

Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

Online Proceedings

POSTER SESSION 1

Commons East, Easel 66

11:00 AM to 1:00 PM

Digital Financial Services for Financial Inclusion in the Developing World

Sarah Yu, Senior, International Studies, Computer Science, Economics

Mary Gates Scholar, McNair Scholar, UW Honors

Program

Mentor: Richard Anderson, Computer Science & Engineering

Financial inclusion - the expansion of access to formal bank accounts, particularly to the poor - has recently moved up the ranks as a priority for development. After the unexpected success of M-PESA - a mobile phone based money transfer service started in Kenya - many quickly joined the camp of mobile money advocates believing that mobile money would be the solution to this newly minted UN sustainable development goal. However, with such nuanced characteristics in each country and even more distinctions within each financial system and economy, mobile money as a solution may not be applicable in every country aiming for financial inclusion. Therefore, this research aims to primarily understand the financial practices and needs of Ghanaians. To do so, I conduct surveys in five different cities ranging from small towns to large cities to evaluate an individuals current financial practices, existing and projected needs for financial services, and the role that mobile money may play in fulfilling either of those goals.

POSTER SESSION 1

MGH 241, Easel 162

11:00 AM to 1:00 PM

Perioperative Activity in Thoracic Surgery: Does Adherence to Daily Activity Monitor Use Predict Actual Activity?

Emilee Anne (Emilee) Kauer, Senior, Biology (Molecular, Cellular & Developmental)

Mentor: Stephen Kaplan

Mentor: Richard Thirlby

Mentor: Michal Hubka

Recovery after thoracic surgery can be prolonged and fraught with complications if patients are not active after surgery. Postoperative recovery can strongly be influenced by preoperative baseline activity level and overall fitness. Surgeons have historically relied upon patient report to understand these variables; however, given the ubiquitous nature of activity monitors in today's society, a new opportunity is presented to objectively evaluate perioperative activity. As part of the Perioperative Activity and Outcomes study at Virginia Mason Medical Center, thoracic surgery patients begin wearing a Fitbit prior to surgery and return the device approximately three to five weeks after surgery. However, there are several patient factors that influence the data, such as simply forgetting to wear the device. The objective of this study is to understand whether or not days missed wearing a Fitbit is associated with objective measures of activity. I hypothesize there is a negative correlation between the number of days a patient does not wear their Fitbit and their average daily steps. I will stratify the analysis by preoperative and outpatient postoperative periods, both of which are times where it is incumbent upon the patient to wear the device. In essence, poor compliance with wearing the device may be a surrogate for low activity. The conclusions I draw from this research will contribute to a risk stratification model for improving patient outcomes. By identifying patients at-risk for slow recovery, tailored interventions can be employed to optimize recovery, prevent complications, and improve overall patient outcomes, satisfaction, and quality of life following thoracic surgery.

POSTER SESSION 1

MGH 241, Easel 148

11:00 AM to 1:00 PM

SUMO and Cellular Stress: Responding to Ethanol

Heather Ruth Borror, Senior, Biochemistry, Applied Music (String Instruments)

UW Honors Program

Mentor: Richard Gardner, Pharmacology

Mentor: Cory Nadel, Pharmacology

Mentor: Amanda Bradley, Pharmacology, Molecular and Cellular Biology

SUMO (small ubiquitin-like modifier) is a protein post-translational modification that has wide ranging influence on protein function. Among its many roles, SUMO is known to regulate transcription, DNA repair, and maintain cellular

homeostasis under environmental stress conditions. Changes in sumoylation patterns under environmental stress have been identified, yet the specifics of these pathways remain uncharacterized. By using mass spectrometry (MS), we have identified three yeast proteins that are sumoylated in response to high levels of ethanol: Top2, Smc5, and Smc6. These proteins play a major role in maintaining DNA stability during replication and are conserved through higher eukaryotes. We have tagged these proteins with epitopes identifiable by western blot by yeast transformation, and subjected cells with these tags to ethanol stress, which allowed us to verify the hits from the MS screen. This will allow us to begin further investigation of the role sumoylation plays on these proteins. Our next goals include generating sumo deficient mutants and observing the changes in protein function within the cell after exposure to ethanol stress. As these proteins are involved in DNA stability and repair, we are notably interested in the interactions with chromatin. Through this work, we seek to gain us a better understanding of the signaling underlying adaptation to environmental stress. This research has implications for human health as it allows us to understand how cells respond to toxic levels of a recreationally encountered substance.

