

Faculty Sponsor: Corneilius Ivory

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

Principal topic:

Isotachophoresis is a practical alternative to chromatography for gadolinium and terbium separations at the milligram scale. Isotachophoresis is a form of electrophoresis, a chemical separation method in which a strong electric potential is applied across a liquid or gel. This electric potential results in the separation of a sample into its chemical components based on the charge and mobility of those components. The separation of gadolinium and terbium is challenging due to the similar chemical behavior of the two elements, but this separation is of interest in medical isotope production. Radioactive terbium-161 has medical applications, and it is produced by irradiating a large gadolinium target. During irradiation, only a small amount of gadolinium is converted into terbium-161, and separating the terbium from the gadolinium is necessary. To date, milligram scale separations of gadolinium and terbium are generally done by chromatography, though micro- and nano-gram scale electrophoretic separations have been previously demonstrated.

Method:

The desired gadolinium and terbium separation by electrophoresis was modeled in COMSOL 6.0 prior to laboratory experiments. Different buffer systems and concentrations were tested in the computer model, and an ammonium acetate/α-hydroxyisobutyric acid/glutamic acid buffer system was chosen from the candidate buffer systems. A large-scale electrophoresis apparatus has been used to test the proposed separation in the laboratory, and ICP-OES analysis to determine the gadolinium and terbium concentration in the samples collected.

Results/implications:

The gadolinium and terbium separation has been demonstrated at 1-5mg. Experiments are ongoing, but the results obtained so far indicate that the modeled separation matched quite closely with the experimental separations. Future work will be aimed at improving the peak separation, and increasing the amount of gadolinium used until it matches the mass of a terbium-161 production target.
DEVELOPMENT AND IMPACT OF PRECISELY TUNABLE MESOPOROUS SILICA-ENCAPSULATED CORE-SHELL NANOPARTICLES

Primary Author: Ellis Hammond-Pereira
Co-Author(s): 

Faculty Sponsor: Steven Saunders

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

Principal Topic
The field of catalysis is largely dominated by the study of zeolite catalysts; structures which form Angstrom-scale internal pockets. Recent research has shown that nearly all the benefits of zeolites (high activity, high yield of the desired product) are achievable using structures an order of magnitude larger. These larger, mesoporous materials are not only cheaper and easier to produce, but thanks to their tunability also allow fundamental studies of both chemistry and mass transport. In this work, a new method for precisely tuning both pore diameter and pore length is detailed.

Method
Silica-encapsulated core-shell nanoparticles (CSNPs) were synthesized using a seeded growth method. It was hypothesized that decoupling the metal core formation phase from the silica encapsulation phase would allow for the precise tuning of both pore diameter and pore length. Pore diameter was tuned via the addition of organic swelling agents and was characterized via N2 gas adsorption. Pore length was tuned by altering the volume of solvent used in synthesis and characterized using transmission electron microscopy.

The catalytic performance of each batch was then tested by catalyzing the aerobic oxidation of benzyl alcohol. After reacting for 1hr, the conversion and selectivity towards the aldehyde product was measured via gas chromatography.

Results/Implications
It was found that pore diameter increased as a function of swelling agent added, and pore length decreased as a function of reaction volume. Most importantly, tuning one parameter individually did not influence the other, allowing for the precise targeting of a specific pore width and length. It was found that catalysts with longer pores demonstrated higher catalytic activity and selectivity than those with shorter pores, without introducing a mass transport limitation. Widening the pores increased catalytic activity by exposing more of the gold surface, but suffered a decrease in selectivity by allowing larger, undesired products to form. These relationships, along with the orthogonal tunability of the catalyst, position CSNPs as a useful platform for targeting specific balances of yield and selectivity, facilitating both fundamental studies in the lab and large-scale implementations in industry.
A Serial Mediation Model of Consumers’ Environmental Knowledge on Intention to Use: The Central Role of Environmental Contributions of Sidewalk Autonomous Delivery Robots for Online Food Delivery

Primary Author: Jiyoon (Jennifer) Han
Co-Author(s): 

Faculty Sponsor: Jenny Kim

Primary College/Unit: Business
Associated College(s)/Unit(s) Administrative & Information Systems
Campus: Pullman

Abstract:

PRINCIPAL TOPIC
This study discusses sidewalk autonomous delivery robots (SADRs), powered by zero-carbon electricity or solar energy, as the new delivery paradigm to tackle increased road congestion and carbon emission caused by the skyrocketing online food orders. Drawing upon Autonomous Vehicle Acceptance Meta-framework and the norm-activation theory, we examine the environmental mechanisms affecting the consumers’ intention to use SADRs, specifically highlighting the role of perceived SADRs’ environmental contribution.

METHOD
A total of 321 respondents participated in the study via Amazon Mturk. A theoretical serial mediation model was created and tested using the Hayes PROCESS macro with a bias-correcting bootstrapping method. Additionally, multiple regression analysis was conducted to explore influential demographic factors on consumer perception of SADRs’ environmental contribution.

RESULTS/IMPLICATIONS
Serial mediation illustrated that consumers’ environmental knowledge is likely to trigger their awareness of environmental consequences (i.e. seriousness of global warming), next leading them to perceive that SADRs would help reduce congestion and carbon emission, and finally, affecting usage intention. Most importantly, our indirect path results evidenced that consumer perceptions of SADR’s environmental contribution must be positively formulated in advance of trying out the innovation. Demographics including age, income, education, and marital status, except gender, had a significant influence on the perceived environmental contribution of SADRs. The results encourage businesses to emphasize the environmental benefit of SADRs and target eco-pursuing consumer groups by providing more green information, via ESG reports and advertisements. By far, this study is the first to discover the environmental mechanism of SADRs in the food delivery context.
Non-native English-speaking undergraduate student task engagement in a blended writing class

Primary Author: Haixia He
Co-Author(s):

Faculty Sponsor: Joy Egbert

Primary College/Unit: Education
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

The purpose of this case study is to explore how students studying in their second language engage in a blended writing class that employs both synchronous and asynchronous learning strategies and the teacher designs tasks based on an innovative task engagement (TE) framework (Egbert et al., 2022). Accordingly, the major questions of the present study are: 1) How do students perceive their task engagement in a blended writing class?; 2) What facilitates them to engage? The participants were an American instructor and 30 non-native English-speaking undergraduate students in two English writing classes. Data sources include a description of ten writing tasks, ten surveys of online task engagement, and one instructor and 60 student interviews. The descriptive data (open-ended questions and interviews) were coded according to the theoretical framework, and the close-ended questions were analyzed with descriptive statistics. The results indicate that the students strongly perceived the existence of authenticity, learning support, and autonomy in all tasks, moderately perceived the existence of interest and challenge, and somewhat perceived that social interaction existed during these tasks. Authenticity was the most important TE facilitator, which students perceived affected their feeling of engagement. In other words, students were more engaged when the tasks they were doing were meaningful to them and were applicable to their futures. Students also felt engaged when they received more support, had enough time to complete the task, and had more control of their learning. This study has implications for effective teaching across disciplines and future research in task engagement.
Capturing a More Complete Picture: Utilizing UAS Imagery in Genomic Prediction of a Large Scale Wheat Breeding Program

Primary Author: Andrew Herr
Co-Author(s): 
Faculty Sponsor: Arron Carter
Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s) Agricultural & Natural Sciences
Campus: Pullman

Abstract:

Multispectral imaging with unmanned aircraft systems (UAS) is a promising high-throughput phenotyping technology that has been shown to help understand the mechanisms associated with crop productivity. Imaging technology can predict complex agronomic traits like grain yield within a given generation, creating the potential to fast-track selections in plant breeding and increase genetic gains. Spectral reflectance indices (SRI), including both vegetation and water indices like NDVI, NDRE, NWI, as well as secondary HTP traits like percent canopy cover, were all used to evaluate Washington State University winter wheat breeding lines between 2019 and 2022. Data was collected using a DJI Inspire 2 drone, equipped with a Sentera Quad Multispectral Sensor, and collected at antheses. Lines were observed from single location, single replication preliminary yield trials to multi-location, replicated advanced yield trials. The calculated SRIs and canopy cover were used individually and in combination with genomic data in rrBLUP model prediction for grain yield. Prediction Accuracy was evaluated on an omitted year dataset. Established HTP research has shown success when making predictions within year but little research has been done when prediction with large populations across years. Preliminary results show that including SRI data in genomic prediction models improves overall performance in across year prediction, especially when dealing of years with extreme environmental variability. This research is vital for plant breeders to understand the utility of UAS imaging in variety improvement when dealing with abnormal growing seasons and an example of how to implement HTP technology while also improving genomic selection strategies.
Sex differences in the neural circuits that predict alcohol dependence development

**Primary Author:** Kelly Hewitt  
**Co-Author(s):** Skylar Nicholson, Angela Henricks  
**Faculty Sponsor:** Angela Henricks  
**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s)** Medical & Life Sciences  
**Campus:** Pullman

**Abstract:**

Although mechanisms of brain activity underlying alcohol use and dependence have been extensively researched, the observed sex differences in alcohol drinking behavior are poorly understood. Brain areas implicated in decision-making (medial prefrontal cortex, mPFC) and motivated behaviors (nucleus accumbens shell, NAcSh) play a key role in the development of alcohol dependence and we have previously shown that activity from these regions predict drinking behavior in non-dependent male rats, but not female rats. Since women are more likely to report using alcohol to cope with stress, we hypothesize that neural circuits associated with stress may contain more information about female drinking behavior. To test this hypothesis, we measured whether mPFC, NAcSh, and/or central nucleus of the amygdala (CeA) activity could predict alcohol dependence in a sex-specific manner.

Male and female Sprague-Dawley rats were trained to self-administer 10% alcohol for 30 minutes/day, 5 days/week before surgically implanting electrodes targeting the mPFC, NAcSh, and CeA. After recovery, half the rats were made dependent to alcohol through alcohol vapor. Local field potentials (LFPs) were recorded from brain regions during self-administration sessions.

Overall, female rats self-administered more alcohol than males, both pre- and post-inducing alcohol dependence. Alcohol dependence increased alcohol self-administration in both sexes, but to a larger extent in males. Preliminary analysis revealed that NAcSh and mPFC LFPs best predict alcohol dependence in males, while CeA activity best predicted alcohol dependence in females. Our current work aims to determine whether this activity can also predict how much the rats drink in each session as well as when they self-administer alcohol versus all other behaviors. These data provide support that sex differences observed in alcohol drinking behavior could be explained by differences in brain activity. Our overall goal is to identify any potential sex differences in alcohol drinking neurobiology to contribute to the development of more personalized, effective therapies for alcohol dependence in women and men.
Potentiometric detection of quaternary ammonium compounds in environmental samples

Primary Author: Nguyen Ho  
Co-Author(s): Jeffrey Bell  
Faculty Sponsor: Jeffrey Bell  
Primary College/Unit: Arts and Sciences  
Associated College(s)/Unit(s) Engineering & Physical Sciences  
Campus: Pullman

Abstract:

Quaternary ammonium compounds are the most common type of cationic surfactant found in fabric softeners, disinfectants, biocides, detergents, and other products. Most quaternary ammonium compounds are released into wastewater treatment plants after use and become dispersed in various environmental settings. Owing to the global COVID-19 pandemic, quaternary ammonium compounds are being used in significantly larger quantities through hand soap, bleach, and disinfections all over the world. In addition to being hazardous to both aquatic and terrestrial creatures, quaternary ammonium compounds increase the possibility of co-selection of antibiotic-resistant bacteria, which is regarded as a significant issue for the health of both humans and the environment. Herein, we present a low-cost quantitative potentiometric sensor capable of detecting and monitoring quaternary ammonium compounds in various environmental samples.
An Exploration of Workplace Discrimination & Women’s Career Decisions During the COVID-19 Era

Primary Author: Shekinah Hoffman
Co-Author(s):

Faculty Sponsor: Julie Kmec

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

The “Shecession” (Alon, 2021), or large number of women who have lost or left employment during COVID-19, has revived public and academic discussion of professional women’s career shifts and employment departures. While the emerging research on the gendered impact of COVID-19 and existing research on women’s career attainment centers around work-family conflict, my dissertation focuses on the role of workplace discrimination in women’s decisions to leave their jobs and/or shift career pathways. I explore women’s employment departures, job changes, and career shifts during COVID-19, the decision-making processes behind their work transitions, and the impact discrimination may play on their career transitions during this time. As a case study, I focus on the casino gaming industry. Gaming’s historically male-dominated, overtly-sexualized environment makes it a unique cultural context of study, yet few studies on women’s employment in this industry exist. Studying gaming’s distinctive culture may be beneficial to more in-depth understanding of the institutional-level inequities and power dynamics that contribute to gender discrimination in broader business (Jahnukainen, 2010). My critical, intersectional analysis of women’s career attainment is anchored in constructivist grounded theory. I use a collection of 55 pre-COVID-19 interviews with women in gaming management and approximately 30 follow-up interviews during COVID-19 to understand how women’s experiences with workplace discrimination may impact their employment decisions over time. As the first longitudinal, qualitative study exploring the impact of workplace discrimination on women’s employment decisions, my dissertation will help uncover organizational solutions to reducing workplace discrimination and promote improved workplace protections for women.
Perceptions of drinking water quality in a Honduran island community

Primary Author: Madison Honig
Co-Author(s): Aaron Blackwell, Jessica Hlay

Faculty Sponsor: Aaron Blackwell

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

Social stratification limits access to drinking water in Utila, Honduras. Given the island’s limited access to freshwater, most islanders purchase drinking water through private sources or rely on unregulated wells or cisterns. We conducted informal interviews to determine local perceptions of drinking water quality and environmental concerns impacting drinking water safety. All participants noted the lack of information about water quality as no known third-party testing has been conducted on municipal and private water providers. Further, two of the participants reported awareness of agricultural and municipal waste carried via ocean currents and deposited on the beaches and natural coral reefs of Utila, particularly visible after storms. Trash burning occurs every 3-4 weeks which causes smoke to blow east and towards the more densely populated areas of the island. This is of particular concern as well and cisterns for rainwater collection for household water use are open and likely exposed to hazardous particles. Locals have concerns that this is related to increased rates of respiratory illness, and allergies. Stagnant groundwater was also consistently mentioned as a significant source of exposure to pollutants. Domestic raw sewage is carried through open pipe systems that run alongside main roadways. These ditches often flood during rainstorms and enter the low-lying houses nearby. Overall, participants cited flooding of groundwater, trash pollution being carried by ocean currents, trash burning and increased construction on the island as key threats to drinking water quality.
Methylation status of certain genes in cattle sperm involved in embryonic development is impacted by cold exposure.

**Primary Author:** Md Nazmul Hossain  
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**Faculty Sponsor:** Min Du  
**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s)**: Agricultural & Natural Sciences  
**Campus:** Pullman  

**Abstract:**

Exogenous factors such as stress, diet, or exposure to adverse environmental conditions have been demonstrated as factors that alter DNA methylation in sperm and impact spermatogenesis, fertilization, and the expression of certain genes crucial for embryonic and offspring development. Breeding bulls from northern regions of the USA become exposed to extreme cold for 2-3 months during the winter; however, no study has reported the consequences of this cold exposure on cattle sperm methylation, which constitutes a major knowledge gap.  

We aimed to evaluate the effect of cold exposure on the overall and gene-specific methylation status. Frozen semen straws from five bulls were collected for whole-genome bisulfite sequencing after exposure to cold in winter and normal temperature in late spring. Cold exposure didn’t induce a change in the overall methylation level. However, we identified 186 unique genes with different methylation levels, including three imprinted genes (Peg10, Mest, and Snrpn) that express in a parent-of-origin manner. Peg10, an imprinted gene where the maternal allele remains silent, and the paternal allele expresses highly in the placenta, had hypermethylation in the promoter region. As an imprinted gene, this hypermethylation in the promoter region is expected to reduce Peg10 expression from the paternal genome and negatively affect placental development. A zinc finger gene, Znf518b, crucial for maintaining DNA methylation of imprinted genes, was also hypermethylated.  

These results indicate that cold-induced methylation changes may alter their corresponding gene expression in the placenta and fetus and thus generate long-term impacts on the growth and performance of offspring.
Robust to Early Termination Optimization: A Novel Approach to Implement Optimization-Based Control Tasks in Cyber-Physical Systems with Limited Computing Capacity

Primary Author: Mehdi Hosseinzadeh
Co-Author(s):

Faculty Sponsor:

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

A common aspect of today's cyber-physical systems is that multiple optimization-based control tasks may be running on a shared computing platform. Optimization-based controllers usually lead to very good results in terms of performance; however, they are typically computationally expensive. Consequently, the time available for online execution of each control task is limited and may vary over time. This research developed a robust to early termination optimization algorithm for these kinds of applications. Underlying this algorithm is the use of a modified barrier function and the primal-dual gradient flow approach to inform a continuous-time dynamical system whose trajectory converges to the optimal solution exponentially fast, while guaranteed to provide a sub-optimal solution and to maintain feasibility and closed-loop stability if terminated early.

This research advances the field of cyber-physical systems by focusing on methods which address the limitation, variability, and unpredictability of the available computing time for implementing optimization-based controllers in applications where multiple control tasks execute in a shared processor. The research outcomes [1]-[2] provide improved understanding of real-time optimization algorithms which can be terminated at any time instant with a guaranteed sub-optimal and feasible solution, and of the interplay between control, computations and closed-loop properties of systems with fast dynamics.

A systematic review of the Social Amplification of Risk Framework (SARF) in health risk communication research

Primary Author: Ying-Chia Hsu
Co-Author(s): Amanda Boyd

Faculty Sponsor: Amanda Boyd

Primary College/Unit: Communication
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

The Social Amplification of Risk Framework (SARF) explores factors that amplify or attenuate responses to a risk. SARF proposes that people form risk perceptions through dynamic and multi-factor processes. The way how individuals perceive risk can be filtered by stations, e.g., the source of information, information channels, social stations, and individual stations. This systematic review aims to examine how SARF is applied to health research. The review yielded 30 articles that met the inclusion criteria by following the guidelines of systematic reviews (Petticrew & Roberts, 2006). A linear trend indicates that infectious disease studies using SARF have increased over time. Specific events have spurred the use of SARF in health research. Public health crises, e.g., COVID-19, Ebola, Zika, and MERS, with significant harm and affected global populations, prompted more studies using SARF to examine risk perceptions and behaviors. Our analysis also shows that “social stations” are most used in SARF as potential predictors, particularly the role of news media, e.g., the volume of media coverage and the framing style of news reporting. We conclude with the strengths and limitations of SARF and recommendations for future studies.
Factors Associated With Latinx and Non-Latinx White Adolescents Meeting Fruit and Vegetable Intake Recommendations

Primary Author: Anaderi Iniguez  
Co-Author(s): Jane Lanigan  
Faculty Sponsor: Elizabeth Weybright

Primary College/Unit: Agricultural, Human and Natural Resource Sciences  
Associated College(s)/Unit(s) Social Sciences  
Campus: Pullman

Abstract:

Adolescent fruit and vegetable intake (FVI) remains below the national dietary recommendations. The Latinx population experiences disproportionate rates of obesity and chronic diseases (e.g., diabetes). Therefore, the purpose of this study is to investigate what factors may predict meeting FVI intake recommendations among Latinx adolescents living in the state of Washington as FVI is known to be protective against chronic diseases.

A secondary analysis was performed using data from 10th grade students living in Washington state who completed the 2018 Healthy Youth Survey. Variables analyzed as predictors in meeting FVI recommendations included gender, weight status, dietary behaviors, physical activity, screen time, acculturation, maternal education, and income. Non-Latinx White (NLW) adolescents were used as a comparison group. Separate multiple logistic regression analysis were conducted to examine factors that predict meeting FVI recommendations.

The logistic regression model for Latinx adolescents (n=2053) and NLW adolescents (n=6797) were each significant at the p<.05 level. Among Latinx and NLW adolescents the factors with the highest odds of predicting meeting FVI recommendations included daily aerobic activity, engaging in muscle strengthening activity, and eating breakfast. There were some factors that were predictive for NLW adolescents, but not for Latinx adolescents, such as having frequent family meals and meeting screen time recommendations.

Latinx and NLW adolescents shared some similarities and differences in the factors that predicted meeting FVI recommendations. Better understanding dietary behaviors of Latinx adolescents should be a public health priority as it can help inform the design of culturally responsive nutrition education interventions.
Potato Hairy Root System to Study a Soilborne Disease, Powdery Scab

Primary Author: Samodya Jayasinghe  
Co-Author(s): Kiwamu Tanaka, Natalia Moroz

Faculty Sponsor: Kiwamu Tanaka

Primary College/Unit: Agricultural, Human and Natural Resource Sciences  
Associated College(s)/Unit(s): Agricultural & Natural Sciences  
Campus: Pullman

Abstract:

Principal topic: Soilborne plant diseases are challenging to control as aboveground symptoms are not unique and often appear in the later stages of the disease. Thus, preventative approaches, such as soil fumigation and disease-resistant cultivars are recommended to manage soilborne diseases. Potato powdery scab is a significant soilborne disease caused by Spongospora subterranea f. sp. subterranea (Sss). The disease symptoms are root galling and tuber skin scabs which reduce the yield of marketable tubers. Sss also vectors the potato mop-top virus that causes tuber necrosis. Both pathogens reduce the economic value of potato production and impede foreign trade, but effective control methods are not available. Some potato cultivars have varying resistance; however, the underlying mechanism is unknown. Therefore, there is a clear need to develop a system to study the powdery scab disease. Here, we introduce the potato hairy root system as a tool to study the genetic basis of the powdery scab disease.

Methods: Hairy roots were generated from potato plant stems using the tumorigenic bacterium Rhizobium rhizogenes. The hairy roots were inoculated with Sss, and pathogen propagation was confirmed by histochemical and molecular detection. The expression of plant defense-related genes was measured following pathogen infection to assess whether hairy roots respond similarly to intact roots. Finally, transgenic hairy roots were generated using gene overexpression and CRISPR/Cas9 gene-editing technologies.

Results/Implications: We found that Sss propagates in hairy roots, and the gene expression profile in the hairy roots following Sss infection is similar to intact roots. Further, the generation of gene overexpression and gene-edited lines were successful, indicating hairy root system can be used for gene discovery studies to identify genetic resistance in the potato genome. Such knowledge of potato genome would lead to successfully controlling the powdery scab disease that threatens the potato industry worldwide. The hairy root system also includes the advantages of fast growth, direct observation of disease progression, and monitoring of the host-pathogen interaction in the root tissues without environmental interference. Thus, results produced in this system are more reliable. This system could be further modified to help study other soilborne potato diseases as well.
Cortical and Subcortical Contributions to Audiovisual Speech Perception in Stuttering and Autism Spectrum Disorder

**Primary Author:** David Jenson  
**Co-Author(s):** Georgina Lynch, Stephen James

**Faculty Sponsor:**

**Primary College/Unit:** Spokane  
**Associated College(s)/Unit(s)**: Medical & Life Sciences  
**Campus:** Spokane

**Abstract:**

Neural activity in people who stutter (PWS) and those with Autism Spectrum Disorder (ASD) is known to differ from typical control subjects, though these clinical populations have not previously been compared to each other. This presentation reports preliminary data using EEG and pupillometry (measuring pupil diameter) to evaluate top-down and bottom-up contributions to audiovisual speech perception in PWS, adults with ASD, and matched controls. Pupillometry evaluates the integrity of the primary sensory process through the bottom-up contribution of the locus coeruleus – norepinephrine system, while EEG signals evaluate the top-down contributions of the sensorimotor processes which integrates auditory and visual signals. Differences in pupillometry measures were observed between PWS and ASD cohorts, while distinct patterns of EEG activity were observed across all experimental cohorts. Findings are discussed in terms of the underconnectivity hypothesis in ASD, sensorimotor differences in stuttering and ASD, and the distinct contributions of primary and cortically-mediated processes to audiovisual speech processing. These findings have implications for better understanding the efficiency of these systems and development of atypical speech production in both clinical populations.
The Impact of the COVID-19 Pandemic on the Well-being of Rural Cancer Patients in Washington State

**Primary Author:** Patrik Johansson  
**Co-Author(s):** Kimny Sysawang, Anthippy Petras, Magdalena Haakenstad, James Volz, Jennifer Lee, Gina Leipertz, Dedra Buchwald

**Faculty Sponsor:**

**Primary College/Unit:** IREACH  
**Associated College(s)/Unit(s):** Medical & Life Sciences  
**Campus:** IREACH

**Abstract:**

Rural areas contain some of the most vulnerable communities that may be more susceptible to the large-scale impacts from a pandemic. Although reliable data are limited, evidence suggests that COVID-19 disproportionately affects rural residents. Residents in rural areas are not only older in comparison to urban populations suffer from health disparities manifested as greater rates of many chronic diseases, including cancer. The combination of older populations, higher rates of preventable cancers, and less access to care puts rural communities at risk for COVID-19 related health disparities. We conducted a cross-sectional survey of 151 adult rural primary care patients in Washington State with a diagnosis of cancer to examine the impact of COVID-19 on mental and behavioral health well-being, healthcare access, barriers to care, and employment and financial stressors. Results demonstrated that 26% of participants received a cancer diagnosis during the pandemic, 72% reported they tend to bounce back quickly after hard times, excellent care when care appointments rapidly moved to telephone or video visits, and a 13% increase in alcohol and substance use during the COVID-19 pandemic. Findings from our study have provided data to participating primary care practices in rural Washington, that will allow them to adapt existing or identify new programs to best suit the long-term needs of patients with cancer.
Source Seeking Database Usage Patterns for Roots of Contemporary Issues Students

Primary Author: Corey Johnson
Co-Author(s): 

Faculty Sponsor: 

Primary College/Unit: Libraries
Associated College(s)/Unit(s) Liberal Arts & Humanities
Campus: Pullman

Abstract:

Since Fall 2012, Roots of Contemporary Issues (RCI; HISTORY 105/305) has served as the foundational, and only required, course for Washington State University undergraduates. All sections feature a term length individual research project with a scaffolded series of Library Research Assignments and a culminating final research paper or portfolio. Both in Fall 2020 and 2022, the Pullman RCI and History Department librarians surveyed students about resources (databases) they opted to use to find the central materials for the project. The first round of research (n=71) was during the Covid Pandemic, characterized by the physical library closure and hiatus from research instruction workshops. The second round (n=131) was after the library reopening and resumption of research workshops. In addition to pandemic implications, this poster will feature explanations of trends in student database usage for scholarly history monographs, history journal articles, and historical primary sources. Focusing on primary sources, the researchers also learned about the format types sought (e.g., newspaper articles, government documents, personal papers) and self-reported difficulties students experienced in locating effective primary sources. Poster viewers will gain knowledge about the fixed mindset students often display as they misguidedly search a known and trusted database for material types which might not be well represented, or are otherwise challenging to discover in that system. A final factor at play in this research are the student generated research topics/questions, which also affect database selection. Poster readers will get an overall better understanding of student information seeking behaviors.
Plant starch could be a key factor for disease progression of a soilborne disease of potato

Primary Author: Hira Kamal
Co-Author(s): Samodya K. Jayasinghe, Hanu R. Pappu, Kiwamu Tanaka

Faculty Sponsor: Kiwamu Tanaka

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s): Agricultural & Natural Sciences
Campus: Pullman

Abstract:

Potato is the most important vegetable crop worldwide. Potato production in the US, including states of Idaho, Oregon and Washington has been affected by a powdery scab disease caused by the soil-born protist Spongospora subterranea f. sp. subterranea (Sss). The disease symptoms include cosmetic damage to tuber skin and the formation of root galls. Root galls exist in different shades of color, from white to brown, depending on the stage of the disease.
In the present study, a microscopic examination of white and brown galls was carried out using scanning electron microscopy (SEM) and Light microscopy (LM). Microtome sections (~0.5 nm thick) were prepared, and different stains (for starch and cell wall) were used to identify cellular contents for the pathogen and the host.
SEM images revealed that white gall samples possess starch granules to start initiation of the spore ball formation, suggesting that Sss consumed plant starch for spore ball formation concomitantly with tissue swelling for the root gall formation. When the white galls turn into mature brown galls, majority of spore balls were observed without any starch granules. The LM images showed that white gall mostly contained starch grains and amoeboid plasmodia that lacked cell wall and is a precursor form of spore balls, while mature brown gall had abundant spore balls without any starch granules. These results suggest that plant starch could be a key factor for the disease progression and the modification of chemical and physical properties of starch could be a way to manage powdery scab disease.
SELF, IDENTITY, AND ACTIVISM IN THE SHADOW OF SOCIAL MEDIA

Primary Author: Arian Karimitar
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Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

Framework
The social context of youth has expanded by the creation of digital media technologies, which increases the awareness of youths about their interpersonal relationships and their associated roles in different social backgrounds. Social media can serve a vital function in the formation of youth’s self-concept by affecting who they want to be and how they want to interact with others (either online or in-person).