POSTER SESSION 1

Commons East, Easel 65

11:00 AM to 1:00 PM

Text Entry Methods for People with Mobility Related Disabilities

Matthew Tao (Matthew) Yang, Senior, Human Centered Design & Engineering

Mentor: Richard Ladner, Computer Science & Engineering

A standard QWERTY keyboard for text entry may not be suitable for people with mobility related disabilities. As such, people with mobility related disabilities may need to find alternative ways to input text. Alternative and Augmentative Communication (AAC) is a field that researches and develops communication methods for people with complex communication needs. The AAC field studies technological solutions and its social implications. Strategic competence is an area of AAC research that focuses on managing the functional constraints of AAC devices such as text entry speed and input accuracy. Social competence is another area of AAC research that focuses on establishing and maintaining interpersonal communication. The ability to effectively communicate emotion plays a large role in one's social competence. An ideal alternative text entry input system should not only consider strategic competence, but also the social competence. This research will survey existing alternative text entry systems and how emotion is conveyed through standard text/text related systems. The results from both surveys will be synthesized to inform an investigation of new methods for

facilitating the communication of emotion through alternative text entry systems. I anticipate discovering new methods of conveying emotion through alternative text entry systems.

POSTER SESSION 1

Commons East, Easel 82

11:00 AM to 1:00 PM

The Acoustics of Deceit

Lydia Kathryn (Lydia) Castro, Senior, Linguistics

UW Honors Program

Mentor: Richard Wright, Linguistics

A commonly held belief is that there is a measurable/observable difference between deceptive and honest speech, yet few studies provide enough information to support this claim. Existing studies focus their analyses solely on prosodic elements of speech (like pitch) and have come up with mixed results (in part due to the difficulty of eliciting genuine lies from subjects). Other studies have found similarly variable results with speech characteristics like pitch, but also found noticeable differences with temporal measures like speaking-rate. Ultimately, the pre-existing studies agree that more data is needed and more studies should be conducted in this field. The present study aims to further explore the question of whether dishonest speech has any detectable acoustic differences from honest speech. Acoustic and prosodic elements of speech (ie. intensity, pitch) are examined between the honest and deceptive tasks for differentiation and potential patterns. Truthful and deceptive utterances are elicited through a modified card game task conducted at the sound-booth in the UW Phonetics Lab. The game task can be played both honestly and with bluffing (similar to Poker). To elicit the words "jack", "queen", and "king" with a high level of density, the card deck used in these tasks exclusively contains the three different face cards from multiple standard playing card decks. Preliminary observations suggest that when a talker lies, they limit the prosodic information of their lies with quieter speech, flattened pitch contours, and reduction of utterance duration. While existing studies in the literature have noted that many acoustic differences between honest and deceptive speech are quite small and exhibit large degrees of speaker and task variability, their conclusions seem to concur thus far with the preliminary observations of this study.

SESSION 1B

TECHNIQUES FOR IMPROVING QUALITY OF MEDICAL CARE

Session Moderator: Eric Seibel, Mechanical Engineering

MGH 228

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

The Role of Socio-Geographic Factors in Recovery after Thoracic Surgery among Rural and Urban Populations

Aneesha J. (Aneesha) Morris, Junior, Biochemistry

Mentor: Stephen Kaplan

Mentor: Richard Thirlby

Mentor: Michal Hubka

Social determinants of health are non-biologic factors that can strongly influence individual health status, healthcare access, and disease vulnerability. While this subject is well studied, limited data exists on the influence of these social factors on surgery, and more specifically, recovery after surgery. The burden of surgical disease remains taxing globally and disproportionately affects marginalized populations. Due to the limited access to higher level surgical care, patients often travel from eastern Washington and various other rural areas to Virginia Mason Medical Center for cardiothoracic procedures. Through this study I aim to identify social-geographic factors that contribute to this burden, and determine the discrepancies that generate variances in recovery. I hypothesize that among patients undergoing thoracic surgery at Virginia Mason Medical Center, distance from Seattle will be associated with measures of recovery in the postoperative period. I quantify the postoperative recovery of patients by measuring length of stay, postoperative complications, and readmission. Due to the burden of transport, inconvenience, missed work, increased personal costs, and other socioeconomic issues, I expected to see slower recovery, and possibly greater complications among patients coming from further distances. By first characterizing the problem, I then identify unique challenges that arise among various demographics of patients, creating a tailored perioperative education. This optimizes clarity in communication of postoperative planning and potential complications to create an improved set of guidelines, specified towards particular demographics of patients.

SESSION 1P

ASTRONOMY AND ATMOSPHERIC SCIENCES

Session Moderator: Suzanne Hawley, Astronomy

JHN 022

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Improving Regional Climate Prediction

Jacob Michael Hendrickson, Junior, Atmospheric Sciences:

Meteorology, Atmospheric Sciences: Climate

Daniel Arens, Junior, Atmospheric Sciences: Meteorology

Mentor: Cliff Mass, Atmospheric Sciences

Mentor: Richard C Steed

Our research seeks to more accurately define how the Pacific Northwest regional climate will look in fifty to one hundred years. Our results help quantify the uncertainty in our climate predictions, a major shortcoming in climate research. Our research is interesting because it utilizes a high resolution numerical weather prediction model to examine regional climate change here in the Pacific Northwest. We are creating a large set (an ensemble) of predictions of climate change in the Pacific Northwest. The tool used in our research is the Weather Research and Forecast (WRF) model. WRF requires General Circulation Model (GCM, also known as Global Climate Model) data to feed it information on the larger-scale climate. A big part of our project is collecting GCM data from a variety of research centers worldwide, and preparing it to be used as input data for WRF. We expect to complete our model simulations by the end of Spring Quarter 2018. These results could be of direct use to a number of local agencies and policy makers so that they can shape their decisions around the future changes that our local climate may experience. We also expect our data to be of great use for further research in quantifying climate prediction uncertainty.

POSTER SESSION 2

Commons East, Easel 44

1:00 PM to 2:30 PM

A Phylogeny of Tecomeae: Bringing New Insights to New World Plant Diversity

Paige Pauline (Paige) Fabre, Senior, Biology (Plant)

Mary Gates Scholar

Mentor: Richard Olmstead, Biology, Burke Museum

The Neotropics contain about 100,000 seed plant species, amounting to ca. 37% of the world's species. The Olmstead lab is currently investigating Bignoniaceae, a plant family comprised of 82 genera and ca. 827 species distributed primarily in the Neotropics. There are 8 recognized clades in Bignoniaceae. One clade, Tecomeae, include 12 genera and approximately 55 species, with species distributed in North and South America, Southeast and Central Asia, and Australia. To create a phylogeny for Tecomeae, I gathered all available sequence data and DNA for species in the tribe from both the Olmstead lab and GenBank. Then, DNA from samples of additional species were extracted using the DNeasy Plant Mini Kits. Three different regions of DNA were sequenced, including two chloroplast regions (*ndhF* and *rpl32-trnL*) and one nuclear region (*ITS*). I amplified these regions via Polymerase Chain Reaction and sequenced the

DNA using an ABI genetic analyzer in the UW Biology Department Center for Comparative Genomics. Sequences for all species were edited and aligned using Geneious. Phylogenetic analyses were performed in both Maximum Likelihood and Bayesian frameworks using RAxML and MrBayes. Creating a phylogeny for the Tecomeae is a crucial step toward deciphering the evolutionary history of Bignoniaceae. The overarching goal of our research is to not only create a phylogeny for Tecomeae, but for all 827 species within the Bignoniaceae family. Having a phylogenetic tree for Tecomeae allows us to identify when important divergences occurred, giving us an improved picture of how Bignoniaceae diversified and, ultimately, a better understanding of Neotropical diversification as a whole.

SESSION 2N

FOREST ECOLOGY AND EVOLUTION

Session Moderator: Gregory Ettl, Forest Resources

MGH 288

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

A Molecular Phylogeny and Classification of Neospartoneae : The Evolutionary Relationships among *Diostea*, *Neosparton*, and *Lampaya*

Meng Lu, Junior, Exchange - Arts & Sciences

Mentor: Richard Olmstead, Biology, Burke Museum

Mentor: Laura Frost

The Verbenaceae, commonly known as the verbena family, consists of mainly tropical trees, shrubs, lianas, and herbs. Verbenaceae's diversity is highest in Latin America (where this family is primarily distributed) and Africa. Early classifications of this family relied on morphological traits. A molecular phylogenetic study was recently undertaken to assess and revise those classifications. Verbenaceae now include 35 genera and about 1000 species. In the current classification of Verbenaceae, there is one new tribe called Neospartoneae which consists of three small genera of Argentine species (*Diostea*, *Neosparton*, and *Lampaya*). According to the morphological traits, *Diostea* and *Neosparton* exhibit similar male reproductive characters and an ephedroid habit (many-branched shrubs with cylindrical, striate stems) while *Diostea* and *Lampaya* share fruit characteristics. Previous studies turned into the molecular data and tried to figure out the relationships between genera of this tribe by chloroplast DNA sequences (loci: *ndhF*, *trnLF*, *ccsA*, *matK*, *rbcL*, *rpoC2*, *rps3*). However, the evolutionary relationships remain unresolved. In my study, I used nuclear DNA sequences (loci: ITS, ETS, PPR123, PPR42, PPR11, PPR70, PPR91) to provide a more robust molecular data and try to figure out the phylogenetic relationships in Neospartoneae. I extracted DNA from samples collected in Latin America. After do-

ing PCR and purifying the PCR products, I conducted the sequencing reaction. After editing sequencing data manually, I aligned the nuclear DNA sequences to analyze data and produce the phylogenetic trees with maximum likelihood and Bayesian methods. The updated phylogeny improves our knowledge of evolutionary relationships among *Diostea*, *Neosparton*, and *Lampaya*.