Research Questions
This project examines how engagement with social media influences the formation of self-identity and social activism of Iranian and American youths. This research branches into two studies. One examines how the joint association between social media communication and offline social connectedness influences the development of self-identity among Iranian and American youths. The other investigates the relationships between social media (Instagram Twitter) and Iranian and American youth in their engagement in social movements.

Methodology
The research design includes both mixed methods and digital methods. Mixed methods research design refers to use of both quantitative and qualitative methods for collecting and analyzing data. Digital methods are techniques for investigating societal change and cultural conditions with online data (e.g., internet and communication technologies).

Results
I argue that Iranians are not a passive audience of social media who are mimicking the behaviors and reactions of others they see online toward similar issues. Instead, by accessing media and online social networks, they learn which actions and movements have led to more productive results. Although they may employ the same actions of others they see on social media in social uprisings and movements — using hashtags and making online communities to spread the words — they adapt their behaviors to the context of their society and culture (e.g., censorship, references to historical and cultural stories and icons) and find new ways of safe communication with global audiences to reconstruct global discourses.

Implications
Studying the influence of globalization on social movements via media and social media communications in Iran can contribute to the body of media anthropology studies. Such studies provide more examples of social media studies and policies on participatory visual and digital methods.
Demonstrating the Use of Realist Evaluation Framework to Design Complexity-Responsive Evaluation of a Large-Scale, Positive Youth Development Initiative

**Primary Author:** Konul Karimova  
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**Faculty Sponsor:** Michael Cleveland

**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s):** Social Sciences  
**Campus:** Pullman

**Abstract:**

Evaluating complex multi-site positive youth development initiatives is challenging due to the disconnect between what is deemed rigorous from a research perspective, and what is practical from a community perspective. To address this disconnect we applied a realist evaluation framework, which accommodates the complexities of real-world program implementation, to the WA State Economic Mobility and Responsible Parenting (EMRP) project. The goal of EMRP is to provide parenting resources and education to youth aged 13-25. The realist evaluation approach accounts for contextual factors and mechanisms explaining why and how a program achieves or does not achieve outcomes. Thus, realist evaluations use the context-mechanism-outcomes (CMO) configuration to build and refine initial program theory about what works (O), for whom and under what conditions (C), and how (M).

**Method**

We reviewed project documents and conducted a series of discussions with the core project team, Washington state Division of Child Support partners, curriculum developers and other program implementers to develop a comprehensive evaluation plan of this complex positive youth development program.

**Results/Implications**

We developed a mixed-method evaluation plan including: i) comprehensive pre-post youth assessment, ii) post-module surveys, iii) fidelity survey, iv) implementation survey, v) implementation interviews. These measures will contribute to the understanding of the CMO configuration of the EMRP initial program theory and provide information on what works, for whom, how, and under what circumstances. The next step of this evaluation study is testing the initial program theory using empirical data and refining it for future evaluations.
Enterohemorrhagic Escherichia coli Reduces Mucus and Barrier Integrity in Translational Canine Colonoid-Derived Monolayers

Primary Author: Minae Kawasaki  
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Faculty Sponsor:

Primary College/Unit: Veterinary Medicine  
Associated College(s)/Unit(s) Medical & Life Sciences  
Campus: Pullman

Abstract:

Background: Enterohemorrhagic E. coli (EHEC) can cause acute colitis in dogs, which can lead to hemorrhagic diarrhea and a hemolytic uremic syndrome similar to those in humans. Understanding of the pathophysiology and treatment recommendations are hampered by the lack of translatable in vitro models which effectively reproduce canine and human clinical disease induced by EHEC.

Objectives: To investigate the effects of EHEC on canine intestinal epithelium using organoid-derived monolayers.

Animals and Methods: Colonoid-derived monolayers were developed using intestinal tissues biopsied from two healthy client-owned dogs. The monolayers were challenged with EHEC at 1x10^6 CFU/ml for 24 hours and impacts of EHEC on epithelial cells were evaluated by trans-epithelial electrical resistance (TEER) measurement, immunofluorescence (IF) staining and scanning electron microscopy (SEM). The results were analyzed using Student t-tests.

Results: The TEER declined significantly in EHEC-infected monolayers after 12 hours compared with that noted in the controls (-24.2% vs -6.3%; p<0.05). An impact of EHEC on the cellular integrity was confirmed by 1.8-fold increase in E-cadherin expression per unit area with IF staining (p<0.01). WGA stain confirmed significantly decreased mucus on the EHEC-exposed epithelial surface (-18%, p<0.05). Attaching/effacing lesions characteristic of EHEC infection were confirmed by SEM imaging.

Conclusions and clinical importance: The results recapitulated in vivo observations reported in dogs and humans with EHEC enteropathy, supporting that the canine colonoid-derived monolayer system can serve as a useful translational model to assess the host-pathogen interaction upon exposure to clinically important enteric pathogens such as EHEC.
Emerging zoonotic disease prediction under resource-limited settings: A case study of Kyasanur Forest Disease using event-based surveillance data and transfer learning

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Co-Author(s):

Faculty Sponsor: Lauren Charles

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Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Pullman

Abstract:

Principal topic:
Kyasanur forest disease (KFD) is a tick-borne zoonosis endemic to southern parts of India. This disease is transmitted by ticks to primarily rodents and shrews but will produce high fatalities in humans and other primates. In recent decades, reports of the disease breaking the endemic barriers by spreading to new regions and crossing state boundaries is alarming. Despite its severity, effective disease surveillance and reporting systems are lacking. Hence, developing better prediction approaches for this emerging zoonosis is critical.

Method:
We built time-series prediction models that utilize meteorological data along with Event-Based Surveillance (EBS) information, i.e., news media reports and internet search trends, to predict monthly KFD cases in humans. We fitted Extreme Gradient Boosting (XGB) and Long Short Memory Chain (LSTM) models both at the national and regional levels. At the regional level, we used transfer learning techniques to predict KFD cases in new outbreak locations where the disease information is scarce by utilizing richer epidemiological data from endemic regions.

Results/implications:
Overall, using EBS data in addition to the meteorological data increased the prediction performance across the models substantially. The XGB produced the best predictions both at the national and regional levels. The transfer learning techniques outperformed baseline models in predicting KFD in new outbreak locations. In conclusion, our study demonstrates that the novel sources of data and advanced machine learning approaches could be effectively exploited to increase disease prediction capabilities in data-scarce settings and help inform policymakers to tackle the threats of emerging zoonotic diseases.
Evaluating instream flow augmentation potential via a coordinated irrigation shutdown

Primary Author: Md Redwan Ahmad Khan  
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Primary College/Unit: Agricultural, Human and Natural Resource Sciences  
Associated College(s)/Unit(s) Agricultural & Natural Sciences  
Campus: Pullman

Abstract:

Many watersheds in the Western US are “fully approriated”- i.e, streamflow is fully allocated for multiple out-of-stream (e.g. irrigation, municipal) and instream (e.g., environmental flows for fish) uses under a legal water rights system. In these regions, supporting strategies to reallocate water across uses is critical for ecological and economic well being given climate variability and increasing pressure on limited supplies. Water rights leasing is one option for temporary reallocation of water, but multiple constraints limit their effective use. The “all or nothing” institutional constraint by which only the entirety of a water right can be leased for a full water year is one constraint. Allowing the lease of a part of a water right could expand leasing opportunities. One possible opportunity to augment instream flows to meet the needs of endangered fish species is a coordinated irrigation shutoff in which a group of irrigators leave water instream for short (weeklong) timeframes. Our research question is to evaluate the optimal timing and length of coordinated irrigation shutoff to augment instream flows. We quantified both streamflow augmentation benefits, and associated agricultural costs in terms of reduced crop production under two policy scenarios - forcing and not forcing diversions reductions, utilizing simulations of a Cropping Systems Model, CropSyst, for watersheds in eastern Washington State as a case study. The augmented instream flow was compared with the timing and magnitude of observed streamflow and the critical-need periods for fish to quantify benefits. We founds spatiotemporal differences in the relative augmentation potential (ranging from 0% to over 100%) as a function of the crop mix, irrigated crop area, crop-specific responses to deficit, and the baseline streamflows. Hotspot stream reaches where we can focus efforts on exploring implementation of these strategies were identified. A seven to fifteen day window was determined as ideal for shutdown with minimal impacts on crop yields (less than 10% reduction in yields). The work highlighted the potential benefits of a coordinated irrigation shutdown, but actual implementation can be challenging and institutional changes will need to be explored as a collaborative effort across diverse stakeholders.
How they know what they know and How they Adapt: Understanding Traditional Climate Change Adaptation Strategies of Pastoralists in Central Karakoram

Primary Author: Athar Ali Khan
Co-Author(s):

Faculty Sponsor: Rob Quinlan

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

The recent global warming and climate change is attributed to the extensive use of coal since the dawn of industrialization which has increased the concentration of heat trapping particles of Green House Gases particularly carbon dioxide (CO2) in the atmosphere. The decades of global migrations efforts to arrest GHGs proved to be insufficient. Hence, Climate Change Adaption (CCA) with ongoing mitigations is increasingly suggest. The CCA is costly and complex as it requires tradeoffs in livelihoods in synchrony with changing social, economic and ecological conditions. This study explored that the CCA strategies of agropastoral communities of Central Karakoram in Pakistan are integrated in their culture and livelihood practices involving traditional ecological knowledge (TEK). Data for this research come from participant observation (PO) and interviews of 80 pastoralists, including local experts in agricultural, animal husbandry, pastures, and glaciers. Interviews were focused on the extent, content, and acquisition of climate change knowledge, and use of TEK in decision-making on CCA. The research finds that TEK of agropastoral culture concerning CCA stems from monitoring and measuring of weather-sensitive Biological and Physical Indicators (BPIs). They use difference scale and units to measure changes in Physical Indicators (PIs) including body height, limbs, and permanent features on the ground to gauge snow, rainfall, and water flow in the streams. The Biological Indicators (BIs) include the timing of flowering, leaf shedding and residency period of free-roaming, heat-sensitive yaks in the village. The changes in BPIs are evaluated corresponding Traditional Seasonal Calendar (TSC) in which seasons are subdivided and named after seasonal variations, major seasonal activity, of the response of BPIs to weather. Agropastoral communities in Central Karakoram attribute the observed changes in BPIs over the past five decades to climate change, and the action taken as their response to enhance resilience. In crux, the CCA of agropastoral community in the Karakoram contains sufficient data and empirical knowledge to increase accuracy of climate model to predict climate change, and to protect livelihoods in mountains areas in future scenarios of climate change.
Social intelligence as moderator in the relation between narcissism and aggression in at-risk adolescents

**Primary Author:** Hyunah Kim  
**Co-Author(s):**  

**Faculty Sponsor:** Chris Barry

**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s)** Social Sciences  
**Campus:** Pullman

**Abstract:**

Adolescence is a time characterized by egocentricity while their social relationships extend, and the importance of peers increases. Narcissism is one way that individuals may express egocentricity through a self-presentation of superiority toward others, and consequently, it is associated with antagonistic social behaviors such as aggression. Surprisingly, studies on narcissism in adolescence have been lacking relative to studies on adults, perhaps due to a difficulty in differentiating pathological narcissism from normative self-centeredness in youth. However, narcissism is different from a common self-centeredness tendency in adolescence, and negative consequences of narcissism above also likely increase during adolescence given that their lacks of insight in peer contexts. Meantime, narcissistic individuals are likely to adopt a bistrategic approach in relationships; they prioritize improving their social status by pretending to be cooperative and prosocial under certain circumstances but also show aggressive and coercive interpersonal strategies due to high egocentricity and entitlement. As a result, they may try to adopt better impression management skills, which help them win more favor from others despite their underlying control motivations. In this process, high levels of social skills, knowledge, or awareness, which consist of social intelligence (SI), may promote their bistrategic effort through better social reasoning. Particularly, this maladaptive use of SI would be more notable in relational aggression (RA) given that RA aims to harm others through manipulation of relationships, which needs developed social skills to control interpersonal situations. Taken together, this study explored whether SI moderated the association of narcissism and aggression with at-risk adolescents aged 15 to 19 with multiple hierarchical regression models. To prevent potential self-report bias as well as shared variance across measures, we used both self- (i.e., narcissism) and peer-nominated (i.e., aggression) data but also controlled socially desirable response tendencies in analyses. Results showed that even after controlling social desirability, SI moderated the relation between narcissism and aggression such that SI works as either a risk or protective factor for adolescents with high narcissism depending on the subdimensions of SI and aggression. The findings indicate that SI may play a role in how adolescent peers perceive the behavior of relatively narcissistic individuals.
Quantum Information Transfer in Dutch Windmill Graphs

Primary Author: Paula Kimmerling
Co-Author(s): Judi McDonald

Faculty Sponsor: Judi McDonald

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s): Engineering & Physical Sciences
Campus: Pullman

Abstract:

The computers we know today are so advanced that we can hold them in our hand, and they handle a staggering variety of problems efficiently. We must imagine quantum computers as being at the evolutionary stage of computers from the 1950’s. The hardware is still small-scale and the problems a quantum computer can tackle are limited. The promise remains, however, that just as classical computers began to outpace humans, quantum computers can outpace classical ones on certain problems. We must determine which mathematical structures are most ideal for transferring information in a quantum computer.

Behind both the physics and computer science needed to implement quantum computers, there is mathematics: studying the behavior of matrices and structures called “graphs” which govern how the quantum computer will evolve over time when we press “start”. Quantum computers are also probabilistic in nature, requiring thousands of repeated computations to say with a given confidence that an answer is likely correct. One could ask, “what is the average probability that information transfer will occur between two nodes?”

Our work builds on [1] but focuses on the long-term behavior of a new set of graphs. After generating data -- the averaged probability matrices -- and proving conjectures about properties of those matrices, we can conclude which graphs are better at keeping information localized and which structures are better at transferring information some distance to other nodes.

From the Back Row to Center Stage: New Music for Horn, Tuba, and Piano

Primary Author: Martin King
Co-Author(s): Chris Dickey, Yoon-Wha Roh

Faculty Sponsor:

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Liberal Arts & Humanities
Campus: Pullman

Abstract:

In the musical world, “chamber music” has a hidden meaning. All musicians learned this definition of chamber music when we were quite young: instrumental music played by a small ensemble. However, the term has come to refer to a few standard ensembles: the string quartet, the piano trio (violin, cello, and piano), and, to a lesser extent, the brass quintet and wind quintet. This narrow definition of chamber music has served to exclude the voices of more contemporary composers and more recently invented instruments. In this project, the newly formed Anonim Trio breaks through this outdated narrative by commissioning new music and promoting existing music for horn, tuba, and piano.

In this project, Dr. Martin D. King, horn, Dr. Chris Dickey, tuba, and Dr. Yoon-Wha Roh (piano), commissioned a brand-new work for horn, tuba, and piano by the Ukrainian-Australian composer Catherine Likhuta called Crikey! The ensemble recorded this work along with works by Alec Wilder, Barbara York, David Gillingham, and Trygve Madsen for an album published on Centaur Records. The album was recorded in the WSU Recording Studio by recording engineer Jon Melcher. Titled Anonim, this album is a major contribution to the corpus of recordings for this ensemble. The trio gave performances of this music at the University of Alabama, University of Georgia, Columbus State University, and Washington State University to very receptive audiences at each location.
Osteopathologies of Borealosuchus formidabilis & Their Relevance to Extant Crocodilian Osteopathologies & Behavior

Primary Author: Kimberly Kramer
Co-Author(s): Lane Wallett, Julie Cary, Alex Hastings

Faculty Sponsor:

Primary College/Unit: Veterinary Medicine
Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Pullman

Abstract:

Principle Topic
Crocodilians have well developed social structures and hierarchies, though these hierarchies are predicated on intraspecific agonism. Such agonism often results in soft tissue damage and fractures, predominately via bite wounds. Understanding this behavior is critical in the conservation of these species which often involves housing some small number of animals in zoological facilities. As such limiting intraspecific agonism is vital for maintaining the health of those captive animals.

Method
A more complete understanding of these behaviors may be gleaned from examining historical behavior in now-extinct crocodilians. The extinct crocodilian Borealosuchus formidabilis was selected here as a model for the behavioral evolution of crocodilians. Nearly 200 pathologic bones of B. formidabilis were examined to qualify the nature of their lesions and to begin to unravel the potential social behaviors of this animal. These pathologies included penetrative traumas (bite wounds), osteoproliferation, and healed fractures of bones across the entire skeleton.

Implications/Results
Many of the lesions are present on the limb bones, suggesting intraspecific agonism targeted towards the limbs, which corresponds with observed modern crocodilian behavior today. However there is also evidence for axial body (truncal) injuries, including multiple fractures of gastralia and a bite wound on the interclavicle. These latter pathologies would suggest there is social behavior underpinning them, which is quite different from most modern crocodilians today.
Effects of tropomodulin 2 on dendritic spine reorganization and motility

Primary Author: Balaganesh Kuruba
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Faculty Sponsor: Alla Kostyukova

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Pullman

Abstract:

Neuronal communications occur through a structure between an axon and a dendritic spine termed a synapse. Synaptic plasticity in neurons depend on dendritic spine morphology and the strength of the input. Remodeling of cytoskeletal actin is required for the formation, development, maturation, and reorganization of dendritic spines. Actin filaments are highly dynamic structures with slow-growing (pointed) and fast-growing (barbed) ends. The kinetics of actin polymerization are regulated by the release of actin monomers at the pointed-end which forms the rate-limiting step in actin polymerization. Very few studies have been conducted on the role of pointed-end binding proteins in regulation of dendritic spine morphology.

In this study, we focus on the role played by the pointed-end binding protein, tropomodulin 2 (Tmod2) - a brain-specific isoform, on the post-development dendritic spine re-organization. Tmod2 regulates actin nucleation and polymerization by binding to the pointed-end via actin and tropomyosin (Tpm) binding sites. We studied the effects of Tmod2 overexpression in primary hippocampal neurons on morphology of spines and number of other actin-based structures. We showed that Tmod2 overexpression affected the number and length of the spines. Destroying tropomyosin-binding ability resulted in an increase in the number of excitatory shaft synapses and mobility of thin spines. Eliminating actin-binding abilities of Tmod2 resulted in the increase in the number of mushroom spines. Tpm mediated pointed-end binding sites decreased depolymerization of actin filaments thus suggesting positive spine maturation; the nucleation ability via two actin-binding sites suggests its involvement in formation of excitatory shaft synapses.
A Quality Improvement Project: Mental Health Resources about Adolescent Depression for the Rural School Districts of Washington State

**Primary Author:** Anna Kuznetsov  
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**Faculty Sponsor:** Dawn DePriest  
**Primary College/Unit:** Nursing  
**Associated College(s)/Unit(s):** Social Sciences  
**Campus:** Spokane

**Abstract:**

Principal topic: Rural populations in Washington State, experience significant disparities in mental health outcomes (Morales et al., 2020). Depression rates among adolescents are as high as 35% in 8th grade, 38% in grade 10, and 45% during senior year of high school (Showalter et al., 2019), and thus additional resources are needed to help identify, educate, and provide information about treatment options. The purpose of this project is to present resources about depression to the rural school districts (teachers, staff, students, and parents/guardians) of Washington State and provide various web-based interventions to increase mental-health literacy and access to resources (Hoover & Bostic. 2021; Patel et al., 2007).

**Method:** In the summer of 2022, WSU-CON DNP students and staff were summoned to identify mental-health topics that are vital for the rural communities. Videos were created for the identified populations. Convenient sampling was conveyed through professional networks to recruit educators and staff to complete a pre-video and post-video survey; measuring the increase in education and health literacy via quantitative measures to rate the confidence in providing mental health education. The total number of video views will be recorded. The surveys are de-identified and responses will be recorded through Qualtrics.

**Results/Implications:** This project is in-process. The website domain will be created on WSU-CON’s Homepage (December 2022) and the pre/post survey links will be uploaded with the videos. The desired outcome is for the rural communities of WA state to have access to mental health resources and increase their education about adolescent depression.
Effectiveness of a Modified TIMI Score for Assessing Acute Coronary Syndrome in High Risk Patients

Primary Author: Michael Lee
Co-Author(s): Kevin Zhou, Shyla Carr, James Nania, Ofer Amram, Deanna Jones, Rollie Parish

Faculty Sponsor: Ofer Amram

Primary College/Unit: Elson S Floyd College of Medicine
Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Spokane

Abstract:

Cardiovascular disease is currently the leading cause of death in the United States. In 2020 alone, 1 in every 5 deaths in the United States was attributed to a myocardial infarction (MI), also known as a “heart attack”. Early detection and treatment of a MI significantly reduces morbidity and mortality. There are several types of MI’s all of which can be categorized under the umbrella terminology of acute coronary syndrome (ACS). Current guidelines for emergency medical responders rely heavily upon the use of electrocardiogram (ECG) for the prehospital identification and triage of ACS. This approach is effective for detecting one type of MI known as an ST-Elevated Myocardial Infarction, but it is not a reliable method for detecting non-ST Elevated Myocardial Infarctions which can occur in up to 70% of all ACS cases. In the hospital setting, an assessment tool known as the Thrombolysis in Myocardial Infarction (TIMI) score was developed in combination with the patient’s signs and symptoms, to help providers better assess the patient's need for acute intervention. We designed a retrospective study that aimed to assess the use of a modified TIMI score in the prehospital triage of ACS compared to that of ECG. With 1,300 patients enrolled in this study, our results showed a 6 to 10% improvement in ACS prediction (Both in terms of accuracy and recall) when using the prehospital risk score and ECG together when compared to using ECG only. Future studies are planned to optimize the criteria and data collection.
Impact of European starlings (Sturnus vulgaris) on lactating dairy cow behavior

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**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s):** Agricultural & Natural Sciences  
**Campus:** Pullman  

**Abstract:**

Recent research revealed the significant economic impact invasive European starlings (Sturnus vulgaris) have on U.S. dairy farms by eating and spoiling feed (USD$55/cow annually), but the impact of starlings on dairy cattle behavior and welfare has not been investigated. The goal of our study was to collect preliminary data to discern if lactating dairy cows altered their daily activity time budgets when the number of European starlings present changed, and if any behavior changes had implications for cow welfare. To study this we estimated starling counts at Knott Dairy Center (KDC) during three four-week observation periods in mid-November to mid-December of 2021, March of 2022, and July 2022. Starlings estimates were conducted once a week from 45 minutes before sunset until 20 minutes after sunset by trained observers that counted starlings flying into the freestall barns to roost for the night. Cow behavior data from 180 cows across two pens were recorded using Cow Manager®, an ear tag that measures cow behavior and health by analyzing their movements. The behaviors of interest were inactivity, ruminating, eating, activity, and high activity. Each behavior for was averaged across a two-hour period at sunset that correlated with starling counts. Our results indicated that as starling counts increased, time spent eating (P < 0.0001) and ruminating (P < 0.001) decreased. Reduction in eating and rumination time in dairy cows can lead to metabolic illness, which can reduce welfare. Further research is needed to better understand the impacts of starlings on lactating dairy cow welfare.
Facile vitrimerization of commercial flexible Polyurethane foam (fPUF) toward thermal reprocessability & recyclability

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**Co-Author(s):** Jinwen Zhang

**Faculty Sponsor:**

**Primary College/Unit:** Engineering and Architecture  
**Associated College(s)/Unit(s):** Engineering & Physical Sciences  
**Campus:** Pullman

**Abstract:**

Unlike thermoplastic polymers, there is no easy solution for recycling polyurethane foam (PUF) products because of their crosslinked nature. In this work, we adopted the vitrimer concept in facile modifying PUFs (formulated on a typical recipe in industrial practice) with dynamic covalent bonds in two respective routes: (a) the use of 2-hydroxyethyl disulfide (HEDS, a disulfide diol) in “softening” hard segments; (b) the use of CO2-based polyether carbonate polyol (Cardyon® LC 05, featuring additional renewable merit) to form soft segments. Both routes significantly improved the thermal reprocessability of PUFs in the subsequent compression-molded hot-press process, where PUFs were converted into a compact sheet or film product with great phase uniformity and mechanical properties comparable with existing rubber products. As a successful case of academic-industrial collaboration research, this work is promising in driving applied polymer materials toward sustainability while being cost-effective and highly practical.
Mule Deer Habitat Selection and Migration in an Agricultural Landscape in Southeastern Washington

Primary Author: Rebekah Lumkes  
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Primary College/Unit: Agricultural, Human and Natural Resource Sciences  
Associated College(s)/Unit(s) Agricultural & Natural Sciences  
Campus: Pullman  

Abstract:  
Through rental payments to farmers, the federal Conservation Reserve Program (CRP) has restored millions of hectares of row-crop agriculture to grass and shrublands that benefits many wildlife species across the U.S. Although most often found in more rugged landscapes, mule deer also reside in southeastern Washington, which is dominated by row-crop agriculture intermixed with patches of CRP and native rangelands. Our objectives are to determine how restored crop fields in CRP influence movements and seasonal habitat selection of female mule deer and characteristics of bed sites used by neonates. We acquired GPS locations from 47 adult female mule deer collected from 2018-2022 and measured habitat characteristics at neonatal bed sites. We found that 17 of 47 deer migrated an average of 25.7 km annually, and the rest were residents. Our preliminary Resource Selection Function (RSF) indicated that mule deer on their summer ranges selected for grasslands and CRP land over both actively growing and fallow cropland. Of the 33 neonatal mule deer fawns located thus far, 6% were bedded in agriculture and 79% in CRP or native rangeland. Our next steps are to complete a second field season, develop seasonal second and third order RSFs, characterize habitat associated with migration pathways, and compare characteristics of fawn bed sites to random sites. Our work will provide critical information about the value of CRP to mule deer in shrub-steppe landscapes, important for natural resource agencies, landowners, and legislators when considering support for the CRP program.
Forward or Backward? The Information Content of Insider Trades

**Primary Author:** Yun Ma  
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**Faculty Sponsor:** George Jiang  
**Primary College/Unit:** Business  
**Associated College(s)/Unit(s):** Administrative & Information Systems  
**Campus:** Pullman

**Abstract:**

The literature posits that insiders are contrarians, i.e., buy under-valued stocks but sell over-valued ones. In addition, insider transactions contain superior information about firm fundamentals. In this study, we jointly examine the above hypotheses. We show that insider trades reflect both their beliefs in stock valuation and their information on future cash flows. First, we identify whether a stock is under- or over-valuated and examine the information content of insider trades separately for each subsample. Consistent with the mispricing argument, we find that net insider buys have a strong positive relationship with future stock returns for under-valuated stocks. Second, we examine whether insider transactions contain information about a firm's future performance. Again, consistent with the literature, we find that insider transactions contain superior information on future cash flows. More importantly, we show that insider transactions contain firms' future cash flow information even after controlling firms' past mispricing information. We divide insider transactions into preplanned and non-preplanned based on SEC 10b5-1 rule and perform the above analysis for both types of transactions. We find consistent results among preplanned and non-preplanned insider transactions, which indicate that even preplanned insider transactions contain significant information about firms' future performance.
ObserFur: Quantifying the Changes to Hair Throughout Aging and Development

Primary Author: Jasson Makkar  
Co-Author(s):

Faculty Sponsor: Ryan Driskell

Primary College/Unit: Veterinary Medicine  
Associated College(s)/Unit(s) Medical & Life Sciences  
Campus: Pullman

Abstract:

As the global population continues to age, understanding the mechanisms of aging and how it affects various biological processes has become increasingly crucial. One common hallmark of aging is hair graying and eventual loss. While changes to hair have been observed throughout aging in many animal models, it is difficult and time-consuming to quantify these changes. ObserFur is a machine learning pipeline that can accurately and efficiently assess hair lengths and hair type proportions. This tool will utilize computer vision techniques, such as image segmentation and deep learning, to analyze and make predictions about fur lengths and hair type proportions. Automating the process of collecting these measurements provides a more streamlined and unbiased method for characterizing fur.

By analyzing images of mouse fur at various stages throughout development and aging, this tool will allow for a more comprehensive understanding of how hair growth changes over the lifespan of the mouse. Additionally, the pipeline can be used to study sex differences in hair growth and aging, as research has shown that hair growth can be influenced by sex differentiation. Understanding these changes can provide insights into the underlying mechanisms of hair growth and aging and how they may be influenced by sex. ObserFur aims to significantly improve hair characterization and provide a valuable resource for researchers studying diseases and genetic disorders that impact hair growth and development.
Men without women: The ideology Depicted in the Iran Language Institute Series

Primary Author: Golrokh Maleki
Co-Author(s):

Faculty Sponsor: Margaret Vaughn

Primary College/Unit: Education
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

The present study aims at “reading” the illustrations and pictures used in the ILI English Series. Iran Language Institute, as a private governmental place, is an important institute which had started teaching foreign languages before the Islamic Revolution. The ILI series are compiled, planned and published by its research team, thus analyzing its content can show the path it has taken, and the ideology it depicts for over 200,000 learners countrywide. This study has adopted Kress and van Leeuwen’s framework (2006) to read the images. The results show that gender identity is represented thorough the stereotypical roles, and male characters outnumber females.
The Impact of Putin’s Personality Traits on Russia’s decisions in Ukraine and Karabakh

Primary Author: Abbas Mammadov  
Co-Author(s):  
Faculty Sponsor: John Preston  

Primary College/Unit: Arts and Sciences  
Associated College(s)/Unit(s) Social Sciences  
Campus: Pullman  

Abstract:

The paper examines the personality traits and leadership style of Vladimir Putin, the President of the Russian Federation. Putin is widely regarded as one of the most pragmatic political leaders with a very active foreign policy, especially towards the post-Soviet countries. Russia’s involvement in various conflicts, such as its recent military deployment in Karabakh as a “peacekeeper” and involvement in the ongoing conflict in eastern Ukraine, demonstrate its great power ambitions in the post-Soviet space.

In order to evaluate Russia’s foreign policy decisions in relation to the aforementioned conflicts, the paper focuses on the central political figure, Vladimir Putin, and studies his personality traits through leadership trait analysis (LTA) developed by an American psychologist Margaret Hermann. Interviews with Russian and international media representatives have been used in the analysis of Putin’s leadership profile.

The results demonstrate that Putin is an opportunistic leader who is an open-minded, more strategic type of politician. He focuses on what is possible and feasible at any point in time. Putin has patience in the situation and takes his time to evaluate the case in detail before making any decision. He considers each case individually and aims for the best possible outcome. In short, the main contribution of this article is the incorporation of the analysis of personality traits into a larger body of research that focuses on ideas, habits, and emotions, but ignores the personality traits and leadership styles of key decision makers.
The Experiences of Women Sports Broadcasters

**Primary Author:** Hannah Martian  
**Co-Author(s):**

**Faculty Sponsor:** Yong-Chae Rhee  
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**Associated College(s)/Unit(s):** Social Sciences  
**Campus:** Pullman

**Abstract:**

Previous research has shown that male broadcasters dominate the sports arena. A survey found that as of 2021, only 14.4% of sports reporters were women (Lapchick, 2021). The experiences of women sports reporters have been researched and explored both historically and currently (Hardin & Shain, 2005; Davis Kempton, S., & Connolly-Ahern, C, 2022). However, there is not nearly the same research on the experiences of women working in the narrower field of sports broadcasting, specifically as play-by-play broadcasters for professional sports. While sports broadcasting continues to grow wider and more popular, the number of women working in the field has stagnated largely since the 1970s (Lapchick, 2021). This study examines the experiences of the limited number of women working in sports broadcasting, as well as the hegemonic structures that reinforce traditional ideals about gender which keep women out of the field and from reporting negative experiences.
Novel Brevinin-2 Peptide Design, Prediction, and Synthesis

Primary Author: Colin McDowell
Co-Author(s): Jennifer Horton, Douglas Call

Faculty Sponsor: Douglas Call

Primary College/Unit: Veterinary Medicine
Associated College(s)/Unit(s): Medical & Life Sciences
Campus: Pullman

Abstract:

The Brevinin-2 peptide family exhibits a broad range of antimicrobial activity against Gram-positive and -negative bacteria, including antibiotic-resistant strains. To varying degrees, these peptides are positively charged and spirally shaped with a conserved disulfide Rana-box motif (C-K-X4-C) at the C-terminus. Although electrostatic interactions and the hydrophobic effect are thought to guide the destructive activity of most antimicrobial peptides, the precise mechanism of selectivity remains unclear. Indeed, several factors – such as high experimental toxicity, a poorly conserved sequence, an incomplete understanding of the factors influencing interactions, and a dependence on local environmental conditions – limit the development of these peptides as therapeutic drugs. To investigate the factors guiding the Brevinin-2 – membrane interaction, we designed a set of four novel consensus sequences from the positional residue frequency of 80 natural sequences. We predicted that these consensus sequences were chemically representative using available computational tools. We produced synthetic peptides that maintain the conserved Rana-box motif by employing standard Fmoc solid phase peptide synthesis, reverse-phase fast protein liquid chromatography, and MALDI-TOF mass spectrometry. We will determine critical endpoints as a measure of specificity by quantifying the peptides’ activity against a panel of antibiotic-resistant bacteria, toxicity against erythrocytes, and killing kinetics under different environmental conditions. By concurrently investigating the peptides’ structural criteria and binding mechanism, we will posit the conditions necessary to elicit a specific endpoint. Ultimately, we aim to provide a recursive framework for future Brevinin-2 peptide design capable of predicting peptide specificity and enhancing the development of these peptides as therapeutic drugs.
Replacement of Oil Biosynthetic Enzymes with Foreign Enzymes for Assembly of Novel Seed Oils

Primary Author: Sean McGuire  
Co-Author(s):  
Faculty Sponsor: Phil Bates  
Primary College/Unit: Agricultural, Human and Natural Resource Sciences  
Associated College(s)/Unit(s): Agricultural & Natural Sciences  
Campus: Pullman  

Abstract:  
Principal Topic: Plant oils are energy-dense reserves required for cellular mechanisms in plants; playing important and diverse roles in seed germination and metabolism. Many oils that we consume daily originate from the oilseed agricultural sector, providing the means to combat food, feed, and fuel dilemmas. How plants produce these oils is through a complex metabolic network. This concerted network has many proteins, with one of the most important being diacylglycerol acyltransferase (DGAT1). The substrate selectivity of these proteins dictates the physical/chemical composition of the resultant oil and its potential value. To engineer plant systems that accumulate valuable oils to assist in both feeding the growing population and reducing our dependency on petroleum, we must understand how DGAT1 from various species produce different oil compositions. Here, we hypothesize that we can exchange native DGAT1 with DGAT1 proteins from different species—within a native context of expression—to probe the roles of how different DGAT1s control oil synthesis and composition.  
Method: We aim to understand the roles of proteins in oil accumulation within the model plant, Arabidopsis thaliana. To interrogate the possibility that DGAT1 proteins from other species can carry out oil synthesis in a novel manner, we use a mutant line which contains no activity of DGAT1. From this mutant line we developed a transgenic system, where foreign DGAT1 proteins are expressed under the control of a native promoter. Following seed oil extractions, the oil compositions are analyzed by gas chromatography. The compositions of the transgenic lines are then compared to that of the DGAT1 mutant alone, providing information about the oil synthesis reaction catalyzed by each of the foreign DGATs.  
Results/implications: The results indicate that each transgenic DGAT1 system has unique total oil amounts and compositions, likely representing the substrate preferences of each introduced DGAT1. Additionally, we demonstrate that we have identified a genetic tool by which we can characterize novel DGAT1 proteins involved in oil biosynthesis. In future work we will identify if a perturbation in the oil biosynthetic metabolic network has occurred in each plant line to elucidate how each protein influences and changes oil accumulation dynamics.
The application of permanent magnets for controlling surface modifications of supercapacitor electrodes

Primary Author: William McLeod
Co-Author(s):

Faculty Sponsor: Jeffrey Bell

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

Principal topic
Supercapacitors are energy storage devices useful for their rapid charging and discharging but limited by poor energy density. To increase their total energy storage, electrode conductivity and surface area are often increased. This is achieved with surface modifications such as electrochemical activation, electroactive polymer deposition, or nanoparticle deposition. It has been shown that the application of a constant magnetic field can influence electrode surface process such as these.

Method
In this work, we use a permanent magnet as a zero-energy-input method to control surface modifications of electrodes for improved energy storage. A conductive polymer is deposited onto an electrode using one of three potentiometric techniques: constant potential, swept potential, or pulsed potential. The capacitance of the modified electrodes is measured by cyclic voltammetry in a non-redox-active electrolyte.

Results/implications
When the polymer was deposited under constant potential, no difference was found between electrodes modified with and without a magnetic field. When the polymer was deposited using swept potential, the magnetic field improved the capacitance over electrodes fabricated under no magnetic field. This improvement increased under slower scan rates but decreased again at ultra-slow scan rates. Under pulsed potential, longer pulse and downtime pairs were found to yield the greatest influence from the magnetic field. With an optimized method, the application of a magnetic field increased the electrodes’ capacitance by more than 50% over the control. This suggests a method for more effective modifications of electrodes to yield better energy storage devices without the need for more expensive, energy-intensive processes.
French and American Flute Methods: Case Study Abstract

Primary Author: Kevin Melendez
Co-Author(s):

Faculty Sponsor: Sophia Tegart

Primary College/Unit: Music
Associated College(s)/Unit(s) Liberal Arts & Humanities
Campus: Pullman

Abstract:

The purpose of this study is to examine the differences in pedagogical approach between French flutist Michel Debost and American flutist Thomas Nyfenger, specifically regarding flute fundamentals. These flutists were chosen as representatives of the French and American flute schools respectively. As these informal flute schools are the most prominent in Western flute music, comparing approaches to fundamentals between two flutists’ methods with each is beneficial to flute players and instructors alike.

Two high-school-age students from eastern Washington received instruction in these methods by a graduate student studying flute performance at Washington State University. Over the course of six weeks, each student was led through a series of lessons with methods from their respective pedagogue and were then asked to apply what they had learned to a solo performance. Throughout these lessons, students were assessed on the effect instruction had on their posture, embouchure, tone production, vibrato, and articulation. The instruction itself was also assessed to find differences in how the pedagogues taught fundamentals.

Through this study, a variety of differences were found in how each pedagogue approached teaching fundamentals, how these procedures affected instruction, and how receptive students were to instruction. The study also provided insight into how different methods can be used within the context of a private lesson. This information could prove beneficial to flute instructors who are not familiar with these different schools of thought, and flutists in general who are hoping to diversify their understanding of fundamentals.
Characterization of Neonectriaceae on pome fruit in the Pacific Northwest

Primary Author: Joseph Mellow  
Co-Author(s): Achour Amiri

Faculty Sponsor: Achour Amiri

Primary College/Unit: Agricultural, Human and Natural Resource Sciences  
Associated College(s)/Unit(s) Agricultural & Natural Sciences  
Campus: Wenatchee

Abstract:

Neonectria-like fruit rot (NFR) of pome fruit are known to be caused by fungi in the Neonectria genus (Ascomycota, Hypocreales, Nectriaceae, Nectria, Cynlindrocarpon). This rot has been recently detected in 40% of lots surveyed in the US Pacific Northwest (PNW). Traditionally, Neonectria-like fruit rot are caused by Neonectria ditissima (syn. Nectria galligena) in Europe, South America, and the eastern US. Here, we characterized the species of Neonectria-like fungi that cause NFR on pome fruit in the PNW. Thus, 138 isolates were isolated from decayed apples and pears collected from Washington and Oregon between 2013 and 2018. Isolates were initially grown on potato dextrose agar for 7 days at 23°C and characterized by colony growth pattern and color. Six major phenotypes have been identified, i.e., light orange (n=59), pink (n=16), dark brown (n=33), light brown (n=20), white (n=4), and purple (n=6). Isolates were identified to the species level using $\beta$-tubulin, translation elongation factor, and large subunit ribonucleic acid genes. Assembled nucleotide sequences were generated and Basic Local Alignment Search Tool (BLAST) search was carried out on NCBI. Based on sequencing results, NFR of pome fruit in the PNW may be caused by at least 5 different species from the Neonectriaceae, i.e., Neonectria nigrescens, Neonectria cinnabarina, Neonectria ramulariae, Sarocladium strictum and Fusarium sp. Our results show diversity in the causal species of NFR and indicate potential management and export management if some of these species are found to be quarantined.
Glass Comes Alive in VR

**Primary Author:** Hallie Meredith
**Co-Author(s):**

**Faculty Sponsor:**

**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s):** Visual Arts & Design  
**Campus:** Pullman

**Abstract:**

Glass is a deceptively simple material, ubiquitous in modern life but often overlooked in its significance. Yet it is both ancient and modern, a fusion of visual art, design, engineering, and technology. To explore the many facets of glass and celebrate the United Nations International Year of Glass and generate interest in and to contextualize the museum’s Marian E. Smith glass collection I am organizing public events celebrating glass on 30th August 2023. In collaboration with the WSU Jordan Schnitzer Museum of Art and the Spark, this free one-day event consists of interdisciplinary public talks about ancient and contemporary material and making, with a glass focus, followed by a demonstration by glassblowers from the Tacoma Museum of Glass Mobile Hot Shop.

During the culminating event contemporary glassblowers will experiment with ways to approach production in antiquity by making versions of Roman, Sasanian and early Islamic glass vessels. The experimental objects made will complement the public presentations, particularly the archaeological history of glass talk, which focuses on debates about interpretations concerning the making of ancient glass, embodied learning and its relevance to the study and practice of technology today. In addition, this talk will include 3D printed versions of complex ancient glass vessels designed in VR by the Spark that students and the local community can handle. These interactive models are the focus of my presentation and highlight some of the uses of contemporary digital means to make the past accessible and demonstrate its continued relevance.
WriteSTEM: Virtual Tools to Help Students Improve Their Writing Skills

**Primary Author:** Phil Mixter  
**Co-Authors:** Michael Dunn, Emma Ledbetter, Martina Ederer

**Faculty Sponsor:**

**Primary College/Unit:** Veterinary Medicine  
**Associated College(s)/Unit(s):** Medical & Life Sciences  
**Campus:** WSU-Pullman and WSU-Vancouver

**Abstract:**

Over 75% of US public school students struggle with writing. This challenge persists well into their university education. This study aimed to help upper-division STEM students at Washington State University-Pullman (MBioS 304 and MBioS 430 N=35 [fall only]; N=12 fall 2021, N=9 spring 2022) improve their writing skills through strategic instruction supporting writing transfer and genre awareness. Drs. Mixter, Ederer and Dunn provided course LMS links to writing webtools and offered students access to in-person editing to obtain detailed feedback on their drafts. We asked the questions: What are participants’ perspectives about writing? Does writing quality and content of participants writing improve with use of WriteSTEM? What do students and instructors think about the provided WriteSTEM tools? Our participant demographics represented a diverse mix of gender and race/ethnicity. Survey results indicated that getting answers to student questions about the writing assignment was the most difficult aspect of writing, followed by spelling, editing, and finding source texts. Several students (N=8) participated in a 1:1 interview assessing their writing strengths and weaknesses, identifying which writing resources were helpful and how these resources could improve. However, most students started a writing assignment close to the due date of the assignment and relied on their own writing skills leaving little time for personalized feedback. Students may ask for peer feedback and liked using Grammarly. Analyses of the assignments completed with editor feedback continues. We expect that quality of writing and content of submissions from students who participate in the intervention will improve.
Application of Drones in Fight Against Pandemics: The Case of Monitoring Social Distance Policies During COVID-19 Era

Primary Author: Amir Hossein Moadab  
Co-Author(s): Chuck Munson

Faculty Sponsor: Chuck Munson

Primary College/Unit: Business  
Associated College(s)/Unit(s): Business  
Campus: Pullman

Abstract:

Due to the new global pandemic, known as coronavirus disease, 2019 (COVID-19), governments decide to make some policies such as social distancing rules to control the situation. This decision put governments into a harsh condition in which they must allocate resources such as police officers to implement this policy. Drone as an emerging technology came to avoid not jeopardizing the life of police officers by monitoring the crowded places as best as they can. In this technical paper, a novel Mixed-Integer programming (MIP) model for location allocation routing problem has been provided in which, police officers locate in a potential place and operate drones to visit some point of interests which people might gather for shopping or entertaining purposes. During their visit, drones can come back to the police officer settlements and charge their battery so that they can continue their operation. Finally, The real case of Babolsar, Iran, has been tested to validate the model.
Survival, Growth, and Toxin Production of Bacillus cereus during Cooking and Storage of Fresh Rice Noodles

**Primary Author:** Barakatullah Mohammadi  
**Co-Author(s):** Stephanie Smith  
**Faculty Sponsor:** Stephanie Smith

**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s):** Agricultural & Natural Sciences  
**Campus:** Pullman

**Abstract:**

Introduction: Stores maintain fresh rice noodles (FRN) at room temperature because refrigeration negatively impacts texture. The room temperature and high water activity of FRNs help spore-forming B. cereus to grow and produce toxins. The effects of steam cooking on survival and storage temperatures on the growth and enterotoxins production of B. cereus in FRN were investigated.

Methods: White rice flour (uninoculated, inoculated with 4.0 log CFU/ml, and autoclaved as a negative control) was used to make FRN. A slurry of rice flour and cornstarch was steam cooked for 4 min at 90°C and incubated for 7 days at 4°C, and for 3 days at 22°C and 32°C. Incubated FRNs were tested for pH, B. cereus growth, and enterotoxins production.

Results: Steam cooking reduced 0.5 log CFU/g of B. cereus spores. Surviving B. cereus spores in FRNs that were made with inoculated and uninoculated flour, germinated over 3 days of storage. No B. cereus was detected in negative controls. The B. cereus population in uninoculated FRNs increased by more than 7.0 log CFU/g at 22°C and 32°C over 72 h, while inoculated FRNs showed a 5.0 log bacterial increase at these storage temperatures. No growth was observed at 4°C in both inoculated and uninoculated FRNs. The pH of inoculated and uninoculated FRNs was reduced from 7.0 to 5.5 at 32°C and 6.3 at 22°C. B. cereus in inoculated FRNs produced enterotoxins over 12 h of storage at 22 and 32°C, and in the uninoculated FRNs after 2 days at 22°C and 3 days at 32°C.

Significance: FRNs are safe to eat one day after preparation; however, further research should investigate the effect of other foodborne pathogens on these products.
Human respiratory syncytial virus activates beta-catenin pathway in lung epithelial cells to regulate pro-inflammatory response

Primary Author: Indira Mohanty
Co-Author(s):

Faculty Sponsor: Santanu Bose

Primary College/Unit: Veterinary Medicine
Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Pullman

Abstract:

Respiratory Syncytial Virus (RSV) is a non-segmented negative-sense RNA virus belonging to the paramyxovirus family. RSV infects respiratory tract to cause pneumonia and bronchiolitis in infants, elderly, and immunocompromised patients. Effective clinical therapeutic options and vaccine to combat RSV infection are still lacking. Therefore, to develop effective therapeutic interventions, it is imperative to understand virus-host interactions during RSV infection. Canonical Wnt/beta-catenin pathway is a well-established signaling cascade regulating expression of Wnt target genes involved in various biological and physiological functions. Our study shows RSV infection of human lung epithelial A549 cells triggering stabilization of beta-catenin protein and subsequent activation of beta-catenin mediated transcriptional activity. Further studies with beta-catenin inhibitors and beta-catenin lacking cells revealed a role of beta-catenin in positively regulating pro-inflammatory response in RSV infected A549 cells. Activation of beta-catenin during RSV infection was mediated by cell surface receptor complex comprising of frizzled receptors and low-density lipoprotein receptor-related protein 5 and 6 (LRP5 and LRP6). Thus, our studies have revealed an involvement of beta-catenin pathway in inducing pro-inflammatory response during RSV infection. The mechanism(s) and host derived factors regulating RSV-mediated beta-catenin activation will be discussed.