POSTER SESSION 3

Balcony, Easel 114

2:30 PM to 4:00 PM

Estimating Orchard Worker Exposure to Pesticide Drift using Water Sensitive Paper

Christine Ivette (Christine) Perez Delgado, Senior, Public Health-Global Health

Mentor: Edward Kasner, Environmental and Occupational Health Sciences

Mentor: Richard Fenske, Environmental and Occupational Health Sciences

Agricultural workers use pesticides to prevent insect damage to crops. There are state and federal regulations about how to handle pesticides safely. However, off-target drift is an undesirable consequence of pesticide application. The Washington State Department of Health tracks pesticide-related illnesses and found that orchard workers can experience pesticide drift exposure. The goal of this study was to use water sensitive paper (WSP) to measure pesticide drift downwind of an orchard where pesticides were being applied. First, we collected passive air samples by evenly distributing WSP at different downwind distances throughout the neighboring orchard in vertical and horizontal planes on two different days. On Day 1, we placed 15 horizontal samples 0.3 meters above the ground at distances 5, 26, and 52 meters downwind. On Day 2, we placed 4 vertical samples at 0, 2, 4, and 6 meters above the ground at the same 15 downwind locations (n=60). We then conducted an analysis to confirm the wind direction and speed. After drying, I analyzed the samples by taking pictures of the WSP and using photo-editing software to emphasize the contrast between the paper and droplet marks and correct perspective angles. I counted the droplets using bioimaging to measure the diameters of fine (106-235 um diameter), medium (236-340 um diameter), and coarse (341-403 um diameter) sized droplets. With this, I quantified the number and size of drift droplets on the WSP. We observed higher concentrations of droplets in the WSP closest to the sprayed orchard, yet all the WSP showed evidence of drift. The results of this study will help provide evidence of pesticide drift and of methods to estimate drift exposure. This is important because the observations provide motive to look into ways to keep orchard workers safe from pesticide exposure.

POSTER SESSION 3

Commons West, Easel 27

2:30 PM to 4:00 PM

Changes in the Expression of Elongation Factor-Thermounstable from Probiotic Cultures at Gastrointestinal pHs

George Rogers, Senior, Molecular Sciences, Bellevue College

Mentor: Richard Glover, Science, Lane Community College

Two in three American adults are considered overweight or obese and research done in the last decade has indicated possible treatment options through the introduction of probiotics to an individual's diet. While there is research indicating the efficacy of probiotic use in the management of obesity, there is little available regarding the specifics of how that process works. Previous studies have shown that Elongation Factor-Thermounstable (EF-Tu) mediates the binding of *Lactobacillus* to mucins and epithelial cells in the intestine, but not the stomach. Our goal was to evaluate if (and how) EF-Tu production would change as *Lactobacillus* moved from the low-pH environment in the stomach to the more neutral intestine. We hypothesized that the rate of external EF-Tu expression would increase at more neutral pHs to facilitate gut colonization. To quantify levels of EF-Tu in different parts of the cell, we measured bacterial growth and EF-Tu levels in cultures of pH 3, 6, and 7.4 representing the averages at each stage in the GI tract. This was done by culturing bacteria in an incubator at each pH for six hours and separating supernatant and cell fractions by centrifugation. Membrane and cytosol were separated using freeze-thaw lysis in liquid nitrogen. SDS-PAGE was then used to isolate EF-Tu, followed by in-gel tryptic digestion. LCMS (a method of molecule separation and identification) was used to detect and quantify EF-Tu from each fraction. Initial results from growth showed the highest turbidity (cloudiness) from the pH 3 culture. Turbidity began before inoculation, indicating turbidity at this pH is not a sufficient measure of cell growth. Understanding how *Lactobacilli* produce and deploy EF-Tu in different pH regimes may help to optimize the use of probiotics in controlling obesity and improving digestive health.