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The perceived risks and benefits of cookie technology on fashion e-commerce platforms

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Co-Author(s): Jihyeong Son  
Faculty Sponsor: Jihyeong Son  
Primary College/Unit: Agricultural, Human and Natural Resource Sciences  
Associated College(s)/Unit(s): Visual Arts & Design  
Campus: Pullman

Abstract:

Globally, e-commerce sales are flourishing, projected to increase by 56 percent, reaching 8.1 trillion dollars by 2026 (Chevalier, 2022). However, there is a lack of research on how e-retailers’ use of the information consumer provide impacts consumers’ purchase intention, although six out of ten consumers in the U.S. believe that their online activities are surveilled (Auxier et al., 2020). For example, cookies tracking and recalling consumer information disclosed on their web browser, distract consumers’ engagement in e-commerce platforms. Therefore, the study aimed to investigate that perceived risks (i.e., personalization risk, privacy concerns, security risk) and benefits (i.e., personalization benefits, trust, control, convenience) of cookie technology on fashion e-commerce platforms influence consumers’ attitudes and purchase intentions with the social exchange and privacy-calculus theories. Quantitative data was collected by online survey. With multiple regression tests, 45 student samples collected in a University located in Pacific Northwest revealed that security risk negatively influences the consumer's attitude towards using a fashion e-commerce platform, whereas perceived trust and convenience positively affect the consumers’ attitude. Furthermore, consumers' attitudes towards cookie technology influenced purchase intention in fashion e-commerce platforms. With the importance of security risk and perceived trust, retailers should consider how to build consumers' trust toward cookies and treat the information collected by cookies securely. By improving the convenience of the service, the consumers will have a positive attitude toward cookies and make more purchases. Therefore, this study recommends that retailers optimize cookies application and that consumers stay vigilant with their information on fashion e-commerce platforms.
Electrochemical Synthesis of U(IV): Investigating Nuclear Waste-Stream Evolution

Primary Author: Liane Moreau
Co-Author(s): Jeffrey Bell, Dalton Glasco

Faculty Sponsor:

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

Nuclear energy presents an efficient route to diminish the carbon footprint that has become such a concern in the context of climate change. We cannot, however, ignore the challenges associated with nuclear waste storage and environmental remediation. It is critical to understand the chemistry that governs how uranium, the radioactive element that constitutes nuclear fuel, moves through the environment and contaminates water-based environmental systems. Specifically, uranium tends to have enhanced mobility when it persists UO$_2^{2+}$ than when it is immobilized as U(IV). Our work aims to interrogate the conditions under which uranium is more easily reduced to immobile U(IV).

Uranium reduction from UO$_2^{2+}$ to create immobilized films was investigated using electrochemistry. Initially, UO$_2^{2+}$ was reduced in oxygen-free water, which mimics environmental conditions under which bacteria have been able to form U(IV). The uranium deposited on glassy carbon electrodes formed a blue film that is particularly intriguing due to its association with a form of uranium that is not typically stable. Interestingly, we find that when different electrode materials are used, film deposition and optical properties are altered. Structural and electrochemical characterization will enable us to correlate the substrate chemistry with the formed films. Our approach enables us to use a simple, lab-based synthesis and characterization strategy to derive how individual environmental signatures affect the mobility of radioactive uranium through the reduction onto a substrate. Such knowledge will propel us to propose remediation strategies in a site-specific manner to better inform waste storage processes to enable widespread use of nuclear energy.
Qlispe Math: 4-H After School Program at the Kalispel Reservation

Primary Author: Tracy Morgan
Co-Author(s): Nancy Deringer, Catherine Glen, Christine King, Melinda McCormick, Vicki Leach

Faculty Sponsor:

Primary College/Unit: Extension
Associated College(s)/Unit(s): Social Sciences
Campus: Tribal Extension office - Kalispel Reservation

Abstract:

Many school-aged students faced academic setbacks from prolonged interruption in school attendance from the pandemic. The Kalispel Reservation is situated in NE Washington and has children for half a day at the Salish Language Immersion School, and the other half in the public school. The tribe is responsible for meeting math standards for the k-5th grade students. WSU Extension has partnered with the tribe to bring up grade levels using an after-school math program partnered with social emotional learning techniques. The daily program involved three ‘stations’: homework, math facts, and math games. Tools for COVID-induced social and math anxiety, staff are utilizing social emotional ethical learning techniques (SEEL, Emory University, another state standard). With the help of a child psychologist, we also customize our approach for individuals. All youth entered the program at least one year behind their age group. Metrics are restricted to progress charts showing the children which facts and standards they have mastered. All students have progressed. One home-schooled 2nd grader started unable to read any numbers and within 10 weeks is now doing both addition and some subtraction. Several others have moved beyond adding and subtracting to more complex math within two months; at least one student is in line to exceed their grade standards by end of year. This pilot project is showing encouraging signs of increasing math literacy and meeting state standards while reducing trauma induced by reintroduction to the classroom setting.
Genetically engineered rhizospheric bacteria for plant protection against a soilborne disease

Primary Author: Natalia Moroz  
Co-Author(s): Benjamin Colvin, Cynthia Gleason, Kiwamu Tanaka

Faculty Sponsor:

Primary College/Unit: Agricultural, Human and Natural Resource Sciences  
Associated College(s)/Unit(s): Agricultural & Natural Sciences  
Campus: Pullman

Abstract:

Bacillus subtilis is a well-studied gram-positive bacterium, naturally found in soil, known to colonize plant roots, and has been used as a biocontrol agent. It’s an important industrial organism, being proficient at secreting proteins and making small chemicals. We tested a genetically modified B. subtilis that releases an immunostimulant for plant protection against a soilborne disease. Powdery scab is a potato disease caused by the obligate protozoan Spongospora subterranea f. sp. subterranea (Sss). This pathogen promotes cosmetic damage to tuber skin, formation of galls on roots, and reduction in yield. Sss is also known as the vector for potato mop-top virus, which causes tuber necrosis and is a quarantine virus in some countries. Despite many efforts, effective fungicides and fumigation treatments have not yet been developed. Current disease management is mainly preventative through the use of disease-free seed tubers and noncontaminated fields. Here, we evaluated an immunostimulant-delivering B. subtilis for powdery scab disease using hairy root cultures and pot-grown potato plants. The engineered B. subtilis strain secretes an immunostimulant peptide, StPep1, which is anticipated to trigger plant immune response at early steps of the pathogen infection and reduce the plant damage caused by the pathogens. First, we found that the potato peptide elicitor StPep1 directly suppressed Sss infection in potato hairy root culture. Second, the pretreatment of potato roots with the StPep1-secreting bacteria substantially reduced the disease symptoms, i.e., root galling and tuber skin scabs. Our results demonstrated that engineered bacteria can be an effective strategy for the disease management.
Quantum mechanical scattering from the perspective of trapped atoms

Primary Author: Annesh Mukhopadhyay
Co-Author(s):

Faculty Sponsor: Peter Engels

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

The physical world that we perceive in our everyday lives is governed by the laws of classical physics. On an atomic scale, however, these classical laws become invalid. In order to understand how individual particles interact on the most fundamental level, new laws of physics, given by the theory of quantum mechanics, must be used. These laws are often counterintuitive and lead to surprising predictions.

In our lab, we study quantum mechanics using an exotic form of matter, known as a Bose-Einstein condensate, as a well-controlled model system. By laser cooling and related techniques, we cool clouds of atoms to ultracold temperatures very close to absolute zero (-460 deg F). At these temperatures, the clouds fully turn into quantum matter and display quantum dynamics on a macroscopic scale.

The present project combines experimental and theoretical techniques to investigate the quantum mechanical scattering between two particles as a building block to comprehend more complex many-body dynamics. To induce scattering, a fraction of the atoms in a Bose-Einstein condensate is accelerated by applying a brief laser pulse. Images of the resulting atomic clouds reveal intriguing dynamics, such as scattering halos and multiple scattering cascades.

Our experiments provide significant benchmark data for the development of advanced theories of quantum dynamics. The understanding gained is essential for the development of future applications in quantum technologies such as quantum sensing, computation, and more.

In conclusion, our work demonstrates how ultracold gases can play a key role in the development of an understanding of complex quantum dynamics by providing essential benchmark data for advanced theories.

Acknowledgment: This work is supported by NSF under grants PHY-1912540 and PHY-2110158.
Examining the triarchic model of grit as a protective factor against narcissism and psychopathy in at-risk adolescents

Primary Author: Mac Murphy
Co-Author(s): Chris Barry, Hyunah Kim

Faculty Sponsor: Chris Barry

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Social Sciences
Campus: Pullman

Abstract:

Principle topic:
Grit is an individual attribute that combines passion, or consistency of interest, and perseverance for long-term goals (Duckworth et al., 2007). It was developed as a non-cognitive explanation for differences in long-term effort and success aside from talent. A meta-analysis has questioned the impact of grit on success and whether the consistency of interest factor has criterion validity (Credé et al., 2017). Adding an adaptability construct might be more inclusive of collectivist cultures because it allows for sensitivity to situational demands and a context-sensitive self. Datu et al. (2017) developed and refined the Triarchic Model of Grit Scale (TMGS) using factor analysis to confirm inclusion of the consistency of interest factor and experimentally support the conceptual inclusion of adaptability. Grit has shown protective effects against a variety of negative outcomes. Psychopathy and narcissism were included in this study because they have been linked with adolescent externalizing behavior (e.g., Barry et al., 2007; Farina et al., 2018).

Method:
The sample consisted of 85 participants ages 16-19 recruited from a 22-week quasi-military residential program. Participants completed the Triarchic Model of Grit Scale (TMGS; Datu et al., 2017), the Antisocial Process Screening Device (APSD; Frick & Hare, 2001), the Narcissistic Personality Inventory (NPI-16; Ames, Rose, & Anderson, 2006), the Hypersensitive Narcissism Scale (HSNS; Hendin & Cheek, 1997), and the Balanced Inventory of Desirable Responding (BIDR-16; Hart et al., 2015).

Results/implications:
Perseverance correlated positively with social desirability (r = .24, p = .03) and negatively with psychopathy (r = -.30, p = .005). Similarly, adaptability correlated positively with social desirability (r = .23, p = .03) and negatively with psychopathy (r = -.23, p = .03). Consistency of interest correlated positively with vulnerable narcissism (r = .22, p = .04) and negatively with social desirability (r = .42, p < .001). Perseverance and adaptability had more similar correlates with each other than either did with consistency of interest. Different aspects of grit are related to lower levels of psychopathy and narcissism. Future research should determine whether grit serves as a protective factor against delinquent behaviors and other problematic outcomes for at-risk youth.
Increasing supplemental energy levels in a tropical environment affects the performance of grazing beef cattle in the rearing phase

Primary Author: Luiza N.C. Silva
Co-Authors: Robert E. Mora-luna, Daniel H.S. Tavares, Mirelle M. Souza, Giulia B.C. Leite, Icaro R.R. Castro, Isabela F. Carrari, José N.M. Neiva, Fabricia R.C. Miotto, Marcos I. Marcondes

Faculty Sponsor:

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s): Agricultural & Natural Sciences
Campus: Pullman

Abstract:

We aimed to evaluate the effects of increasing energy supplementation on the performance of grazing beef cattle during the rearing phase in a tropical pasture. The project was developed at the Tocantins Federal University in northern Brazil. The treatments consisted of the evaluation of supplements composed of whole grain corn and protein pellet with increasing energy supply while maintaining protein intake from the supplement: T1 - Concentrated feed composed 100% of protein pellet; T2 - Concentrate composed of 50% protein pellet and 50% corn; T3 - Concentrate composed of 34% protein pellet and 66% corn; T4 – Concentrated diet in the proportion of 25% of protein pellet and 75% corn. A completely randomized design was used with four treatments and two sets of paddocks. The experimental grazing area comprised 4 hectares of pasture formed with Megathyrsus maximus grass cv. Mombasa. The data were submitted for analysis of variance following a completely randomized design. The treatment effects were evaluated with polynomial orthogonal contrast for linear and quadratic effects using a 5% probability level. Performance and DM intake increased linearly as energy supplementation increased (P < 0.050). The same behavior was observed for final body weight (P = 0.041), total weight gain (P = 0.021), average daily gain (P = 0.021), stocking density (animals/hectare; P< 0.001), and total weight gain per ha/day (P = 0.001). Therefore, providing supplementation with a higher proportion of corn can be helpful as a strategy to reduce the duration of the rearing phase.
Canine patient-derived gallbladder organoids for personalized gallbladder mucocele modelling and drug screening

Primary Author: Itsuma Nagao
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Faculty Sponsor: Yoko Ambrosini

Primary College/Unit: Veterinary Medicine
Associated College(s)/Unit(s): Medical & Life Sciences
Campus: Pullman

Abstract:

Background: Gallbladder mucocele (GBM) is one of the most common diseases of the gallbladder in dogs. The pathogenesis of GBM is unclear due to lack of appropriate in vitro models. Recently, organoid technology has been applied in the gallbladder from humans, mice, and pigs as a novel in vitro disease model.

Hypothesis/Objectives: To develop, characterize, and assess the functions of a gallbladder organoid (GBO) in dogs with GBM.

Animals: GBOs were derived from gallbladder tissues isolated from one client-owned dog undergoing cholecystectomy.

Methods: Surgically removed gallbladder was treated with trypsin to collect stem cells, which were then embedded in Matrigel to form GBOs. Phase-contrast imaging and immunofluorescence (IF) were utilized to evaluate the size, morphology, and protein expression in GBOs. The function of cystic fibrosis transmembrane conductance regulator (CFTR), an ion channel mainly expressed in the gallbladder, was examined using Forskolin-induced swelling assay. Results were evaluated by Mann–Whitney U test.

Results: Successful GBO development and maintenance were achieved. Phase-contrast imaging demonstrated the budding structure of the organoids which were similar to what has been reported with the organoids from Cystic Fibrosis. IF staining revealed expression of epithelial cell marker and tight junction proteins. Furthermore, the Forskolin-induced swelling assay demonstrated that GBOs hold functional CFTR (2.2-fold swelling after 2 hours; p<0.01).

Conclusions and clinical importance: We demonstrated a successful development of GBOs from a dog with GBM. Our novel GBO model can serve as a useful ex vivo system for GBM pathophysiology investigation as well as pharmaceutical drug transport studies.
Function versus Appearance: The Consequences of How Large-Bodied Individuals are Portrayed by Marketers

**Primary Author:** Deepika Naidu  
**Co-Author(s):** Andrew Perkins, Elizabeth Howlett  
**Faculty Sponsor:** Andrew Perkins

**Primary College/Unit:** Business  
**Associated College(s)/Unit(s):** Administrative & Information Systems  
**Campus:** Pullman

**Abstract:**

Principal topic:  
In response to consumer demand for diverse body size representation, marketers have been increasingly featuring large-bodied individuals in their advertising. Since the average American woman is between sizes 16 and 18, large-bodied individuals are more representative of the average consumer; however, extant research provides inconsistent findings on how featuring large-bodied individuals in marketing influences consumers' behavior. Combining the social comparison, body image, and dehumanization literatures, the current research seeks to identify a way that marketers can feature large-bodied individuals in health-related advertising without negatively impacting consumers' intentions to purchase the advertised product.

**Method:**
We conducted five online experimental studies that manipulated the marketing message accompanying images of large-bodied individuals in health-related advertisements. The marketing messages were framed to focus either on the body as a process (BAP), which emphasizes how the body functions, or the body as an object (BAO), which emphasizes how the body looks. After viewing one of the two advertisements, participants completed existing measures of perceived humanness and purchase intentions. Across the five studies, we used four different large-bodied individuals and three different health-related products (gym membership, fitness tracker, and multivitamin dietary supplements) to generalize our findings. To analyze our results, we ran t-tests and PROCESS to test how pairing BAP (vs. BAO) marketing messages with large-bodied individuals in health-related advertising influences consumers' perceived humanness and purchase intentions.

**Results/Implications:**
The results of these studies suggest that pairing images of large-bodied individuals with BAP (versus BAO) marketing messages in health-related advertising increases women and gay men consumers' perceived humanness and purchase intentions, but these effects do not hold among straight men. Our research studies a current marketplace practice – pairing images of large-bodied individuals with appearance-focused messaging in health-related advertising – and uncovers that this practice is hurting consumers’ purchase intentions. Our research suggests that pairing images of large-bodied individuals in health-related advertising with functionality-focused messaging increases consumers’ purchase intentions. Furthermore, our research underscores the importance of not just featuring diverse individuals who have historically been excluded from advertising but doing so in a way that does not negatively impact consumers’ purchase intentions.
Factors Influencing Instrumental Birth Rates: An Evidence-Based Project

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Faculty Sponsor:

Primary College/Unit: Medicine  
Associated College(s)/Unit(s): Medical & Life Sciences  
Campus: Spokane

Abstract:

Between 5% and 20% of all births are instrumentally assisted, posing risks to the parturient woman and neonate. For example, the woman may experience increased vaginal and perineal tearing and damage, anal sphincter injury, hematomas, or long-term damage to the pelvic muscles. The neonate may suffer fractures and damage to the skull, facial nerve damage, or death. Factors known to increase the risk for this procedure include pre-birth use of analgesics and prolonged active labor. It is important to quantify the rate of this incident and associated factors in our facilities to provide the best care for our patients.

This project utilized data retrospectively extracted from the electronic medical records of hospital accounts at either a 650-bed medical center or a 200-bed community-based hospital in Eastern Washington. Data were included from hospital encounters of parturient women presenting for live, vaginal birth between October 2017 – October 2022 who were at least 18 years of age at the time of admission with a gestational age between 35.0 to 42.0 weeks.

A total of 16,612 encounters met criteria for analysis, n=823 (5%) had documentation of an instrument-assisted birth. Bivariate analyses suggested that cases receiving an instrument-assisted birth had significantly longer time from admission to birth (17.8h versus 14.1 h, p<0.001). Additionally, proportionally more women with instrument-assisted births were parity less than one (67.2% versus 35.9%, p<0.001) and were administered a pre-birth analgesic as follows: CLE (91.2% versus 80.2%, p<0.001), opioid (12.6% versus 5.9%, p<0.001), and acetaminophen (20.1% versus 11%, p<0.001).
Comparisons of Amputations and Limb Salvage during the Global War on Terror: A Systematic Review and Meta-Analysis

Primary Author: Ryoma Nichols
Co-Author(s): Alexander Pursel, Kristina Lindquist

Faculty Sponsor:

Primary College/Unit: Spokane
Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Spokane

Abstract:

Advances in trauma care, evacuation, and protective equipment have contributed greatly to survivability of combat wounds during the Global War on Terror. With greater survivability and the blast mechanism of injury that defined this war came a greater need to consider implications of amputations. Several notable efforts to define differences in outcomes and inform decision making have been undertaken, but there is still no clear guideline for healthcare providers when considering procedures to save limb versus amputation. The aim of this meta-analysis was to identify differences in outcomes between American combat amputees and their peers who undergo limb salvage following their injury.

An extensive literature search was conducted in July 2022 using PubMed, EMBASE, CINAHL Complete, MEDLINE, and Web of Science. Included studies consisted of comparative groups of combat amputees and combat casualties who underwent limb salvage. Study appraisal was conducted using the CASP checklist. Meta-analysis was conducted via forest plots, relative risk (limb salvage/amputation) within a 95% confidence interval, and intertrial heterogeneity (I2).

Some differences in mental health outcomes, such as PTSD, adjustment disorder, and substance abuse disorders were found. Complications such as anemia, infection, DVT/PE, heterotopic ossification, non-healing wound, and non-union fracture were more common in amputees. Differences in these outcomes are worth considering at various points in the management of severe extremity injuries that may require limb salvage efforts or amputation.
PRENATAL N-ACETYLCYSTEINE PREVENTS MATERNAL IMMUNE ACTIVATION INDUCED CHANGES IN ALCOHOL SELF-ADMINISTRATION IN A SEX SPECIFIC MANNER

Primary Author: Skylar Nicholson  
Co-Author(s): Kelly Hewitt, Angela Henricks  
Faculty Sponsor: Angela Henricks

Primary College/Unit: Arts and Sciences  
Associated College(s)/Unit(s): Medical & Life Sciences  
Campus: Pullman

Abstract:

Prenatal exposure to infection is a risk factor in the development of several psychological disorders, including schizophrenia and depression. These disorders often co-occur with alcohol misuse which leads to adverse outcomes, including increased hospitalization and mortality. Despite these consequences, little is understood regarding the mechanisms of how prenatal exposure to infection impacts brain development, which inhibits our ability to create effective therapies. We have previously demonstrated that maternal immune activation (MIA), a rodent model of prenatal exposure to infection, combined with adolescent alcohol exposure (AE) leads to enhanced home-cage drinking and disrupts normal brain activity in adult offspring. The current project aims to determine whether the anti-oxidant n-acetylcysteine (NAC) may be effective in preventing the effect of MIA on adult drinking behavior.

MIA was induced in pregnant Sprague-Dawley rats through exposure to poly(I:C) (4mg/kg) or saline on gestational day 15. Additionally, rats were exposed to NAC (100 mg/kg) or saline 24 hours before and after MIA treatment. During adolescence, offspring were given 24-hour home cage access to 10% ethanol (AE) using a two-bottle choice technique. In adulthood, rats were trained to press an active lever to self-administer 10% ethanol for 30-minutes, 5 days per week. Our data suggest that alcohol self-administration is reduced in MIA females, while MIA males demonstrate a small increase in self-administration and a preference for the active vs. inactive lever. Furthermore, our results show that prenatal NAC exposure normalizes these MIA-induced changes in drinking behavior in both sexes.

These data indicate that stress contributes to changes in alcohol drinking behavior in the MIA offspring. To better understand the neurobiological underpinnings of these changes in behavior, our current work investigates how MIA and/or AE might affect brain development by measuring dendritic spine density in adulthood. Overall, these data demonstrate the utility of NAC in decreasing alcohol intake in this model and provide support for a mechanism by which MIA alters drinking behavior in adult offspring. Additionally, our ongoing work may uncover further neurobiological targets for therapeutic development by identifying synaptic changes that occur as a result of MIA and/or AE.
A Qualitative Exploration of the Relationship Between Cannabis and Sex Among Young Adults

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**Faculty Sponsor:** Jessica Willoughby

**Primary College/Unit:** Communication  
**Associated College(s)/Unit(s):** Social Sciences  
**Campus:** Pullman

**Abstract:**

With the legalization of cannabis recreationally growing across the country, there is more and more cannabis advertising on social media. Young adults use social media often, and the literature on alcohol suggests that sex appeal is often used as a marketing strategy. Knowing that young adults may be faced with these advertisements more commonly, it is important to understand how this may impact sexual health decision-making. Therefore, the goal of this study was to examine the effects of cannabis advertising on young adults to better understand their attitudes and intentions to use cannabis prior to sexual activity.

Using in-depth interviews, our sample consisted of 9 participants who had used cannabis prior to sexual activity. Participants were asked questions about their experiences with cannabis and sex, media portrayals of similar experiences, as well as their feedback on social media posts that are about cannabis and sex.

Results show that sexual activity under the influence of cannabis differed from having sex sober in that they felt using cannabis helped lower their inhibitions and anxieties. Some participants also felt they were able to feel more connected to their partner when they had used cannabis. Therefore, understanding the implications of using cannabis prior to sexual activity sheds light on the implications for cannabis advertising. This work has implications for public health as well to further improve sexual health practices.
Using TikTok to Educate, Influence, or Inspire? A Content Analysis of Health-related EduTok Videos

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Faculty Sponsor:

Primary College/Unit: Communication  
Associated College(s)/Unit(s) Social Sciences  
Campus: Pullman

Abstract:

This study explored how people engage with educational and motivational content related to health on TikTok. We collected and analyzed 400 health videos from the prosocial EduTok campaign using a mixed-methods approach. Our analysis was guided by two theories: the motivational theory of role modeling and the health belief model.

We found that the most engaging videos were related to diet, exercise, and sexual health, and often featured role model appeals. However, these videos often presented information in an idealized way, without including the details needed for behavior change. Videos that incorporated constructs from the health belief model were less common and less engaging.

Our findings suggest that health professionals should use role model appeals and evidence-based information to create and promote effective content on TikTok. This research provides insights for using role modeling and theory-driven appeals in eHealth communication on social media. In particular, it highlights the importance of using role model appeals to engage audiences and the need for including evidence-based information to support behavior change. It also identifies areas for improvement, such as the underutilization of the health belief model and the need to address less engaging topics. Health professionals can use these insights to create and promote more effective content on TikTok and other social media platforms.
Effect of Concept Map Formats and Motivational Variables on Chemistry Map Quality

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Faculty Sponsor: Olusola Adesope

Primary College/Unit: Education
Associated College(s)/Unit(s): Social Sciences
Campus: Pullman

Abstract:

Research has found concept maps to be an effective strategy for meaningful learning in chemistry. Much of the research on the concept map focus on student transfer, and retention outcome. However, little is known about the effects of various concept map formats on map quality. The present experimental study investigates the effects of three concept mapping activities: map translation, fill-in-blanks, and map correction on map quality scores. Students (N = 204) enrolled in an introductory chemistry course were randomly assigned to concept map format and choice no-choice groups. Results found significant differences in concept map formats with map translation and fill-in-blanks outperforming map correction on map quality score. However, we found no significant difference in choice conditions on the map quality score.
Coxiella burnetii infection regulates caspase-8-mediated apoptosis

Primary Author: Chelsea Osbron  
Co-Author(s): Heather Koehler, Alan Goodman

Faculty Sponsor: Alan Goodman

Primary College/Unit: Veterinary Medicine  
Associated College(s)/Unit(s): Medical & Life Sciences  
Campus: Pullman

Abstract:

Coxiella burnetii is an obligate intracellular bacterial pathogen and the causative agent of the global zoonotic disease Q Fever. Though C. burnetii is considered a bioterrorism agent, limited treatment options exist for acute and chronic infections. To develop new, targeted therapeutics, a greater understanding of how C. burnetii interacts with host immune signaling pathways, such as host cell death responses, is needed. C. burnetii inhibits host cell apoptosis, but bacterial interactions with extrinsic apoptotic signaling components remain largely unknown. We hypothesize that C. burnetii manipulates caspase-8 signaling to prevent induction of apoptosis. To evaluate how caspase-8 signaling is influenced by C. burnetii, we measured caspase activation and cell death induction in infected human cells either overexpressing caspase-8 or treated with TNF α.

We found that caspase-8 activation and apoptosis are inhibited during C. burnetii infection of human THP-1 macrophage-like cells treated with TNF α, but are not inhibited in epithelial-like HEK293T cells overexpressing caspase-8. Additionally, we observed increased levels of cFLIP in infected cells, suggesting a possible mechanism by which C. burnetii inhibits caspase-8. Next, we will interrogate the importance of cFLIP in mediating bacterial inhibition of caspase-8 and assess the role that caspase-8 may have in restricting C. burnetii replication. The results of this study will aid in uncovering the relationships between caspase-8 and C. burnetii infection, thereby providing necessary information for effectively targeting host cell death pathways to enhance the immune response against C. burnetii.
Repetitive practice attenuates EEG spectral features associated with upper-limb movement

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Co-Author(s): Shikha Prashad  
Faculty Sponsor: Shikha Prashad  
Primary College/Unit: Education  
Associated College(s)/Unit(s): Neuroscience  
Campus: Pullman

Abstract:

Brain machine interfaces (BMIs) are systems that allow individuals with paralysis to control assistive devices (such as wheelchairs or robotic limbs) through their mind. BMIs work by monitoring a user’s brain waves and detecting neural patterns associated with the user’s movement intent. In this study, we explore if BMIs can be affected by a phenomenon known as neural efficiency, where the brain becomes more efficient as the individual becomes skilled in a motor task. This was observed in neuroimaging studies, where experts displayed less brain activation compared to novices when both groups performed the same motor task. We hypothesize that when participants repetitively perform a motor task, their brain waves related to movement will become weaker over time and their movement intent will become more difficult to detect by a BMI. To test this hypothesis, we used an open access electroencephalography (EEG) dataset where participants performed a reach-and-lift task in 10 sessions. Between the early and late sessions, we compared the movement-related brain activations and compared a virtual BMI’s ability to predict when users were moving or resting based on their brain waves. We found that from the early to late sessions, the brain activations related to movement became significantly weaker and the BMI’s ability to predict movement states became significantly less accurate. These results suggest that neural efficiency can occur in a short time frame due to task repetition and can affect a BMI’s ability to predict user intent over time, compromising its effectiveness.
Error monitoring in mild cognitive impairment: Cognitive correlates and relationship to an everyday task

**Primary Author:** Carolyn Pagan

**Co-Author(s):**

**Faculty Sponsor:** Maureen Schmitter-Edgecombe

**Primary College/Unit:** Arts and Sciences

**Associated College(s)/Unit(s) Social Sciences**

**Campus:** Pullman

**Abstract:**

Principal Topic:
Accurate error monitoring is important for successful completion of everyday tasks and use of compensatory strategies. This work examined error monitoring in individuals with amnestic MCI (aMCI) as compared to healthy older adults (HOA) using a computerized task. This work also examined cognitive domains associated with error monitoring and the contribution of error monitoring to objective and self-reported measurement of everyday functioning.

**Method:**
Twenty-four individuals with aMCI and 24 HOAs were administered neuropsychological tests (domains assessed: attention, working memory, executive functioning, memory, language, visuospatial abilities); a sustained attention task that included an error-monitoring score (Sustained Attention to Response Task; SART); a naturalistic, performance-based measure of everyday functioning (Day Out Task; DOT); and self- and informant-report measures that captured everyday dysexecutive difficulties (DEX).

**Results/Implications:**
T-test comparisons revealed the aMCI group (M = 0.48; SD = 0.22) exhibited poorer error monitoring (the number of accurately self-corrected errors on the SART divided by total errors) compared to the HOA group (M = 0.71; SD = 0.23), d = 1.02. Partial correlation analyses with age as a covariate revealed significant correlations between the error monitoring score and the cognitive domains of working memory and executive functioning for both the aMCI group and the HOA group. Hierarchical regression analyses revealed that after accounting for age and global cognitive status, the SART error monitoring score significantly predicted DOT total time, but not accuracy, as well as both self- and informant DEX scores.

This study revealed that the ability to recognize errors was significantly poorer in individuals with aMCI compared to HOAs and most associated with the cognitive domains of executive functioning and working memory. After controlling for age and general cognitive status, error monitoring predicted performance in everyday functioning as assessed by a naturalistic, performance-based test and questionnaires assessing everyday dysexecutive difficulties. This suggests that if individuals with aMCI do not recognize performance inaccuracies, they will not be able to correct errors, leading to mistakes in everyday task completion and reduction in implementation of appropriate compensatory strategies. These results implicate error monitoring as a potential target for early interventions with individuals with aMCI.
Investigating Chromospheric Activity from Mg II $\lambda$2800 in Stars Using Scattered Light Corrected NGSL Spectra

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Faculty Sponsor: Guy Worthey

Primary College/Unit: Arts and Sciences  
Associated College(s)/Unit(s) Engineering & Physical Sciences  
Campus: Pullman

Abstract:

Stellar libraries are collection of spectra from stars. The Hubble Space Telescope (HST) is a space based telescope that can provide high quality stellar spectra from a large number of stars. The HST was used to obtain spectra for one such stellar library called the Next Generation Spectral Library (NGSL). It currently contains spectra from 376 distinct stars with wavelength coverage from $0.2 < \lambda < 1 \ \mu m$ at a moderate resolution. This type of stellar library is a crucial ingredient in modelling evolution of stars and galaxies.

One major problem with NGSL is that it is not complete and the UV part of the spectrum contains unwanted signal. In this work, 138 more spectra are added to NGSL increasing its coverage in terms of stellar temperature, and other parameters. All the 514 (376+138) spectra are also corrected after removing unwanted signal from the UV part of the spectrum increasing the fidelity of the library.

The chromosphere is a stellar atmospheric layer that lies between the photosphere below and the corona above. The Mg II $\lambda$ 2800 spectroscopic feature can arise from either the photosphere as an absorption feature or from chromosphere as an emission feature. We find that stars cooler than 4000K always show Mg II $\lambda$ 2800 feature in emission and hotter stars show it in absorption. This trend is also independent of surface gravity. No notable dependency is found for strength of MgII $\lambda$ 2800 feature on amount of metal present in a star.
Determining the pathway by which apelin modulates neurodevelopment in the hippocampus.

Primary Author: Kyra Parker
Co-Author(s):

Faculty Sponsor: Gary Wayman

Primary College/Unit: Veterinary Medicine
Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Pullman

Abstract:

Principal Topic
Maternal metabolic health has largely been recognized as a contributor to offspring brain development. Exercise is linked to positive changes in emotion and cognition including increasing memory and preventing diseases associated with aging. Previous research shows offspring from mothers who exercised during pregnancy also share beneficial changes in metabolism and cognition. The offspring have also been shown to have higher levels of circulating apelin than offspring from controls. Apelin was originally identified as a molecule released during exercise and has recently been implicated in learning and memory as a neurotrophic factor in the hippocampus. We can determine if apelin is required for neurodevelopment by analyzing dendritic spines. Dendritic spines are the post-synaptic components of excitatory synapses. Decreases in the mature form of these spines is associated with various neurodevelopmental disorders.

Methods
We hypothesized that apelin is required for the development of dendritic spines through the TrkB/BDNF complex. Cultured hippocampal neurons from mice pups were transfected with an APJ short-hairpin RNA, the g-protein coupled receptor for apelin, dominant negative forms of TrkB or BDNF, or short-hairpin RNAs for Irisin or PGC1a. These molecules have all been shown to be required for spine growth. For in vivo experiments, apelin was administered to post-natal day (PND) 7 mice 24 hours before extracting the hippocampus. Finally, to examine the effects of exercise by itself on the brain development of the offspring, dames ran 1 hour a day on a treadmill for the duration of the pregnancy and the hippocampus was extracted from the pups on PND 8. Neurons were visualized using Dil and immunohistochemistry and then imaged using a confocal microscope.

Results
Apelin and insulin administration in vitro and in vivo significantly increased the density of dendritic spines on hippocampal neurons and APJ, TrkB/BDNF, and Irisin/PGC1a are required. In mice, offspring from mothers who exercised during pregnancy have significantly higher densities of hippocampal dendritic spines. Results indicate that apelin and insulin may work together to modulate neurodevelopment in response to metabolic changes. This research could lead to a therapeutic target to ensure a healthy pregnancy for individuals who cannot exercise while pregnant.
Buzzing for Blood: A Cartographic Exploration of Mosquito Ecology

**Primary Author:** Kellen Pautzke  
**Co-Authors:** Kristin Saba Fisher, Molly L. Kelton, Emily Garfield, Robert W. Danielson, Jeb P. Owen

**Faculty Sponsor:** Jeb Owen

**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s):** Social Sciences  
**Campus:** Pullman

**Abstract:**

Principal topic  
The use of art to navigate complex scientific systems is an area of increasing interest within the field of STEMM (science, technology, engineering, mathematics, medicine) education. Entomology, the study of insects, provides an additional framework for young students to be introduced to science. Cartographic art can provide contextual, impactful connections to spatial biological phenomena, while developing students’ visual literacy skills.

**Methods**  
The principal focus of our study, the importance of insects to human and animal health (and vice versa), is a key component of a functional entomological education. In collaboration with visual artists and rural-agricultural Washington communities, we designed and implemented a 6-day, 30-hour curriculum to increase entomology-focused STEAMM elementary education. This curriculum, Buzzing for Blood (B4B), covered aspects of mosquito ecology and vector control through cartographic art projects. Image selection surveys were used to assess student ecological learning, and thematic and network analyses were used to assess student artwork.

**Results/Implications**  
Upon program completion, students demonstrated increased understanding of interactions between mosquitoes and people in the context of landscape, as demonstrated by image selection (paired t-test, P = 0.01). Network analyses demonstrate students used two primary methods of mapping to explore mosquito ecology, including spatial arrangement and presence of ecological needs. Community-wide conversation and learning emerged from students talking about their artwork and through an end-of-program art show. The construction of intentional, impactful entomology education is foundational for the future of science education, and additional work on the subject should explore long-term student engagement and science retention.
Characterization of Lipase Genes in the Murine Testes

Primary Author: Dakota Pfister  
Co-Author(s): Alfian Tanggono, Ted Chauvin

Faculty Sponsor:

Primary College/Unit: Elson S. Floyd College of Medicine  
Associated College(s)/Unit(s): Medical & Life Sciences  
Campus: Spokane

Abstract:

Hormone-sensitive lipase has previously been shown to be a key factor for fertility, with a deficiency of hormone-sensitive lipase showing decreased sperm counts, sperm motility, and fertility. Our lab has demonstrated that free fatty acid efflux occurs in capacitated sperm. The release of fatty acids, including linoleic acid, arachidonic acid, docosapentaenoic acid, and docosahexaenoic acid, was observed in the media of capacitated sperm as compared to non-capacitated sperm. We hypothesize that there are additional lipases in sperm. This study aimed to investigate which other lipases are expressed in the testis that could facilitate the efflux of free fatty acids during capacitation. Lipf encodes for an enzyme, gastric lipase, that aids in the digestion of triglycerides. Plb1 encodes for a membrane-associated phospholipase that catalyzes the hydrolysis of fatty acids esterified at the sn-1 and sn-2 position of glycerophospholipids, forming free fatty acids and lysophospholipids.

To evaluate the presence of lipases in the testes, individual tissues were collected from mice, and RNA was isolated. cDNA was created from the isolated RNA and qPCR was completed on each tissue to evaluate Lipf and Plb1. The reference gene we used was Rps29 which shows ubiquitous expression in our tissues of interest. Overall, there appears to be an expression of Lipf and Plb1 in the mouse testis upon completion of qPCR. We believe these genes, like Lipe, are integral to quantitative and qualitative spermatogenesis and warrant more investigation. Future direction includes further evaluation and characterization of these genes including protein studies.
An epigenetic roadmap for fibroblast differentiation to achieve skin regeneration.

**Primary Author:** Quan Phan  
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**Faculty Sponsor:**

**Primary College/Unit:** Veterinary Medicine  
**Associated College(s)/Unit(s)** Medical & Life Sciences  
**Campus:** Pullman

**Abstract:**

Understanding the mechanisms of skin fibroblast differentiation during embryonic development has important implications for wound healing and tissue regeneration. This is because the molecular and cellular pathways that are responsible for the formation of skin are active during embryogenesis but become inactive shortly after birth, which is one reason skin scars when deeply wounded. In this study, we performed an integrated multi-omics analysis to investigate the differentiation of skin fibroblasts as skin forms during embryogenesis. Our use of single-cell-RNA-seq and single-cell-ATAC-seq combined with ChIP-seq and transgenic mouse technology allowed use to map the architectural and epigenetic changes occurring when an undifferentiated 'fibroblast stem cell' differentiates into either hair follicle supporting cells or to adipocytes of the fat layer of the skin. Surprisingly, we found that fibroblast stem cells have condensed and closed chromatin that is made accessible by the chromatin modifier Kdm6b, which specifically removes the H3K27me3 modification as fibroblast differentiate. Our findings could be used to develop new therapies that target genes that Kdm6b regulates to promote skin regeneration in wounds, instead of scarring.
Characterizing the function of skeletal muscle growth genes in vertebrates using CRISPR gene edited Rainbow Trout (Oncorhynchus mykiss)

**Primary Author:** Michael Phelps  
**Co-Author(s):** Jasmine Richman, Leah Davis

**Faculty Sponsor:**

**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s):** Medical & Life Sciences  
**Campus:** Pullman

**Abstract:**

The growth of skeletal muscle is controlled by a number of signaling factors that regulate the number and size of muscle fibers. One of the most important signaling pathways that determines muscle fiber size in vertebrates is the activin/myostatin signaling pathway. Disruption of this signaling pathway can lead to significant increases in muscle mass, termed “double muscling”. While some members of this pathway, such as myostatin, have been heavily characterized, there is limited understanding of the role of other factors such as the Activin in regulating skeletal muscle growth. This is particularly true for lower vertebrates like fish. Using a large, fast-growing model species, the rainbow trout (RBT; Oncorhynchus mykiss) we examined the expression pattern of activin signaling pathway genes across tissues and during several key developmental stages. We identified unique trends in the expression of activin signaling pathway genes that suggest common as well as unique mechanisms of skeletal muscle growth in fish compared to what is known in mammals. To examine how these genes function in RBT we used CRISPR genome editing technology to create fish with targeted DNA modifications in 7 important activin signaling pathway genes. These model organisms are being used to define the mechanisms by which the activin signaling pathway controls tissue growth and development in fish which will improve our understanding of this essential animal tissue.
TRADE-OFF ANALYSIS AND RESOURCE OPTIMIZATION FOR RESILIENCE PLANNING IN POWER DISTRIBUTION SYSTEMS

Primary Author: Abodh Poudyal
Co-Author(s):

Faculty Sponsor: Anamika Dubey

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

• Principal topic:
The US has incurred more than $1.5 trillion dollars in economic losses due to weather-related events. The primary reason for those losses is due to unanticipated events, also known as black swan events. Existing infrastructural planning frameworks for electric power systems focus on expected events rather than those with a lower probability of occurrence. However, climate change has played a significant role in the changing weather patterns across the globe. In this work, we aim to develop a multiple-resource planning framework that can optimize multiple resources for a limited system operator’s budget while analyzing the trade-off between several planning objectives.

• Method:
The overall problem is formulated as a two-stage stochastic optimization framework. The first stage provides the planning decision, and the second stage handles the inner-loop operation based on the planning decisions. The risk of extreme weather events is modeled using the Conditional value-at-risk parameter, and the method is validated on a standard IEEE 123 bus feeder for several cases. A dual decomposition algorithm is leveraged to solve the problem in high-performance computing environments.

• Results/Implications:
The simulation results show that there is a trade-off when the planning is performed for expected outcomes vs. risk. Additionally, the resource portfolio changes drastically based on the problem objective. The trade-off is further implicated by the number of event scenarios used for optimization. Such an infrastructural planning framework is highly beneficial for electric power system operators with a limited budget for upgrades and searching for a proper planning solution.
A qualitative exploration of youth’s perceptions of cannabis-infused product packaging appeals in Washington state

**Primary Author:** Ron Price  
**Co-Author(s):** Leti Couto, Soojung Kang, Christina Nickerson, Opeyemi Johnson, Stacey Hust, Jessica Willoughby

**Faculty Sponsor:** Stacey Hust

**Primary College/Unit:** Communication  
**Associated College(s)/Unit(s)** Social Sciences  
**Campus:** Pullman

**Abstract:**

In 2012, Washington State became one of the first states in the nation to allow recreational cannabis use. Since then, the cannabis industry and associated marketing methods have expanded significantly, including the industry surrounding cannabis-infused products, that often look like non-cannabis products. There is a pressing need to research young people’s views toward cannabis-infused commodities, because existing theory implies that positive attitudes toward a product or behavior might lead to behavioral intentions.

We used virtual focus groups (N=28) with adolescents to determine how adolescents view cannabis product packaging. Participants viewed pictures of cannabis edible packaging and discussed their perceptions. We then used thematic analysis to examine the data. According to participants, aspects on packaging such as bright colors, product depictions, and popular flavors are appealing to young people.

Participants in the focus groups had varied levels of cannabis knowledge and media literacy. Participants experiences with cannabis and their media literacy also seemed to impact awareness of appeals in packaging and perceived effects. These findings highlight the importance of teaching packaging literacy as well as discussing cannabis usage with teenagers, especially because they are growing up in an environment in which cannabis is legal. Policy makers also need to consider the nuanced appeals that may be of interest to youth when creating laws around cannabis product packaging.
In vitro and in vivo characterization of pathogenic and saprophytic fitness costs in fungicide-resistant isolates of Penicillium expansum

**Primary Author:** Jonathan Puglisi  
**Co-Author(s):** Achour Amiri  
**Faculty Sponsor:** Achour Amiri  
**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s):** Agricultural & Natural Sciences  
**Campus:** Pullman

**Abstract:**

Blue mold (BM), primarily caused by Penicillium expansum, is the most important postharvest disease of apple and pear worldwide and in the Pacific Northwest (PNW). BM is primarily managed through robust sanitation protocol and application of fungicides at harvest. Packinghouse surveys showed that P. expansum has begun to exhibit resistance to thiabendazole (TBZ), pyrimethanil (PYR), and fludioxonil (FDL), the three most used postharvest fungicides in the PNW. To better understand if the evolution of fungicide resistance alters the ability of resistant populations to cause epidemics of BM, P. expansum isolates sensitive or resistant to TBZ, PYR, and FDL were evaluated using several fitness parameters. Spore germination, mycelial growth, sensitivity to reactive oxygen species, osmotic stress, and resistance stability were assessed in vitro, while virulence, sporulation, and resistance stability were assessed in vivo. In preliminary in vitro trials at 1°C, resistant isolates exhibited reduced conidial germination on nutrient restricted media and susceptibility to osmotic stress. Resistant isolates showed virulence levels similar to those of sensitive isolates on detached fruit after 3 months at 1.5°C. Our preliminary findings indicate that while some fungicide-resistant phenotypes of P. expansum may incur fitness costs, their ability to cause BM in cold storage may not be affected. The goal of this research is to help fruit packers effectively assess and mitigate the risk of fungicide resistant disease populations.
An Exploratory Study on the Influence of the School Building Physical Space on Educational Practices

Primary Author: Alana Pulay  
Co-Author(s): Pam Woolner  
Faculty Sponsor:  
Primary College/Unit: Engineering and Architecture  
Associated College(s)/Unit(s) Visual Arts & Design  
Campus: Pullman

Abstract:

Few studies have examined the influence of the physical school environment on educational policy and practices. This study identifies physical school building variables and how they might contribute to chain effects that moderate educational policy and practice. The aims of this study were twofold: first, to compare design features between international school buildings and second, to detect how these features might affect educational practices.

Twelve schools located in the United States (n = 4), Iceland (n=4), and United Kingdom (n=4) were documented on the Learning Space Rating System (Educause, 2021). This tool examines structure and support of administration, teachers, parents, and students and architectural and interior variables, such as windows, classroom size, etc. Data was collected through site visits, observations, and interviews. The was analyzed using the constant comparative method.

Results indicated that finishes, materials, furniture and lighting were similar, however, classroom layout, overall building plan and architectural style differed in Iceland the most. Administrations’ opinions and use of spaces differed depending upon pedagogy, building age, and location. Iceland schools utilized open classrooms and corridors, yet all locations had outdoor recreation areas. Given the small sample size, no direct link can be made between building characteristics and educational policies, however, these preliminary data provide a foundation for the future understanding of the characteristics, training, roles and responsibilities, challenges and research interests of school buildings around the world. This study, and future research collaborations intend to help interior designers and architects in creating more effective schools that support educational practices.
Acquired Drug Resistance Enhances Imidazoquinoline Efflux by P-Glycoprotein

**Primary Author:** Anunay Pulukuri  
**Co-Author(s):** Cliff Berkman

**Faculty Sponsor:**

**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s) Medical & Life Sciences**  
**Campus:** Pullman

**Abstract:**

Multidrug-Resistant (MDR) cancers attenuate chemotherapeutic efficacy through drug efflux, a process that transports drugs from within a cell to the extracellular space via ABC (ATP-Binding Cassette) transporters, including P-glycoprotein 1 (P-gp or ABCB1/MDR1). Conversely, Toll-Like Receptor (TLR) agonist immunotherapies modulate activity of tumor-infiltrating immune cells in local proximity to cancer cells and could, therefore, benefit from the enhanced drug efflux in MDR cancers. However, the effect of acquired drug resistance on TLR agonist efflux is largely unknown. We begin to address this by investigating P-gp mediated efflux of TLR 7/8 agonists. First, we used functionalized liposomes to determine that imidazoquinoline TLR agonists Imiquimod, Resiquimod, and Gardiquimod are substrates for P-gp. Interestingly, the least potent imidazoquinoline (Imiquimod) was the best P-gp substrate. Next, we compared imidazoquinoline efflux in MDR cancer cell lines with enhanced P-gp expression relative to parent cancer cell lines. Using P-gp competitive substrates and inhibitors, we observed that imidazoquinoline efflux occurs through P-gp and, for Imiquimod, is enhanced as a consequence of acquired drug resistance. This suggests that enhancing efflux susceptibility could be an important consideration in the rational design of next generation immunotherapies that modulate activity of tumor-infiltrating immune cells.
Scalable sketch-based schemes for mapping long reads to contigs

Primary Author: Tazin Rahman
Co-Author(s):

Faculty Sponsor: Ananth Kalyanaraman

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

Recent emergence in long-read sequencing technologies shows a promising front toward genome assembly.
The first generation of long read technologies was error-prone, however, the latest generation of technologies such as PacBio HiFi, have significantly improved accuracy (99.9%). Hence, the prospects of assembling long contiguous portions of the genome (with contigs over 100Kbp) have become a reality. We visit the problem of combining HiFi long reads with contigs assembled from short reads (100-250 bps). In order to implement this strategy, we need a way to efficiently map the long reads to the contigs, as that step is likely to be the computational bottleneck. The classical alignment-based approaches are time-consuming.

Sketching is a class of techniques that uses samples derived from the input sequences to be compared in order to approximate similarity. We present a new unified algorithmic abstraction based on sketching to perform the alignment-free mapping.

Method:

Given an input query set (long reads) and a subject set (contigs), the goal of the problem is to generate a mapping based on a similarity function. Simulated read inputs were generated from real-world genomes, downloaded from NCBI GenBank, for six different organisms.

First, the sketches are generated from the subjects. Next, during query processing time, sketches are generated from the long reads. If a query generates a sketch in common with a subject then that subject is likely to share sequence-level similarity with the query. Based on these candidate hits, the algorithm then searches and selects a top matching subject.

Results:

Experimental results show that all our implementations show comparable or better quality compared to the state-of-the-art MashMap tool. The parallel runtime reduces with an increase in p (the number of processes), demonstrating improving speedups. Our distributed memory implementation also outperforms the MashMap tool in total runtime.
Abstract:

Cratons are the thick, ancient cores of continents that hold the potential for understanding the earliest periods in Earth’s history. Seismic imaging provides snapshots of multiple shapes for present day cratons, but it’s not clear what processes shaped cratons. If cratons are permanent geologic structures within the Earth’s interior, then why are there variations in observed present day craton shapes? Are these variations due to recent deformation, or can multiple shapes be long-lived over Earth’s history? Prior work indicates that the material properties of cratons controls survivability, but craton shape itself can also impact long-term preservation with some shapes promoting longevity over others. However, the impact of changing mantle dynamics on craton shape has yet to be thoroughly studied. Differing mantle dynamics may favor stability of different craton shapes. Understanding this potential could indicate which shapes may resist significant deformation, whereas other shapes may experience large-scale deformation. This increased knowledge on the control on craton shape is important, as it can indicate shape may provide a diagnostic for early Earth processes. Here, we will present results from numerical modeling that demonstrates the conditions under which craton shapes are long-lived.
Protein Functionality is Critical for the Texturization Process During High Moisture Extrusion Cooking

Primary Author: Jana Richter
Co-Author(s):

Faculty Sponsor: Girish Ganjyal

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Pullman

Abstract:

Principal topic: Health, environmental and ethical concerns lead to an increasing number of people to follow a vegetarian diet. Plant-based meat analogs can be produced using extrusion processing, a technique that combines multiple functions, such as mixing, cooking, forming, and others, in one system. Most plant-based meat analogs are made from soy and wheat protein. In recent years, other plant proteins, including those from pulses, have gained more attention. Even though significant research has been conducted on explaining the mechanism of protein texturization, it is still not fully understood. Understanding the complete mechanism of protein texturization during high moisture extrusion cooking will help the successful innovation of plant-based meat analog products made from various protein sources. The increased use of protein sources other than wheat and soy will provide choices for a wider range of consumers, including those sensitive to wheat and soy.