POSTER SESSION 3

Commons West, Easel 26

2:30 PM to 4:00 PM

Comparison of C18 and QuEChERS for the Isolation and Detection of Imidacloprid in Honey Samples Using GC-MS

Maxwell Runyon, Sophomore, Chemical Engineering, Bellevue College

Mentor: Richard Glover, Science, Lane Community College

Mentor: Grady Blacken, Chemistry, Bellevue College

Neonicotinoid pesticides have been identified as a possible contributor to colony collapse disorder (CCD), decimating honeybee populations. Development of methods to extract neonicotinoids from environmental matrices are important in exploring the correlation between pesticide exposure and CCD. Imidacloprid was chosen as representative neonicotinoid given it is the most commonly used agricultural pesticide in its class. Two extraction methods, QuEChERS and SPE C18, were evaluated for their effectiveness in quantifying imidacloprid concentrations in honey and water. The effectiveness of each extraction method was evaluated using gas chromatography-mass spectrometry (GC-MS). QuEChERS kits use a buffered extraction technique to absorb excess water and stabilize the pH of the solution and cleanup with weak, anionic and cationic exchange resins to remove complex sugars/macro organic molecules. The SPE C18 extraction method used a non-polar solid phase to isolate Imidacloprid from other undesirable solutes in the solution. Preliminary experiments have indicated the SPE C18 extraction method appeared to have better performance with water based solutions. However, honey solutions were ineffective due to more organic interference. Additionally, QuEChERS extraction appears to be more efficient for isolating analyte, but did not concentrate as efficiently compared to SPE C18 extraction. We hypothesize that QuEChERS and SPE C18 extraction methods will be more effective in tandem, as QuEChERS will remove organic interference, while SPE C18 extraction will concentrate the samples. The impact of pH adjustment of samples on peak area and shape was also investigated in both polar and non-polar GC-MS columns. The results obtained will help identify best practices for extraction and detection of imidacloprid in honey samples.

POSTER SESSION 4

MGH 241, Easel 156

4:00 PM to 6:00 PM

Galanin in the NTS

Sharda Raina, Sophomore, Pre-Major

UW Honors Program

Mentor: Richard Palmiter, Liberal Arts

Mentor: Carolyn Roman

Galanin is a small protein found in the gastrointestinal tract, and several places within the central nervous system. My project is to test the function of galanin-expressing neurons in

the hindbrain of mice, specifically the projection from the Nucleus of the Solitary Tract to the Parabrachial Nucleus. Contrary to effects shown in other brain areas, my preliminary data suggest that the activation of galanin expressing neurons in the hindbrain decreases feeding, in mice. These neurons are activated artificially in genetically modified mice, allowing us to then measure food intake and body weight. Their activation decreases food intake under normal conditions, but not with prior food restriction. I predict that these neurons are activated by visceral signals from afferents, or neurons that carry input from sensory organs, which are then responsible for the ensuing lack of appetite. By expressing a fluorescent protein in these neurons, I can also trace this projection to see where other connections are. Then, by examining Fos, a marker of neuronal excitation, I will investigate the activation of downstream projections. This is relevant to many current health issues, such as obesity and anorexia, as the circuits involved in hunger and appetite are not entirely understood yet.

POSTER SESSION 4

MGH 241, Easel 157

4:00 PM to 6:00 PM

The Role of Calcitonin Gene-Related Peptide Expressing Neurons in the Parabrachial Nucleus during Anorexia Associated with a Diet Devoid in Essential Amino Acids

Silvano Isaac Ross, Senior, Biochemistry

Mary Gates Scholar

Mentor: Richard Palmiter, Liberal Arts

Mentor: Philip Ryan, Biochemistry

Our laboratory has identified a group of neurons that expresses calcitonin gene-related peptide (CGRP) in the parabrachial nucleus (PBN), which are involved in appetite suppression and responses to fear. For example, CGRPPBN neurons mediate the suppression of food intake during a conditioned taste aversion (CTA) and are activated following conditioned fear responses [1,2,3]. Here, we investigate whether CGRPPBN neurons mediate anorexia associated with a diet deficient in essential amino acids (EAA-def anorexia). We inactivated CGRPPBN neurons by injecting an associated adenovirus (AAV) carrying the tetanus toxin light chain (Tet tox) in the PBN of CalcaCre/+ mice (Calca is the CGRP gene) and showed increased food intake and decreased body weight loss compared to control animals on a prolonged diet deficient in EAAs. In a pair fed group of mice injected with the Tet tox virus, there was not a significant difference in body weight loss. These results suggest that CGRPPBN neurons modulate appetite during EAA-def anorexia, but are not responsible for a change in energy homeostasis during EAA-def anorexia.