Methods: This study investigated the importance of the protein functionality for its texturization by dual extrusion processing in which the first extrusion process altered the protein functionality. The performance of the proteins during the second extrusion run compared to the first run help to understand the relevance of the proteins’ functionality. High moisture meat analog extrudates were obtained by extruding wheat and pea protein at a moisture content of 55% (w.b.). Extruded products were freeze-dried, milled, and were then extruded once again. Single and dual extruded materials were compared using visual, wet-chemical, and textural analyses.

Results: The texture of single and dual extruded products differed greatly. Especially extruded wheat samples showed a considerable decrease in fibrousness when extruded twice. Wet-chemical analysis, including hydration properties and content of sulfur containing groups, revealed no significant differences between raw and extruded wheat material, while extruded pea samples differed from raw pea protein. The loss in fibrousness of the wheat sample after dual extrusion process in combination with the equality of certain characteristics and the retention of the chemical composition suggests that the protein’s functionality, like the one of wheat gluten, is of tremendous importance for successful texturization.
Facing COVID-19 Challenges: Assessing Impact of Change in Data Collection for a Mixed-Mode Survey of Behavioral Health Enrollees

**Primary Author:** Felix Rodriguez  
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**Faculty Sponsor:**

**Primary College/Unit:** Communication  
**Associated College(s)/Unit(s):** Social Sciences  
**Campus:** Pullman

**Abstract:**

Surveys have been useful in gauging client evaluation of health services. The COVID-19 pandemic in 2020 affected not only the providers and users of health services but also the implementation of survey operations. As an academic survey organization, we report on our experience launching an annual survey of Medicaid behavioral health enrollees in Washington state. Traditionally, the survey relied primarily on two modes for completion: telephone with web option. The pandemic-related restrictions resulted in the loss of our on-campus pool of student interviewers and staff reduction in our telephone lab. Consequently, we had to shift our data collection strategy to encourage greater use of a mail-in paper questionnaire.

The aim of the study is twofold: to assess the impact of the shift in our data collection strategy; and to compare enrollee evaluation of behavioral health services between pandemic year 2020 and pre-pandemic 2019. Less reliance on telephone in 2020 resulted in an overall lower response rate of 5.1% compared to 18.1% in 2019. The observed differences in measures of enrollee evaluation of behavioral health services were attributable to the survey mode, self-administered (web/mail) versus interviewer-facilitated (telephone), and were not attributable to differences in enrollee experience with behavioral health services before versus during the pandemic. The study hopes to generate lessons about the effects of a transformative event, the COVID-19 pandemic, on survey implementation, on one level, and the relationship between survey mode and enrollee assessment of behavioral health services on another level.
Scalable Control method for Electric Power Distribution Systems

Primary Author: Rabayet Sadnan
Co-Author(s):

Faculty Sponsor: Anamika Dubey

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

Principle topic: For the reliable and economic supply of electricity, optimal operation of the modern electric power system is mandatory. The traditional approach of optimally controlling the power system using a single computational agent has various disadvantages. This includes, but is not limited to the fact that the failure of that agent jeopardizes the entire operation. Besides, the vast-scale of power networks with thousands of control variables increases computing complexity. On top of that, the addition of a significant number of renewable energy resources in the modern power system increases the difficulty by adding more assets to manage. The existing techniques include distributed optimization methods where multiple computing agents share the computational burden. The main disadvantage is the large number of needed communication-rounds among those computing agents - often in the range of 1000. In this research, a novel distributed optimization approach for the optimal operation of any generic, large electric power system is given, which reduces communication-rounds to the order of 10 instead of thousands, and as such decreases computing expenses.

Method: The proposed method leverages the power distribution system's unique network structure by dividing it into zones. Each zone approximates the neighboring zones as either an electric generator or as electrical loads. This specific approximation, which makes use of the system's structure, greatly decreases the problem size and the computing complexity. Further, this approximation exploits the physics of electric power systems, and solutions can be achieved with very little communication (4 iterations instead of 1000) among computing agents.

Result: The proposed novel algorithm has been simulated for several standard IEEE (Institute of Electrical and Electronics Engineers) test-systems. In comparison to state-of-the-art approaches, communication rounds are in the order of ten (10) - instead of thousands, to reach the solution. Further, this proposed method enables compute safeguarding the electric power system in adverse weather. Besides the simulated results, we also analytically proved the guaranteed convergence of the proposed method. The approach is applicable to any large-scale power system, and utilities may stand to gain significantly from the method to operate modern electric power systems with high renewable energy resources.
Co-Design Process for Community Engagement - 3 Recent Projects

**Primary Author:** Michael Sanchez  
**Co-Author(s):** Robert Krikac

**Faculty Sponsor:**

**Primary College/Unit:** Engineering and Architecture  
**Associated College(s)/Unit(s)** Visual Arts & Design  
**Campus:** Pullman

**Abstract:**

The Rural Communities Design Initiative, a part of the School of Design and Construction at Washington State University, endeavors to deliver on the university’s land-grant core values by harnessing our passion and concern for underrepresented populations and compromised landscapes using “design” as a vehicle for improving the quality of life in rural communities of the Pacific Northwest.

The field of community engagement scholarship has its roots in service learning primarily centered around student volunteerism.[1] Since the late 1990s service learning has been combined with civic engagement and a new body of knowledge around engaging the community through a reciprocal participatory “co-design” process, reaping benefits for both the community and the university. Co-design is “designing with” rather than “designing for” and empowers community members to be active participants in solutions to their built environment challenges.[2] Three recent engagements with rural communities in developing 1) a new library, 2) an ice age floods museum & heritage center, and 3) a fire station will be presented where our team of faculty and students from the design disciplines led a series of co-design workshops where community stakeholders provided input as to the community’s specific needs, wants and challenges. Using this input, conceptual designs were created that put the community’s needs and wants into a graphic format for all to evaluate and agree on a proposed built solution. These designs are then used by the community to seek funding and hire professional design firms to bring the work to fruition.


Studying effects of disease-related mutations in progranulin using molecular dynamics simulations

**Primary Author:** Eduardo Sanchez Diaz  
**Co-Author(s):** Garry Smith, Alla Kostyukova, Dmitri Tolkatchev

**Faculty Sponsor:** Alla Kostyukova

**Primary College/Unit:** Engineering and Architecture  
**Associated College(s)/Unit(s)** Engineering & Physical Sciences  
**Campus:** Pullman

**Abstract:**

Progranulin is a secreted glycoprotein of 75-80 kDa, containing 7.5 granulin modules (p,G,F,B,A,C,D and E) which are encoded by the GRN gene. Mutations within the GRN gene have been linked to the development of frontotemporal lobar degeneration (FTLD). FTLD is an early-onset dementia syndrome characterized by a progressive decline in behavior or language. So far, the effect of the mutations on the structural characteristics and unique cysteine-cysteine pairing pattern of granulin modules is not well understood. Using molecular dynamics simulations (MDS), we studied the effects of the W541C mutation in granulin module E on stability and disulfide bond patterns. For this, we used the known structure of the zebra fish granulin (pdb # 6cku), a stack of three β-hairpins stabilized by a total of six disulfide bonds, which has high homology to granulin E. The mutation was introduced in silico using UCSF Chimera. The 1000ns MDS were run for the wild-type protein and mutated protein, either with all six disulfide bonds intact or with two of them reduced. First, we studied the propensity of disulfide bonds in the wild-type protein. Then we compared structure and bond formation for wild-type and the mutant. Our results demonstrated that the formation of the disulfide bond between C10 and C26 is disfavored due to the mutation.
Persistent photoconductivity is a phenomenon in which the conductivity of a material increases upon light exposure and remains high without the source of exciting illumination. Potassium tantalate KTaO$_3$ (KTO) is a cubic perovskite semiconductor with a wide bandgap of 3.6 eV. Grown by Czochralski methods, this novel material is a subject of interest due to its possible applications in electronic and storage devices. KTO crystals have been annealed in a silica ampoule filled with hydrogen gas and a piece of tantalum wire, creating an oxygen-poor environment and thus oxygen vacancies. After exposing the crystals to 340 nm light-emitting diode (LED) light, evidence of persistent photoconductivity (PPC) was observed as well as a color change. Two-point electrical measurements show a decrease in resistance of one to two orders of magnitude that last for several weeks. Moreover, the PPC effect can be reversed by an open-air anneal and re-induced by repeating the irradiation. Hall effect experiments determined the charge carriers to be electrons with low mobility. UV-visible measurements show the transmittance of the irradiated samples to decrease relative to as-grown samples. IR spectra of KTO before and after the heat treatment indicate that the O-H peaks vanish in annealed samples, likely due to hydrogen occupying oxygen vacancy sites. Conductive paths were also attempted by focused LED irradiation between two contacts.
A new die design for the constrained groove pressing process to achieve homogeneity and uniform properties.

**Primary Author:** Swapnil Sawalkar  
**Co-Authors:** David Field

**Faculty Sponsor:** David Field

**Primary College/Unit:** Engineering and Architecture  
**Associated College(s)/Unit(s)** Engineering & Physical Sciences  
**Campus:** Pullman

**Abstract:**

The constrained groove pressing process is a prominent technique to achieve ultrafine-grained microstructure and thus improved mechanical properties in the metal sheet. CGP process uses grooved and flat dies to press the metal sheet simultaneously to impart huge strain in it without altering dimensions. There has been a limitation of CGP process that there is inherent inhomogeneity in the processed sheet. Literature has shown that this is due to the sharp edges of the grooved die which are responsible for additional bending strain with shear strain. In this research, it has been shown that inhomogeneity can be reduced by eliminating the sharp edges of the die. Nevertheless, just eliminating sharp edges and making them round won’t help to eliminate inhomogeneity completely because shaping the grooves round makes bending strain constant over the sheet but not shear stress. To have homogeneity in the metal sheet, it is required to impart a constant combination of shear strain and bending strain. One such die has been designed to impart constant combined strains on the metal sheet. It has been found that processed sheet through modified die showed isotropic properties. Moreover, metal sheet not only showed improved mechanical properties but also, the properties were uniform over metal sheet. This work has been cross-verified by doing experimental and simulation work.

**Keywords:** CGP, SPD, ultrafine-grained microstructure, inhomogeneity, bending strain, Shear strain,
Characterizing Tree Defoliation and Mortality from Insect Damage Using High-Resolution Remote Sensing Imagery

Primary Author: Luke Schefke
Co-Authors:

Faculty Sponsor: Arjan Meddens

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Agricultural & Natural Sciences
Campus: Pullman

Abstract:

Principal Topic

Coniferous trees in North America face many threats, with both native and invasive insect damage a key component of their decline and mortality. As insects, particularly bark beetles, attack the trees, they undergo a color shift from green to red to gray. Attacks from other insects can result in defoliation, or the thinning and loss of needles. These changes can be detected by remote sensing instruments such as satellites and drones. Mortality may however come from multiple variables such as fire or drought, which causes stress to a tree, making it more susceptible to insect infestation. Three areas of interest were chosen, one each in Washington, Idaho, and Montana, to study these effects.

Methods

This study aims to examine the spectral and spatial patterns displayed across multiple types of trees, with the damage caused by a range of insects. Multiple levels of spatial resolution are analyzed and classified, using field measurements, drone data and high- and moderate-resolution satellite data. Field studies consisted of measuring variables such as diameter, health, and needle color on both trees near each other in plots as well as isolated trees. For drone and satellite data, the pixels from these data sets are classified using several modeling techniques, resulting in a map of different tree health classes and other land classes such as bare ground and herbaceous vegetation.

Results & Implications

Current results are preliminary but include a classification of different tree and land cover types along with measurements of their accuracy. By comparing classification results at different resolution levels, it is possible to see what information is retained or lost at each step down in resolution. Field measurements provide corroborating evidence for modeling input and results. This can assist forest managers and natural resource scientists in analyzing forests, giving them guidelines for when to invest more time and resources. This research will also allow for general trends for areas with insect-specific mortality, allowing for possible future comparisons with other causes of tree mortality.
Emotion Reactivity Moderates Degree of Emotion Regulation in Rested but not Sleep-Deprived Individuals

Primary Author: Anthony Scholes  
Co-Author(s): Courtney Kurinec, Hans Van Dongen, John Hinson, Paul Whitney, Anthony Stenson  
Faculty Sponsor:  
Primary College/Unit: Spokane  
Associated College(s)/Unit(s): Medical & Life Sciences  
Campus: Spokane  

Abstract:

Individuals with higher baseline emotion reactivity, who are more sensitive to or have more intense or persistent responses to emotion-evoking stimuli, would be expected to have more difficulty controlling their stronger emotional responses under fully rested conditions. We investigated how total sleep deprivation (TSD) impacts this relationship between baseline reactivity and the ability to regulate emotion.

N=55 healthy adults (ages 22-37, 28 females) completed a 4-day/3-night in-laboratory study comparing a group randomized to 38h TSD (n=35) with a well-rested Control group (n=20). Participants completed the Emotion Reactivity Scale (ERS). Later, a standardized emotion regulation task was administered after a night of baseline 10h sleep opportunity, and 24h later after either a night awake (TSD) or another 10h sleep opportunity (Control). The task required participants to view pictures that elicit negativity and to rate their experience for each. Prior to some pictures, participants were instructed to decrease negative emotion by telling themselves something about the picture to make them feel less negative.

Ratings from the second task administration were analyzed using mixed-effects ANOVA with fixed effects for group (TSD or Control), instruction (decrease or not), ERS score, and their interactions. The three-way interaction was significant (p=0.021). For the Control group, higher reactivity scores were associated with greater reduction in negative emotion after instruction to decrease negative emotion, while this relationship was absent in the TSD group.

These findings suggest that sleep deprivation makes it difficult for emotionally reactive individuals to reduce their negative emotions.

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Covert Allies: German Personnel in United States Military Research and Intelligence Programs During the Early Cold War

**Primary Author:** James Schroeder  
**Co-Author(s):**

**Faculty Sponsor:** Noriko Kawamura

**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s)** Liberal Arts & Humanities  
**Campus:** Pullman

**Abstract:**

During the late 1940s, the United States government pursued diverse research and intelligence programs that integrated German veterans, scientists, administrators, and intelligence officers into an expanding American national security infrastructure. Project Paperclip recruited several hundred German scientists and technicians for military research programs in the United States even as the Army Historical Division employed high-ranking German prisoners of war to analyze the Wehrmacht’s successes and failures against the Soviet Union. As these programs unfolded, US Army Intelligence recruited German personnel to construct and staff intelligence networks targeting the Soviet Union and its satellites. One of the most famous examples of this cooperation is Operation Rusty, an Army-funded network of German veterans led by former Wehrmacht intelligence chief Reinhard Gehlen.

This paper analyses Project Paperclip, the Army Historical Division’s Operational History (German) Section, and Operation Rusty, arguing that while historians have focused on these programs individually, analyzing them together illustrates the pivotal role US Army intelligence services played strengthening US-German relations. Cooperative interactions between American and German personnel instigated and exemplified the paradigm shift in US-German relations as “enemies” became “allies.” American and German participants within these research and intelligence programs united around shared anticommunist sentiments, fears about the external threat posed by the Soviet Union, and pragmatic efforts to mitigate extreme social, political, and demographic upheaval in Europe. These covert relationships shaped the national security infrastructure of both the US and West Germany while laying the foundation for contemporary cooperation between US and German military and intelligence services.
Title: Evaluating hyperspectral imaging for the rapid identification of foodborne pathogens at the colony level

Primary Author: Amninder Singh Sekhon
Co-Author(s): Phoebe Unger, Sonali Sharma, Xiongzhi Chen, Girish Ganjyal, Minto Michael

Faculty Sponsor: Minto Michael

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s): Medical & Life Sciences
Campus: Pullman

Abstract:

Principal topic: Hyperspectral imaging (HSI) integrates conventional imaging and spectroscopic techniques to simultaneously acquire spatial and spectral information. The HSI is a novel optical tool in food processing with great potential for rapidly identifying bacterial colonies on agar media. This study aimed to obtain hyperspectral data of bacterial colonies isolated from pure cultures to build a reference library and subsequently evaluating the accuracy of HSI setup to classify bacteria isolated from artificially inoculated food matrices (milk or milk powder).

Method: Three strains of Listeria monocytogenes (LM), 4-strains of Escherichia coli O157:H7 (EC), big six non-O157:H7 EC, 3-strains of Staphylococcus aureus (SA), and 10-serovars of Salmonella (SAL) were used in this study. Pure cultures of given pathogens were streaked for isolation on respective selective media. Milk or whole milk powder were artificially inoculated with individual pathogenic strains or serovars. Before isolation, the respective samples were enriched using Brain Heart Infusion (BHI) broth at 37°C for 24 hrs. For an individual pathogen, the isolated colonies on a petri dish were analyzed under the HSI setup to gather hyperspectral data. The acquired images were imported into ENVI software, and 3 regions of interest (ROI) were selected for each image. The data was analyzed using the K-nearest neighbor (kNN) technique using the R-software.

Results/implications: Using kNN classifier and cross-validation technique, an accuracy of 97.2, 97.2, 96.6, and 75.8 % were obtained for LM, SA, SAL, and EC, respectively, at genus level. Future work will be done to increase the size of reference library and shortening the enrichment time.
Third Person Effect of Covid-19 Misinformation and the Role of Media Literacy in Health Behavior

Primary Author: Hae Yeon Seo
Co-Author(s):

Faculty Sponsor: Erica Austin

Primary College/Unit: Communication
Associated College(s)/Unit(s): Social Sciences
Campus: Pullman

Abstract:

As COVID-19 misinformation is prevalent in diverse societal sectors and affects decision-making, it is essential to consider why misinformation is taking over society, putting public health at risk. In such an environment, individuals tend to consider that others are more likely to be influenced by negative media messages than themselves, which is called the third-person effect (TPE). However, media literate individuals can understand how media messages are constructed and media distort reality, nullifying such effects on them. Such social conflicts call for more research to mitigate the effect of COVID-19 misinformation on the public and their health behavior. Based on two theoretical frameworks, the primary purpose of this study is to examine the relationship between media literacy skills and TPE as little empirical evidence exists explaining this relationship. This study also examines how TPE and media literacy (ML) (source, content) can help in taking preventive behavior and corrective actions. Lastly, this study aims to examine how ML could mediate the relationship between TPE and two behavioral components (corrective actions, preventive behaviors).

An online survey was conducted to test the hypotheses (N=272). This study showed that ML can significantly predict TPE implying that people think others are affected by the misinformation because they are more media literate. Multiple regression analyses also revealed that TPE predicted corrective actions. However, ML for news source only predicted preventive behavior, while ML for news content only predicted corrective actions. Lastly, mediation analysis revealed that media literacy skills could mediate the relationship between TPE and two behavioral components (corrective actions, preventive behaviors). Results hold implications for the future direction of a health campaign to promote healthy behavior by enhancing ML skills. More importantly, the finding also shows the current health campaign dilemma, suggesting that TPE may create an atmosphere of resentment that current health campaigns are problematic among populations who perceive them as media elites.
Diversion Risk in Prescription Opioid Supply Chain

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**Faculty Sponsor:** Paul Skilton

**Primary College/Unit:** Business  
**Associated College(s)/Unit(s)** Administrative & Information Systems  
**Campus:** Pullman

**Abstract:**

Principal topic:  
Product diversion involves the distribution of products into markets other than those originally intended, adversely affecting society, especially in the case of hazardous products. While recent research shows oversupply in the prescription opioid market, the underlying mechanisms are still veiled. We focus on how supply chain structural attributes relate to the diversion risk. We draw on expectancy theory to develop and test hypotheses.

**Method:**
We use a dataset based on DEA records of transactions in the supply network for prescription opioids. We develop measures for retailer diversion risk as the dependent variable, and for supply chains risk profile (network diversion risk), size of supply chains (reputation), vertical integration, and dependence on powerful unrelated suppliers as explanatory variables. We employ within-between hybrid regression analysis controlling for regulation of opioids in different states, prescription rates, and type of chain governance among others.

**Results/implications:**
Results provide evidence that supply chain attributes play a critical role in the creation of diversion risk for hazardous consumer goods: when supply networks are structured to avoid negative evaluations, retail diversion risk increases, and vice versa. Additionally, negative evaluations can be avoided by choosing like-minded suppliers and through vertical integration, which obscures outcomes by internalizing them. We argue that because negative evaluations are more consequential for firms that are more sensitive to reputation risk, and are more likely when sourcing from outside suppliers, these factors reduce diversion risk. Finally, we conclude that regulators should control production more strictly than consumption as the diversion risk is systemic.
Developing sustainable apparel supply chains by clothing the loop

Primary Author: Shirin Shahsavand
Co-Author(s):

Faculty Sponsor: Charles Munson

Primary College/Unit: Business
Associated College(s)/Unit(s) Administrative & Information Systems
Campus: Pullman

Abstract:

• Principal topic
The apparel industry contributes significantly to increased carbon emissions and overflowing landfills across the globe. Americans produce 17+ million tons of textile waste each year, of which over 80% are incinerated or landfilled. The total energy expenditure associated with reverse logistics for used garments is estimated at 2.2% of the energy used for the original manufacture from raw materials. Despite the potential for considerable energy savings, sustainability researchers have largely focused on sourcing of raw materials, production, and transportation in the apparel industry rather than end-of-use/life (EOU/L) opportunities. My research addresses this gap by exploring the EOU/L initiatives in the apparel industry and developing an operational framework that promotes more environmentally sustainable supply chains.

• Method
Historically, charity organizations have been the only option for giving used garments a second life. More recently, fashion retailers have introduced take-back initiatives aimed at reducing waste and increasing recycling. The success of these initiatives is contingent on the degree to which customers participate. Therefore, retailers often offer incentives (e.g., discount coupons) to encourage participation. We have developed a mathematical model to investigate the impact of these initiatives on a retailer’s profit and environmental sustainability. We consider the customers' level of environmental concern/consciousness and explore optimal incentivizing strategies. We plan to compare the results with the “charity only” option and outline the conditions under which one model outperforms the other in terms of environmental sustainability. Finally, we hope to propose a collaboration framework between charity organizations and fashion retailers that can further enhance the sustainability performance of apparel supply chains.

• Results/implications
We have found the retailer’s optimal incentivizing strategy to be a function of the customers’ level of environmental concern/consciousness. In markets with highly conscious customers, the retailer should offer little to no discount. This is intuitive as more conscious customers are likely to participate, regardless of incentives, to mitigate their environmental impact. On the other hand, if customers have a low level of environmental concern/consciousness, the retailer should offer large discounts to encourage participation. This is an ongoing research project, and we are currently investigating the interaction between charity organizations and retailers.

**Primary Author:** Lin Shao  
**Co-Author(s):** Jinwen Zhang, Baoming Zhao  

**Faculty Sponsor:** Jinwen Zhang  

**Primary College/Unit:** Engineering and Architecture  
**Associated College(s)/Unit(s)** Engineering & Physical Sciences  
**Campus:** Pullman

**Abstract:**

As the demand of PLA increase, post-consumer disposal strategies must be carefully considered. We would love to embrace a bioplastic future, but we also need to tread carefully. While PLA is widely claimed to be biodegradable, full degradation often requires conditions not typically found in landfills or industrial composting. Therefore, it will negatively impact the environment if treated carelessly. In this work, we report a simple PLA upcycling path to turn existing PLA wastes into new 3D printable materials within 48 hours. The ester bonds of PLA can be cleaved efficiently via aminolysis. The obtained monomeric compound was derivatized with methacrylic anhydride, which introduce double bonds and thus cross-linkable monomer is obtained. In combination with comonomer and initiator, a photocurable resin is produced. The resin can be fed into any commercially available photocuring 3D printer. The 3D printed parts derived from PLA wastes exhibit impressive performances with tensile strength of 58.6 MPa, young’s modulus of 2.8 GPa, and glass transition at 180 °C. Our work demonstrates a new route to active upcycling PLA while minimizing the need of disposal.
Magnetic Fields for Enhanced Cyclability of Aqueous Zinc-Bromide Batteries and Beyond

**Primary Author:** Anjaiah Sheelam  
**Co-Author(s):** Jeffrey Gordon Bell  
**Faculty Sponsor:** Jeffrey Gordon Bell

**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s)** Engineering & Physical Sciences  
**Campus:** Pullman

**Abstract:**

High safety, long lifespan and large-scale energy storage devices are attracting intensive efforts because of ever-increasing demand for advanced portable and stationary electronic devices. Dendrite growth and cross-diffusion are the most common problems plaguing metal-based batteries and flow batteries, respectively. We have demonstrated the effect of Lorentz force using internal magnets to retain the reversible capacity for mitigated cross-diffusion of Br3-, dendrite-free zinc deposition, enhanced cycle-life, improved voltage efficiency and energy efficiency of aqueous Zn-bromide batteries (AZBBs) via magnetohydrodynamics. Of the magnetic field strengths investigated (0 – 70 mT), cells incorporating 50 mT achieved a high energy efficiency of 88.8% (coulombic efficiency of 99.3%) with a small decay of 7.6% after 550 cycles. Interestingly, internal magnets resist the self-discharge and exhibit an improved rate-capability (up to 3C rate) of AZBBs. X-ray diffraction, scanning electron microscopy images and energy dispersive X-ray analysis of zinc electrodes of AZBBs containing 50 mT revealed the suppressed cross-diffusion of bromine and dendrite-free zinc deposits. Operando UV-Vis spectroscopic data of membrane electrode assembly (MEA) of AZBB confirmed the retention of Br3- ions at 50 mT, whereas the MEA without magnets suffered severe leaching of Br3- ions into the electrolyte. Further investigations on high-voltage decoupled Zn-MnO2 and Na-ion batteries are in progress.
Impact of the Non-traditional Soil Amendments Application on Soil Health and Cephalosporium Stripe Disease

**Primary Author:** Hongyan Sheng  
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**Faculty Sponsor:**

**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
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**Campus:** Pullman

**Abstract:**

Soil acidification has a negative impact on soil health and crop production and occurs widely in the Pacific Northwest, USA. Acid soils encourage Cephalosporium stripe, which is a major winter wheat disease in the region. Non-traditional soil amendments including fly ash and biochar have been considered for managing soil acidification in recent years. The overall objective was to determine whether biochar and fly ash can improve crop productivity. Field experiments were conducted in two locations during the 2019-20 and 2020-21 crop seasons, and data were collected on rotation crops through 2022. The Pullman, WA site had an initial 0-6” soil pH <5.3. The Rockford, WA site had a 0-6” pH <4.6. Agricultural lime, fly ash, two different types of biochar, and their combinations were incorporated to a 6” depth at both locations in summer 2019 and 2020. The 0-3” soil pH increased significantly in all plots amended with lime or fly ash compared with unamended plots in both locations 10 months after application; however, biochar had no effect. Application of lime and fly ash resulted in significant increases in yield at both sites. The correlation between yield and soil pH was positive with the greatest yield occurring at the highest pH. In addition, the correlation between Cephalosporium stripe disease index and soil pH was negative with the least amount of disease at the highest pH. These results demonstrate the potential for nonconventional liming agents to ameliorate acid soils and improve crop productivity but need to be tested on a larger scale.
Non-Accidental Trauma Trends in Hospitalized Infants with Extremity Fractures

Primary Author: Upinder Sidhu  
Co-Author(s): Gabe Alemayehu  
Faculty Sponsor: André Miguel  
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Campus: Spokane

Abstract:

Introduction: Fractures are common injuries in children with physical abuse. Previous studies suggest an association between abuse and non-accidental trauma (NAT) in non-ambulatory children with fractures. In this study, we reviewed trends and characteristics of non-accidental extremity fractures among hospitalized infants.

Methods: The 2016 to 2020 National Inpatient Sample database was used to identify hospitalized infants 12 months or younger with upper and lower extremity fractures. Patients with diagnosis codes for physical abuse were identified. The queried hospitalizations were weighted to provide national estimates. Primary outcomes of interest were concomitant abuse diagnosis with fractures and injury characteristics.

Results: Our results indicated 4,645 (46.8%) hospitalized patients with concomitant physical abuse and fracture diagnosis. Between 2016 and 2020, fractures associated with physical abuse among hospitalized infants increased from 36.9% to 52.4% in all cases, 36.1% to 51.9% in shoulder and upper arm fractures, and 34.6% to 50.3% in femur fractures. Fractures of the femur (44.2%) and shoulder and upper arm (41.4%) were the most common fracture sites among patients with a concomitant NAT diagnosis.

Conclusion: Our findings reveal an increasing trend in the diagnosis of physical abuse-related fractures among infants. This suggests a possible increase in the occurrence of NAT-related fractures that require hospitalization. Moreover, the diagnosis of NAT may also be increasing as clinician awareness and identification of these presentations is expanding. Providers should continue to be cognizant of the possibility of physical abuse when evaluating infants with fractures.
Literature Review of Human Trafficking in Pediatrics, Trauma and Surgery

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**Campus:** Spokane

**Abstract:**

Human trafficking (HT) is an international crime industry impacting millions of victims. Victim-survivors (VS) of trafficking are forced into sex work, labor, or domestic servitude and, are often physically, mentally, and sexually abused. The prevalence of HT is rising, and healthcare providers should have knowledge regarding HT and its impact on the patients they are treating.

Reviewing the literature on this topic, or lack of it, provides a framework for summarizing key statistics and findings which apply to a surgeon or physician treating a VS. The current surgical literature relating to HT was reviewed, including case reports, systematic reviews, and survey-based studies.

Domestically, over 100,000 minors are at risk of being trafficked annually, and most are recruited between the ages of 12 -14 years, risk factors include: homelessness, LGBTQ, foster care, “run-away” status, and school truancy.

A majority of VS seek medical and surgical treatment for traumatic injuries, burns, suicidal ideation, and sexually transmitted infections while being trafficked. Recurring physical exam findings among VS include: pelvic pain, traumatic injuries, fractures, and branding. Despite recurring presentation patterns, the lack of surgical literature and training in this topic makes identifying VS challenging. Although the surgical literature regarding this topic is limited, relevant trends and statistics exist. The current literature could be used to inform future HT curricula for surgeons as studies suggest formal training improves attitudes, skills, and comfort in identifying and caring for VS. In addition - continued efforts to increase the academic literature would be beneficial to patients, and surgeons.
Chemical Nature and Molecular Structure of Biochar

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Campus: Pullman

Abstract:  
Comprehending how all the operational parameters influence biochar’s molecular structure is required to improve efficiency in the pyrolysis process and obtain a high-value product. More importantly, maximizing the conversion of the carbon present in biomass to biochar is needed. This matter can be addressed by understanding the theoretical formation mechanism of biochar during the pyrolysis process by identifying pathways to remove oxygen from biomass in the form of H2O instead of CO and CO2. Besides, an adequate prediction of molecular structures is a fundamental task for computational quantum chemistry. Nevertheless, the complex nature of the large systems that make up biochar represents a tremendous challenge for molecular modeling and formation mechanism studies. Complexity is due to the multilevel character of biomass pyrolysis, the multiple reaction steps that occur in the process, the solid-gas interaction, and the multiscale of the phenomena involved in the process. Additionally, a simplification in the representation of this molecule can lead to prediction models that lack depth and agreement with experimental data. Most of the molecular models developed in the last decades were for diverse coal ranks; these molecular structures are built based on characterization data. Therefore, each molecular structure highly depends on the conditions employed to obtain the sample characterized in a specific experiment; it is challenging to compare molecular models between authors. Therefore, we develop a methodology that allows the characterization data to be interpreted appropriately, avoiding the researcher’s bias and giving molecular structures of biochar samples that can be comparable and realistic.
Evaluation of the ability of a hydrology model to capture snow processes

Primary Author: Bhupinderjeet Singh
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Faculty Sponsor: Kirti Rajagopalan

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
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Campus: Pullman

Abstract:

Hydrology models used in water resources management are primarily calibrated to streamflow observations. Intermediary processes like snow accumulation and melt – key for estimating streamflow magnitude and timing in snow-dominant watersheds – are not typically calibrated for. The lack of observational data has been one historical bottleneck. Snow telemetry station observations and recently derived gridded products, allow us to perform comprehensive evaluations of the snow model components. Our goal is to understand discrepancies between model simulations and observations for snow metrics, understand how these discrepancies translate to discrepancies in water supply estimates, and explore the benefits of adding snow metrics to the model calibration process. We used a Variable Infiltration Capacity (VIC) model application for the Columbia River basin from 1982 to 2015 as a case study. The evaluation dataset is from NASA’s National Snow and Ice Data Center. We evaluated the model’s ability to capture two aspects (a) the magnitude of snow water via the snow water equivalent (SWE) metric, and (b) the timing via the snow-initiation day, snow-off day, and snow-duration metrics. The observed spatial patterns of all metrics were generally captured by the simulations. There were spatiotemporal differences in the absolute and relative discrepancies. As expected, the absolute discrepancies in SWE were larger in the high-elevation watersheds with more snow ( -1318 to 1135 mm) as compared to lower-elevation areas ( -318 to 425 mm). However, relative discrepancies were also large (median of ~25%) leading to large discrepancies in watershed-level supply estimates. With respect to timing, the higher elevation regions had lower discrepancies in snow duration. This is because both the snow-initiation day and snow-off day were overestimated leading to lower discrepancies in the snow duration as a difference of these metrics. In contrast, in the lower elevation regions, the discrepancies in snow-initiation and snow-off dates were opposing in direction, magnifying the differences in snow duration. These discrepancies highlight the importance of considering this critical intermediate process in model calibration and opportunities to enhance decision support via data assimilation of in situ and remotely sensed observations of snow metrics.
Building an academic-community partnership to facilitate federally-funded research in a Tribally-owned clinic

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**Faculty Sponsor:**

**Primary College/Unit:** College of Behavioral Health/College of Nursing  
**Associated College(s)/Unit(s)**: Medical & Life Sciences  
**Campus:** Spokane

**Abstract:**

Background: American Indian/Alaska Native (AI/AN) people are disproportionately affected by chronic pain. Despite growing acceptance of cannabis for pain management, scant research exists to evaluate its palliative effects. A Tribally-owned clinic contacted Washington State University and Northwest Indian College researchers to investigate the use of cannabis as medicine in their community. The goal of this poster is to describe methods used to create, fund, and implement a study developed in partnership with a Northwest Tribe. Materials/Methods: Initial meetings included key stakeholders to plan a competitive research proposal for federal funding. The project used decolonization methodologies that prioritized the needs of the tribe. AI/AN health science students and research personnel were recruited to ensure the project maintained an AI/AN-centered approach. Permissions were obtained to designate a single Institutional Review Board and create a data sharing agreement. The Tribe’s legal representation was included to assure that contracts maintained Tribal Sovereignty. Weekly videoconference meetings facilitated team-building while specifying roles and study procedures. Results: Funding was secured from the National Institutes of Health for a 4-year prospective longitudinal observational study. Two in-person meetings joined Western and Eastern Washington team members to foster relationship-building and trust. Implementation of recruitment and data collection began November 2022 with the goal of 350 participants. Qualitative data collection includes interviews structured to center AI/AN voices and experiences. Conclusion: Intentional collaboration between project stakeholders led to successful proposal development and launch of study protocols. In-person meetings allowed for questions and issues to be resolved in real-time.
Quick-cooking laminated white salted noodle development

**Primary Author:** Gabriely Maria Soncin Alfaro  
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**Faculty Sponsor:** Alecia Kiszonas

**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s):** Agricultural & Natural Sciences  
**Campus:** Pullman

**Abstract:**

**TOPIC:** This study developed a novel quick-cooking, fresh white salted noodle (Udon noodles) by combining the pasting characteristics offered by full waxy wheat and the texture provided by wheat with a normal starch profile in a three-layer laminated noodle. The different amylose/amylopectin ratios in varieties of wheat starch influence the pasting properties of flours milled from those varieties as well as the resulting food applications. Pasting properties are important in establishing optimal reduced cooking times. Developing a faster cooking process represents a benefit to the noodle industry, restaurants, and also home preparations, saving time and energy, and lowering production costs. Using waxy wheat flour to reduce the amylose content in white salted noodles increases the cohesiveness of the noodle; however, noodles created entirely from flour that is milled from full waxy wheat results in undesirably high softness in the resulting noodle.

**METHOD:** Flour from three wheat varieties – Otto (normal starch), Ryan (partial waxy), and USDA Lori (full waxy) – were used to create these Udon noodles. The impact of the new formula and process on noodle texture, color, weight increase, cooking time, and cooking loss was investigated with American Association of Cereal Chemists approved methods of analysis and compared with results from the control – standard noodles made from commercial flour.

**RESULTS:** The three-layer laminated noodles with outer layers of normal starch and inner layer of waxy wheat cooked faster (8min 30s; P<0.0001) than regular or three-layer commercial flour noodles (10min 30s). The combination of normal-starch and full waxy wheat produced laminated noodles with lower cooking time, similar cooking loss, slightly firmer texture, and lower water absorption than noodles made with commercial flour.

**IMPLICATIONS:** With noodles being a staple food in many Asian countries and consumption increasing in other regions of the world, this novel three-layer laminated noodle is a time and energy saving new application for waxy wheat.
Effects of Environmental Heat Stress on Potato Physiological Aging

Primary Author: Morgan Southern
Co-Author(s):

Faculty Sponsor: Jacob Blauer

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s): Agricultural & Natural Sciences
Campus: Pullman

Abstract:

Potatoes (Solanum tuberosum L.) are a temperate, heat-sensitive crop that are particularly threatened by increased stress from abiotic factors such as heat. Both global and regional heat events are predicted to increase in intensity and frequency, causing significant decreases in potato production worldwide by the end of the century. The future of potato production is dependent on understanding the implications of heat stress on potato physiology and the potato industry’s ability to adapt grower practices to the changing environment. Heat has been demonstrated to play a critical role in physiological aging (PAGE) of potato tubers with alterations in PAGE resulting in measurable phenotypic responses such as stem count, size, and yield that directly impact the quality of the crop and subsequent grower returns. Each season’s expected spring warming patterns provide a window of opportunity for improved practices and crop performance across cultivars of varying maturity indices. Altered planting times have the potential for practical responses to heat stress by understanding its modification of heat unit accumulation rate and intensity, oxidative stress, respiration rate, and the tuber size and yield distribution. Findings from two years of study have shown evidence that delayed planting times contribute to the PAGE of tubers through increased basal respiration rates and changes in stem counts. Ongoing investigations into the molecular mechanisms behind these phenotypic changes include analysis of IAA oxidase which may explain a loss of apical dominance associated with increased stem counts, reactive oxygen species which may explain increases in respiration rates, and genome analyses of dormancy-related genes. Similar changes have been demonstrated to impact the subsequent year’s crop performance by altering the expected phenotype and associated grower returns. Continued understanding of heat stress as it relates to PAGE and planting timing may provide growers with an opportunity to maximize returns and minimize waste while potentially increasing food security both domestically and internationally.
visual reporter system for tracing extracellular adenosine triphosphate signaling in plants points to root tip tissues

Primary Author: Joel Sowders
Co-Author(s): 
Faculty Sponsor: Kiwamu Tanaka
Primary College/Unit: Agricultural, Human and Natural Resource Sciences
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Campus: Pullman

Abstract:

Topic
All living cells utilize adenosine triphosphate (ATP) to fuel cellular activity. Central to metabolism, ATP is kept at high concentrations within cells and is found in low concentrations in the extracellular environment. Aside from an energy source, ATP is a potent signaling molecule in plants and animals. A steep concentration gradient between intra- and extracellular ATP lends to sensitive detection of ATP efflux. Acute mechanical distress can cause individual cells to rupture, which bleed ATP from its cellular compartment into the surrounding microenvironment. There, extracellular ATP (eATP) becomes a danger stimulus—signaling cellular damage. In plants, cells adjacent to damage detect rising eATP concentrations through the cell surface receptor kinase, P2K1. Following eATP perception, P2K1 initiates a signaling cascade mobilizing plant defense. Cellular damage in plants is characteristic of herbivory and pathogen invasion. Without specialized and adaptive immune cells, plants instead rely on general features of cellular damage, such as extracellular ATP, to initiate an appropriate immune response. To better understand the contribution of eATP to plant immunity, the long-term goal of our work is to characterize the signaling activities of plant eATP receptor, P2K1, and describe the physiological response generated by its activity.

Method
Recently, we used a next-generation sequencing approach to identify transcriptional responses initiated by P2K1 following perception of eATP. From there, a profile of eATP-induced genes was constructed including many pathogen- and wound-response genes—consistent with our working model of eATP as a defense-mobilizing danger signal. To build on the transcriptional footprint and broaden our understanding of the eATP signaling response in plants, we aimed to (i) generate a visual toolkit for eATP-inducible marker genes using a $\beta$-glucuronidase reporter system (GUS) and (ii) evaluate the spatiotemporal response of these genes to eATP in plant tissues.

Results
Here, we report eATP signal reporters were highly induced in primary root meristem and elongation zones and responses were maximal two hours after extracellular ATP elevation. These results support a suggestion for primary root tip tissues as a signaling core for eATP-mediated defense response through P2K1 receptor activity.
Assessing wildlife communities in relation to land use in east-central Washington

**Primary Author:** Allison Stift  
**Co-Author(s):** Steven Woodley, Lisa Shipley, Daniel Thornton  
**Faculty Sponsor:** Lisa Shipley  
**Primary College/Unit:** Agricultural, Human and Natural Resource Sciences  
**Associated College(s)/Unit(s):** Agricultural & Natural Sciences  
**Campus:** Pullman

**Abstract:**

Principle Topic  
Sagebrush-steppe habitat and the associated wild vertebrates are a conservation priority in Washington. However, the remaining sagebrush-steppe in east-central Washington has been fragmented by row-crop agriculture on private lands for decades. In response, a variety of conservation actions have been implemented such as shifting from conventional to direct-seeding farming and restoring permanent vegetation cover on former croplands through the federal Conservation Reserve Program (CRP).

**Methods**

In this study, we examined occupancy of native wildlife within the complex agricultural CRP-sagebrush mosaic within east-central Washington using camera traps from May-August in 2021 and 2022 in Douglas, Lincoln, and Grant counties of Washington. We placed four trail cameras within a 10-ha plot at 94 study sites within native sagebrush steppe, CRP, and croplands that used either direct or conventional seeding. At each camera, we conducted vegetation and pellet surveys along a belt-transect. We are currently identifying wildlife species from camera images to model the occupancy of wildlife in relation to land use, agricultural practices, habitat features, and landscape context.

**Results/implications**

From these models, we plan to identify the key local and landscape features that influence occupancy of wildlife and identify connected areas of high occupancy probability for sagebrush species. This study seeks to provide conservation planners and local private landowners with a better understanding of the conservation benefit to wildlife from agriculture practices, land restoration projects, and intact sagebrush.
Design and Synthesis of Low-Cost Precursors for High Energy Density Battery

Primary Author: Muqiao Su  
Co-Author(s): Min-kyu Song  
Faculty Sponsor: Min-Kyu Song  
Primary College/Unit: Engineering and Architecture  
Associated College(s)/Unit(s): Engineering & Physical Sciences  
Campus: Pullman  

Abstract:

Silicon is one of the most promising anode materials for next-generation lithium-ion batteries, because it possesses a specific capacity that is almost ten times higher than that of current graphite anode. However, silicon-based anodes usually suffer from a short cycle life due to the particle pulverization caused by large volume change of Si (~300%) during the lithiation and delithiation process.

To extend the cycle life of silicon anodes, we have developed a scalable and low-cost process to synthesize porous silicon that can alleviate the detrimental effects brought by the volume expansion. The process includes Mg2Si synthesis through thermal processing of Si and Mg mixtures, air oxidation of Mg2Si, and MgO removal through HCl leaching. Among many processing parameters studied in this work, we found that two distinct particle morphology can be obtained by carefully controlling the amount of Mg used in Mg2Si synthesis. When deficient Mg is used, porous silicon with a bulk core and three-dimensional (3D), interconnected porous shell can be obtained.

The bulk core-porous shell silicon anode showed excellent electrochemical performances up to 300 discharging/charging cycles, much greater than 3D fully porous and bulk silicon counterparts. Our research offers a scalable and low-cost production route for silicon anodes in high energy density lithium-ion battery applications.
The Impacts of Restricted Rotational Diffusion on Catalysis within the Small Pores of Mesoporous SBA-15 Silica

Primary Author: Zengran Sun  
Co-Author(s): Steven Saunders  
Faculty Sponsor: Steven Saunders  
Primary College/Unit: Engineering and Architecture  
Associated College(s)/Unit(s) Engineering & Physical Sciences  
Campus: Pullman  

Abstract:  
• Principal topic  
Catalysts facilitate the production of synthetic chemicals that enable modern life, and small improvements in their efficiency create more sustainable chemical synthesis processes. Nano-scaled metallic catalysts equipped with pores show improved efficiency in enhancing the rate of chemical reaction due to the added surface reaction sites. Our previous work has demonstrated that porous gold catalysts are more efficient in oxidizing benzyl alcohol compared to nonporous gold catalysts, suggesting that the pore structure enhances catalysis. When the reaction species (e.g., benzyl alcohol) and the catalysts are in different phases, the reaction species must first approach the catalyst surface via diffusion and then attach to the catalyst surface with a preferential direction, allowing for a surface reaction. However, the direct observation of molecular motions (e.g., translation & rotation) is difficult due to the small pore size and the obstruction within the pore environment. We hypothesize that the pore structure does not impact the translation and hinders the random rotation of the reaction species.

• Method  
Herein, diffusion-ordered spectroscopy (DOSY) and proton nuclear magnetic resonance (1H NMR) relaxation are used to determine diffusion coefficients, allowing for the investigation of translation and rotation of benzyl alcohol. Translation decides if the obstruction prevents reaction species from reaching catalyst surface, and rotation determines the direction of surface attachment. Once the diffusion coefficients are obtained at different temperatures, they can be related via Arrhenius behavior to provide an energy barrier for that type of motion, where higher barriers indicate more difficult for molecular motions within pore environment.

• Results/implications  
We measured the diffusion coefficients at different temperature and determined the energy barriers for the translation and rotation of benzyl alcohol in the porous and nonporous gold catalysts. The pore structure imposes a higher energy barrier for the rotation and lessens the energy barrier for the translation of benzyl alcohol. This suggests that, compared to the nonporous gold catalysts, the porous gold catalysts can facilitate the transportation of the reaction species to reach catalyst surface and effectively restrain the randomly oriented reaction species, creating the desired direction for the surface attachment of reaction species onto the catalyst surface.
Disparities in Access to Radiation Therapy by Race and Ethnicity in the United States with Focus on American Indian/Alaska Native People

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**Faculty Sponsor:**

**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s)** Medical & Life Sciences  
**Campus:** IREACH

**Abstract:**

Racial and ethnic minority patients experience striking disparities in accessing radiation therapy (RT). This study analyzed census block group data to evaluate differences in travel distance to RT as a function of neighborhood race and ethnicity, socioeconomic status, and rurality. Results demonstrate that travel distances in American Indian and Alaska Native-majority block groups (i.e., ≥ 50% population AI/AN people) were 39 to 41 miles longer than in areas with non-AI/AN majorities. Travel distance was 1.3 miles longer in more deprived areas versus less deprived areas, and 16 to 32 miles longer in micropolitan, small town, and rural areas versus metropolitan areas. Patients with cancer in census block groups with majority American Indian and Alaska Native (AI/AN) populations, non-metropolitan location, and low socioeconomic status experience substantial travel disparities accessing RT. There is a need for future research with more small community- and individual-level data that explore other known barriers to access to cancer care and their relationship to the barriers posed by distance to RT care.
Sublethal effects of interactions between salinity and temperature in an intertidal copepod

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Faculty Sponsor: Wes Dowd

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Medical & Life Sciences
Campus: Pullman

Abstract:

Accurate prediction of organismal responses to changing climates requires careful consideration of interactions between multiple stressors, as these understudied interactions can lead to unpredictable outcomes. We use intertidal splash pools as a model, dynamic system to explore responses to temperature at various salinities in the copepod Tigriopus californicus. Temperatures of the splash pools this copepod inhabits in Northern Washington can change by more than 20°C in a day, and salinities range from around 10 to 140ppt. Interestingly, T. californicus’ heat tolerance increases upon introduction to higher salinities, contrary to what may be expected by examining effects of these stressors singularly. To further elucidate sublethal organismal responses to these interacting abiotic factors, here we measure activity and metabolism under changing regimes of temperature and salinity. Activity was quantified at all salinities with a microplate-based temperature ramping assay, and copepod aerobic metabolic rate was quantified at all salinities and temperatures with a microplate-based respirometry system. Results from activity assays show a significant interaction such that temperature’s effect on activity is dependent on the acclimation salinity. Metabolic rate data show an expected influence of temperature on metabolic rates as well as a significant temperature by salinity interaction, where increased temperature imposes a smaller cost at high salinities. These results provide evidence that effects of multiple stressors interact with one another beyond merely survival, emphasizing the importance of considering multiple stressors simultaneously when applying research outcomes to predict organismal responses and managing environments in the face of climate change.
Developing Elementary Teachers’ Noticing of Access and Equity through Lesson Study

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Campus: Pullman

Abstract:

We examined how lesson study supported teachers in enacting equitable practices that support students’ access to high quality mathematics learning. Twenty-two teachers were part of an Elementary Math Committee (EMC) who planned, enacted, and debriefed mathematics lessons in a K-5 context. Lesson study is a collaborative approach that enables the design, analysis, and ongoing improvement of teaching methods through observation and assessment of student learning (Lewis, 2019). With a focus on equitable practices, teachers planned lessons centered on cultural practices and connected mathematics content to students’ experiences (Rubel, 2017).

We used qualitative, instrumental case study methods to better understand how lesson study supported teachers in achieving this goal (Yin, 2014). Qualitative methods support researchers in understanding and investigating complexities in social systems. With a focus on equity-based practices, we addressed the following research question, how did lesson study support the EMC teachers to increase students’ access to math content through equitable practices? We collected lesson study artifacts (curriculum materials and lesson plans) and video recordings of lessons and meetings. We engaged in multiple data analysis cycles that included thematic coding and analytic memo writing (Saldaña, 2021).

Our findings suggest that lesson study supported teachers in noticing curriculum, student access, and equity in different ways. Teachers identified opportunities in the curriculum to connect to students’ experiences and home-based practices to support students’ access to mathematical content. Moreover, teachers observed students’ strategies and built on those to respond to students’ needs. This study has implications for mathematics teacher educators and professional development.
Evaluating the impact of gas ultrafine bubbles on the efficacy of antimicrobials for eliminating fresh and aged Listeria monocytogenes biofilms on dairy processing surfaces

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**Associated College(s)/Unit(s):** Medical & Life Sciences  
**Campus:** Pullman  

**Abstract:**

Principle topic: Ultrafine bubble (UFB) technology is a novel concept in food processing with the potential to enhance the potency of antimicrobials to eliminate biofilms. This study investigated the impact of incorporating gas [air, carbon dioxide (CO2), and nitrogen (N2)] UFBs on the potency of chlorine (Cl2; 50, 100, and 200 ppm) and peracetic acid (PAA; 20, 40, and 80 ppm) antimicrobial (AM) solutions against fresh (3 days) and aged (30 days) Listeria monocytogenes (LM) biofilms on polypropylene, silicone, and stainless steel surfaces.

**Method:** The LM biofilms were statically grown on polypropylene, silicone, and stainless steel coupons at 25°C for 3 days or 30 days, by immersing in LM-inoculated brain heart infusion broth. The coupons were then treated by submerging in AM solutions with and without UFBs for 1 minute, and thereafter swabbed into Dey-Engley neutralizing broth and enumerated on BHI agar. The log reductions for the respective antimicrobial treatments were calculated by subtracting post-treatment biofilm bacterial populations from untreated biofilm bacterial populations.

**Results/Implications:** Incorporation of CO2 UFBs in AM solutions resulted in significantly greater log reductions (2.4- 3.9 log CFU/cm2) of fresh and aged LM biofilms on polypropylene, silicone, and stainless steel compared to AM solutions without UFBs on the respective surfaces (1.4-2.9 CFU/cm2). The incorporation of 200 ppm Cl2 resulted in significantly greater log reduction of LM biofilms on fresh and aged on all surfaces compared to 50 ppm Cl2, 20 ppm PAA, and 40 ppm PAA.
Automated Lag Phase detection in Wine grapes

Primary Author: Priyanka Upadhyaya
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Faculty Sponsor: Manoj Karkee

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s): Agricultural & Natural Sciences
Campus: Prosser (IAREC)

Abstract:

Lag phase is an important phenological stage in wine grape production when the berry growth reaches roughly half of their final size and pauses for about two weeks. Accurate detection and prediction of lag phase is vital for crop-estimation and overall vineyard management. In this study, an automated berry growth tracking system was developed using cell-phone-based imaging, which was then used to detect lag phase occurrence in a wine grape plot. A Mask-R-CNN-based berry detection model was used to delineate berries for tracking. The instant segmentation mask and bounding box covering the individual berries were used to segment out individual berries and estimate their diameters in pixels. A reference object with known size was placed in the camera field of view to calibrate the images such that physical size of berries could be estimated from pixel diameter. The berry detection algorithm achieved a Mean Average Precision of 0.9 and the diameter estimation algorithm achieved a Root Mean Square Error (RMSE) of 0.473 mm. The estimated diameters over the season were plotted to observe the berry growth trend and obtain the growth model. Lag-phase for the test vineyard was estimated with this growth model to start from 22nd July in 2021 and from 8th August in 2022. The actual start of lag-phase was observed on 24th July in 2021 and on 14th August in 2022. Since this model used cellphone images for berry growth tracking and lag-phase estimation, it will be a simple and low-cost solution offering a user-friendly and convenient sensing system for lag phase detection in wine grapes.
Abstract:

The Metaverse offers a new distribution channel to e-fashion retailers for providing physical product experience online. Then, consumer acceptance of and interaction with digital fashion in physical and online environments is crucial. Therefore, to provide the insights to enhance customer experience and increase competitiveness in the fashion industry, this study explored how consumer knowledge in digital fashion influence consumer’s perceived risk and attitude toward metaverse which lead intention to purchase physical products. To test hypotheses, this study conducted an online survey with snowball sampling via social media. 32 U.S. consumer samples with multiple regression tests showed that consumer knowledge of metaverse positively influences attitude toward digital fashion. Then, positive attitude leads purchase intention. Therefore, e-fashion retailers to educate consumers of this new metaverse distribution channel, considering it seems increasingly likely that virtual worlds like the Metaverse will become an important channel for connecting with the next generation of consumers.
Transcriptomics analysis of hemocytes isolated from Rhipicephalus microplus female ticks infected with Babesia parasites reveals effector components of tick innate immune system.

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**Faculty Sponsor:** Massaro Ueti

**Primary College/Unit:** Veterinary Medicine  
**Associated College(s)/Unit(s):** Medical & Life Sciences  
**Campus:** Pullman

**Abstract:**

The defense mechanism against parasites via arthropod hemocytes consists of cellular and humoral responses. The arthropod humoral effector components such as Prophenoloxidase, Antimicrobial Peptides, and Pattern Recognition Receptors, produced by hemocytes regulate the infection. The cellular immunity derived by hemocytes comprises phagocytosis, encapsulation, nodulation, and coagulation. Despite the critical involvement of hemocytes in immune responses against bacteria, fungi, and parasites by arthropods, our understanding of their anti-protozoan potential is still limited. In this study, we evaluated high throughput RNA-Seq of hemocytes from infected female Rhipicephalus microplus ticks with protozoan parasites, Babesia bovis and Babesia bigemina. The goal of this study is to identify potential immune responses against Babesia parasites. Together with dual transcriptome analysis, the elevation of transcripts of humoral effector components such as defensin, microplusin, receptor expression-enhancing protein 5-like, cytochrome C, B-cell receptor-associated protein 31-like, and complement C3-like indicate the activation of humoral immune response of hemocytes against Babesia parasites. Interestingly, the major cellular immune response, apoptosis is not active upon the infection, where the transcripts of Homeodomain-interacting protein kinase 2 (HIPK2), Apoptosis-stimulating of p53 protein 2-like, and Endosome/lysosome-associated apoptosis and autophagy regulator family member 2-like are down-regulated upon the infection. The data present herein will provide insight into the tick hemocytes-mediated immune response against protozoan parasites.
Enhanced collagen gene expression is a hallmark of healthy aging

**Primary Author:** Archer Wang  
**Co-Author(s):** Ben Liu

**Faculty Sponsor:**  
**Primary College/Unit:** Office of Research  
**Associated College(s)/Unit(s):** Medical & Life Sciences  
**Campus:** Spokane

**Abstract:**

Advances in nutrition, technology, and healthcare have led to a drastic increase in human life expectancy, which has more than doubled since 1900. Also of note is the decline in birthrates in developed countries. Taken together, it is estimated that by 2050, 22% of the world’s population will be over the age of 60. With an increased life expectancy there comes an increased occurrence of chronic conditions associated with aging. These conditions not only negatively affect the quality of life for the individual but can also have immense negative impacts on society through increased healthcare costs. With these impacts in mind, the focus must shift to increasing the healthy lifespan, or “healthspan.” Although this term is not currently well defined, it does include several important metrics including stress resistance, mobility, and cognitive function. Here we have used the model organism C. elegans to investigate the healthspan. Our earlier work has demonstrated that collagen expression is involved in both the worm’s resistance to infection and high temperature. In this study, we utilize our RNAseq data in conjunction with publicly available datasets to demonstrate that enhanced collagen expression, being a hallmark of healthy aging, could potentially be used as a biomarker to further investigate the efficacy of treatments affecting the healthspan.
Subjective Sleepiness is Influenced by Emotional Reactivity

Primary Author: Jiayi Wang  
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Faculty Sponsor:

Primary College/Unit: Spokane  
Associated College(s)/Unit(s): Social Sciences  
Campus: Spokane

Abstract:

During total sleep deprivation (TSD), individuals report decreased positive affect and increased sleepiness. However, positive affect questionnaires often ask people about their level of arousal, which may conflate with subjective sleepiness. If individuals use similar information to evaluate subjective affect and sleepiness, those who are more emotionally reactive, and experience more intense emotions, should experience more intense subjective sleepiness.

N=34 healthy normal sleepers (22-37y, 21 females) participated in an in-laboratory study with 10h baseline sleep, 38h TSD, and 10h recovery sleep. During TSD, subjects completed the Karolinska Sleepiness Scale (KSS) to assess subjective sleepiness in bouts scheduled every 2-4h. Prior to the study, subjects completed the Emotional Reactivity Scale (ERS), a self-report measure of emotional reactivity.

To assess the relationship between baseline emotion reactivity and subjective sleepiness during TSD, we conducted a regression on KSS ratings with bout, ERS scores, and their interaction, controlling for sex and age. The effect of bout was significant (F=19.20, p<0.001). Overall, subjects reported greater sleepiness as a function of time awake and time of day (p<0.01). Additionally, there was an effect of ERS (F=6.81, p=0.009), with increasing scores predicting greater subjective sleepiness overall.

These findings indicate that baseline emotional reactivity influences subjective sleepiness. This suggests that self-reported sleepiness reflects people’s underlying state of arousal or some other non-specific characteristic that may be conflated with emotion. This has important implications for people’s judgments of readiness in operational settings and theoretical implications for the assessment of subjective states.

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X-ray Emissions of Galaxies with Active Central Black Holes

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**Primary College/Unit:** Arts and Sciences  
**Associated College(s)/Unit(s)** Engineering & Physical Sciences  
**Campus:** Pullman

**Abstract:**

Studying massive black holes at the centers of galaxies is essential for understanding how black holes form and grow. However, black hole activity is sometimes obscured by dust and contamination of star formation. Thus, it is important to collect data for active galaxy centers in every wavelength possible, combining resources from a set of observatories to discern the environment of the black hole. Using archival data from the Chandra X-ray Observatory and the XMM Newton Serendipitous Source Catalogue, we collect X-ray emissions for 16 objects galaxies that were previously identified as having active black holes based on their ultraviolet variability. We find that 11 of these objects have bright X-ray emission, indicative of an active central black hole. For the other five galaxies, we measured an upper limit on their X-ray emission. We compile additional data for these galaxies from optical and infrared surveys. We can then compare to known relationships of X-ray-to-optical and X-ray-to-infrared. We find that objects whose optical spectroscopy identified them as having central active black holes fit closer to these relationships then those whose optical spectrum contained did not identify an active black hole. This points to the effects that dust and absorption can have in clouding the signatures of black hole activity.
Descriptive analysis of rural training track residency program websites

Primary Author: Jeffery Weyand  
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Faculty Sponsor:  
Primary College/Unit: Spokane  
Associated College(s)/Unit(s) Medical & Life Sciences  
Campus: Spokane  

Abstract:  
The first place medical students go to learn about residency programs across the country is the internet. Several databases exist for learning about general program characteristics. However, the information provided is very limited and some require a paid membership, which can be a barrier for some students. Students also visit program websites, but the effectiveness, thoroughness, and relevance of the information on each program website is highly variable.

My project has been to look for the presence or absence of 52 components of each website of the 72 family medicine residencies that are members of the rural training track (RTT) collaborative. These RTT residencies equip physicians with remarkably broad skill sets to address the varied needs of patients living in rural communities. Only a minority of medical students are aware of RTT programs. It is crucial for RTT program websites to be high-quality resources that students can rely on when learning about rural training opportunities.

Here are a few examples of what I’ve discovered: 32% of RTT program websites describe the clinical rotations their residents complete, 57% describe general procedural training offered, 22% describe on-call requirements for residents, 11% offer the average number of deliveries residents participate in, 5% describe the number of emergency department visits to the program’s main hospital, 8% describe housing opportunities in the rural community, and 24% link to a social media account. Understanding the current state of residency websites is an important first step in encouraging more physicians to train and practice in rural locations.
Effects of electric fields and oxygen vacancies on CO2 and H2O co-reduction on La-Based perovskite surfaces

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Faculty Sponsor: Jean-Sabin McEwen

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

Principle Topic
Renewable energy used in conjunction with solid oxide electrolysis cells (SOECs) can produce renewable fuel precursors like H2 and CO from the reduction of CO2 and H2O feedstocks to store energy in chemical bonds. Past work has focused on the application of metal catalysts in SOECs, but they suffer from reduced activity under redox conditions of this process. Perovskites catalysts offer an alternative pathway for catalyzing this reduction reaction due to their higher stability under redox conditions but have limited activity as compared to metal catalysts. La-based perovskites are noteworthy due to their stability and higher activity for the reduction reaction.

Method
To improve the understanding of surface reactivity, we propose using theoretical studies using Density Functional Theory to better understand the reduction mechanism combined with experimental results to ground the theory calculations. Our hypothesis is electric fields and oxygen vacancies improve surface reactivity and exploring their properties using accurate models will enhance the understanding of the complexities of perovskite surfaces (LaNiO3, LaFeO3 and LaCoO3).

Results
In our initial studies, we have found that DFT can be used to accurately predict the O 1s spectra of LaNiO3 and LaCoO3 by capturing the effects of adsorbed species on the surface core level binding energy shifts. We have studied the effects of coverage on the adsorption of CO2 on all studied surfaces using vibrational calculations and we found that CO2 adsorbs in a bidentate configuration on LaNiO3 and in a monodentate and bidentate configuration on LaFeO3 and LaCoO3 matching experimental DRIFTS results. Our mechanism studies revealed adsorption of CO2 on all surfaces was favorable showing that the CO2 dissociation or CO desorption are the rate limiting step and oxygen vacancies increased adsorption energy. Finally, we studied the effects of electric fields on the local potential shifts of the LaNiO3 where we found that the direction of the electric field shifted the potential in the same direction. Further studies on electric fields will investigate their effects on surface properties culminating in adsorption studies. These results are important for creating an overall model to get accurate results concerning the surface reduction mechanism.
Works for the Bassoon by Native American Composers

Primary Author: Jacqueline Wilson

Co-Author(s):

Faculty Sponsor:

Primary College/Unit: Arts and Sciences
Associated College(s)/Unit(s) Liberal Arts & Humanities
Campus: Pullman

Abstract:

Native American and Indigenous composers are often overlooked in the field of Classical music performance and recording projects. Indeed, awareness of these composers appears to be lacking amongst performing Classical musicians, including those who proport to be engaged in repertoire-diversifying efforts. For example, the Institute for Composer Diversity, an organization based at the State University of New York at Fredonia that provides databases of composers from underrepresented groups, includes only nine Native Americans in their collection of over 1,700 composers. Similarly, No Broken Links, a website that features instrument-specific repertoire lists highlighting composers who are womxn, transgender & gender non-conforming individuals, and/or Black, Indigenous, or persons of color, includes only three pieces by Native and Indigenous composers in their list of over 480 works for the bassoon.

This project features the premiere recordings of works for the bassoon by Native American composers employing a decolonized approach that promotes self-representation. Multi-dimensional and diverse points of view are presented by incorporating transcriptions, commissions, and original works from PI Jacqueline Wilson (Yakama) by composers of various tribal, stylistic, and aesthetic perspectives including pieces by Louis W. Ballard (Quapaw), Juantio Becenti (Diné), Raven Chacon (Diné), Connor Chee (Diné), and Jack Kilpatrick (Cherokee). The culminating project resulting from these efforts, Works for the Bassoon by Native American Composers is a classical music album released on the WSU record label in November 2022.
Understanding the herding behavior of China’s hospitality stocks

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**Faculty Sponsor:** Ming-Hsiang Chen  
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**Campus:** Pullman  

**Abstract:**

As a novel attempt of introducing behavioral finance to hospitality finance research, this paper investigates the existence of herding behavior among investors in China’s hospitality stocks based on daily stock data of 20 A-share listed firms during the period from March 28, 2001, to August 1, 2022. Using the non-linear model proposed by Chang et al. (2000) and the least squares regression, several unique evidence of herding behavior in these stocks is demonstrated. Concretely, there exists more evident herding behavior in hospitality stocks and tourism stocks in particular than that of all A-share stocks, SSE A-share stocks and SZSE A-share stocks in China, but no herding behavior in hotel stocks. Also, herding behavior is asymmetric under different market status as it generally more prominent during market losses. Moreover, identified as a time-evolving anomaly, herding behavior is more pronounced in recent period than in early period. In addition, investors hold attentions on large hospitality stocks are more likely to herd than those interested in the small ones. These findings offer valuable investment strategies for investors interested in China’s hospitality stocks.
Implementing Universal Design for Learning Principles into Multi-Tiered System of Supports: A Discussion Paper

**Primary Author:** Yu Xue  
**Co-Author(s):** Marcus Poppen

**Faculty Sponsor:** Marcus Poppen

**Primary College/Unit:** Education  
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**Campus:** Pullman

**Abstract:**

Universal design for learning (UDL) is widely discussed in special education; it provides three principles of instruction (representation, action and expression, and engagement) and nine guidelines teachers can implement to meet the different needs of all students, including students with disabilities. Multi-tiered system of support (MTSS) is a continuum of the system-wide model adopted in K-12 public schools to provide multi-tier instructions and interventions to monitor all students’ academics and behavior, aiming to improve students’ development and cultivate a positive school climate (Averill & Rinaldi, 2011). In general, MTSS identifies students in one of three tiers (universal, targeted, and intensive) and provides evidence-based interventions that meet a student's needs. UDL is considered a primary teaching strategy from the beginning to the end of this support. However, teachers still have barriers to implementing UDL principles and guidelines across the three tiers of MTSS. For the Academic Showcase, I seek to present a new model that I have developed to help illustrate how UDL can be implemented within a MTSS in practical ways. The model – Multi-tiered Universal Learning Support Model (MTULS) – was developed using evidence-based research and theories and aligns the various principles and guidelines of UDL within an MTSS framework. Through this model, I can show that as the instructional needs of students increase, so does the need for more comprehensive teaching methods. These are important findings for the field and support the need for additional guidance on UDL strategies for teachers working across the different tiers of MTSS.
A META-ANALYSIS OF INTERNAL BRANDING IN HOSPITALITY

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Primary College/Unit: Business
Associated College(s)/Unit(s): Administrative & Information Systems
Campus: Pullman

Abstract:

Introduction
Research on internal branding’s impacts on hospitality organizations is limited to three perspectives. First, the conceptualization and scope of internal branding did not reach a consensus (Dhiman & Arora, 2020). Second, different ways of specifying internal branding make it difficult to establish an incremental understanding of this concept (Buil et al., 2016). Third, internal branding-related antecedents in the hospitality work context and the magnitude of their effects on desired outcomes remain unclear. In order to address these limitations, this study conducted a meta-analytic review of hospitality literature.

Methods
We searched the articles published since 1999 in academic databases and hospitality journals. After screening out studies that did not meet our inclusion criteria, 49 articles were selected for further meta-analysis. Following Hunter and Schmidt’s (2004) meta-analysis procedure, we employed a random-effects model and addressed unreliability in the observed correlations at a single study level (Gui et al., 2020). 95% credibility intervals, Hedges’s Q, and Z-test were performed.

Results
Internal communication ($\rho = .54$), brand knowledge ($\rho = .72$), brand leadership ($\rho = .66$), and brand value fit ($\rho = .75$) showed positive correlations with brand commitment. Brand knowledge ($\rho = .63$), brand training ($\rho = .56$), brand leadership ($\rho = .45$), and internal communication ($\rho = .47$) were significant antecedents of brand loyalty. Brand knowledge showed a significant correlation with brand word of mouth ($\rho = .78$). Brand value fit significantly correlated with brand citizenship behavior ($\rho = .64$). Internal communication was a significant antecedent of brand behavior ($\rho = .44$) and brand identification ($\rho = .53$).
Electrochemistry of Deep Eutectic Fluorinated Ether Electrolyte in Li-SeS2 batteries

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**Primary College/Unit:** Engineering and Architecture  
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**Campus:** Pullman

**Abstract:**

Lithium-Selenium disulfide (Li-SeS2) batteries are a promising electrochemical system with much higher energy density compared to current Li-ion batteries. However, Li-SeS2 batteries with conventional ether-based electrolytes undergo rapid performance degradation due to the "shuttle phenomena" associated with the formation and dissolution of poly-sulfide/selenide intermediates during battery cycling. Deep Eutectic Solvent (DES) electrolyte promise wide thermal stability and cost effectiveness compared to conventional commercial electrolytes. However, at high lithium salt concentrations, the high viscosity of DES hinders interfacial lithium-ion transport and it can passivate Li-metal anodes. Dilute fluorinated ether has been implemented to improve bulk lithium-ion transport in other battery systems. In this study, we have designed novel, DES-based fluorinated ether electrolyte and investigated their thermal stability and lithium-ion solvation structure. Implementing novel DES-based electrolytes in Li-SeS2 battery, we were able to reduce the performance degradation, retaining (>92%) of initial discharge specific capacity after high-rate cycling, achieve high coulombic efficiency (>99%), and achieve good battery cycling performance. This work provides new strategies for developing highly stable liquid electrolytes for high-energy Li-SeS2 batteries.
Photo-curing 3D Printing of Thermosetting Sacrificial Tooling for Fabricating Fiber-Reinforced Hollow Composites

Primary Author: Baoming Zhao
Co-Author(s): Cheng Hao, Yu-Chung Chang, Yiding Cao, Tuan Liu, Mingen Fei, Lin Shao, Jinwen Zhang

Faculty Sponsor:

Primary College/Unit: Engineering and Architecture
Associated College(s)/Unit(s) Engineering & Physical Sciences
Campus: Pullman

Abstract:

Global trends toward CO2 reduction and resource efficiency have driven the increasing demand for lightweight fiber-reinforced composite materials in automotive and aerospace industries. As an example, the airframe of Boeing 787 Dreamliner is primarily made of composites, and each aircraft contains approximately 77,000 pounds of composite materials. While composite structures with basic shapes and uniform cross sections can be easily manufactured, fabrication of composite structures with hollow interiors or complex geometries presents a unique manufacturing challenge. Any geometry that traps a mandrel or core inside requires sacrificial tooling. Currently, such tooling can be 3D printed using fused deposition modeling (FDM) and binder jetting techniques. However, the low printing resolution of FDM/binder jetting requires several post processing steps before the printed tooling can be used for composite manufacturing. Further, the materials used in FDM/binder jetting exhibit inferior performance compared to common engineering plastics. The low printing speed of FDM/binder jetting also limits its practical application.

For the very first time, high performance sacrificial tooling that can be used to fabricate fiber-reinforced hollow composites was produced using ultrafast and ultra-high-resolution photocuring 3D printing technology. When compared to current state-of-the-art technology, the printing speed was improved by >10 times and the printing resolution was doubled. The ultrafast printing speed will lead to short design-to-part time and the ultra-high-resolution printing will eliminate the tedious post processing steps. Combined with the design freedom, 3D printing of sacrificial tooling using photocurable yet soluble resin will greatly accelerate the development and production of complex hollow composite structures.
Development of flexible and functional wearable textile sensors using 3d printing technology

Primary Author: Zihui Zhao
Co-Author(s): Hang Liu

Faculty Sponsor: Hang Liu

Primary College/Unit: Agricultural, Human and Natural Resource Sciences
Associated College(s)/Unit(s) Visual Arts & Design
Campus: Pullman

Abstract:

Smart wearable sensors have recently sparked tremendous interest owing to their potential in the apparel industry. The existing material and manufacturing methods limit the function and innovation of the products. Herein, we present a novel 3D printing technology to print conductive ink directly on different types of fabrics with customizable geometries. Using this technology, six patterns, including solid square, solid reentrant, solid hexagon, hollowed square, hollowed reentrant, and hollowed hexagon were printed quickly and accurately on three different types of fabric. The 3d printed textile sensors show excellent sensor performance in terms of shape deformation and humidity change. The sensor with a cotton-based matrix has good sensitivity over a small strain range, while the sensor with a Poly(lactic acid)/Ethylene vinyl acetate-based matrix has greater stability and sensitivity over a large strain range. Moreover, the Poly(lactic acid)/Ethylene vinyl acetate-based sensor can maintain its high electrical conductivity under severe bending and wash conditions, making it a great candidate for wearable sensors. Meanwhile, the sensitivity and cyclic stability of the sensor can be easily controlled by the pattern geometrics during 3d printing process. The designed hollowed and solid reentrant structures on woven fabric delivered a clear and obvious electrical resistance change curve compared with other sensor samples which offer promising applications for comfortable wearable smart apparel.
Open Reduction and Internal Fixation with Bone Morphogenic Protein-2 for Correction of Nonunion Humeral Shaft Fracture with Pseudoarthrosis in the Geriatric Population

Primary Author: Kai Zhu
Co-Author(s): Ryan Tapio, David Frolov, Vadim Dolgov, Miguel Schmitz

Faculty Sponsor:

Primary College/Unit: Spokane
Associated College(s)/Unit(s): Medical & Life Sciences
Campus: Spokane

Abstract:

Introduction: Bone morphogenic protein-2 (BMP-2) is a potent growth factor cytokine, with indications for interbody spinal fusion surgery and open tibial shaft repairs due to its osteoinductive properties. Off-label usage of BMP-2 has been documented, however, there are limited studies regarding the efficacy of using BMP-2 in nonunion humeral shaft fractures.

Case Presentation: We present a case of a comminuted left humeral shaft fracture with pseudoarthrosis in a 64-year-old woman. Due to the patient’s significant comorbidities, initial fracture management focused on non-surgical intervention with the use of a humeral cuff to correct the fracture. However, the patient's report of persistent and significant pain and serial radiographs indicating poor healing with a nonunion fracture prompted surgical intervention. The patient underwent an open reduction and internal fixation (ORIF) with an infusion of BMP-2 at the fracture site to promote osteogenesis. To our knowledge, there is limited information about the efficacy of using BMP-2 for humeral fractures.

Discussion: Six months following the surgery, the patient has shown appropriate fracture healing of the left humerus without loosening of hardware and other significant complications. The usage of BMP-2 in this patient has shown to be effective in promotion of healing her nonunion humeral shaft fracture.

Conclusions: Although BMP-2 has typically been indicated for use in interbody spinal fusion surgery and open tibial shaft repairs, this case demonstrates that BMP-2 can also promote healing of humeral shaft fractures.
Do women directors give more to charity?

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Abstract:

Principal topic
Hotel charity (HC) is an important business strategy since it can improve the corporate image to increase competitiveness. From agency cost theory, directors on board can pursue their own private interests from charity events. However, women prefer to protect the interests of shareholders and thus they will give less to charity. On the contrary, gender socialization theory suggests a positive impact of women on hotel charity because of their greater moral sensitivity. Therefore, this study aims to test the linear and nonlinear effects of women directors on HC.

Method
The sample includes ten listed China’s hotels from 2003 to 2018 based on Markets and Accounting Research database. Women directors are measured by the ratio of women directors to total directors. HC is the ratio of corporate cash donations to sales revenue. Several control variables were considered. The regression method is GMM estimation which applies instrumental variables to deal with unobserved heterogeneity and endogeneity issues.

Results/Implications
This study found that female directors have significantly positive effect on HC, implying that female directors would like to give more to charity. In addition, nonlinear regression test results reveal that the impact of women directors on HC is non-linear (an inverted U-shape) with a critical value of 23.3%. The finding implies that women directors give more until reaching 23.3% (support of gender socialization theory), and when female directors is higher than 23.3%, they would give less to charity (support of agency cost theory).