Undergraduate Research Symposium May 20, 2016 Mary Gates Hall

Online Proceedings

Poster Session 1

MGH 241, Easel 140

11:00 AM to 1:00 PM

Physician Assessment of Blinded Adverse Events in Randomized Controlled Trials in Cystic Fibrosis

Madeline (Maddy) Wessels, Senior, Computer Science
UW Honors Program
Mentor: Christopher Goss, Medicine and Pediatrics

We are investigating adverse event (AE) reporting in clinical trials on cystic fibrosis (CF) to address whether specific approaches to coding AEs prior to un-blinding of study data is informative. While attribution standards are available in the Common Toxicity Criteria; there are no formal guidelines on how this determination should be made. The process of reporting attributions increases both time and cost of the trial although it is uncertain whether this process is accurate or valuable. This is a retrospective data repeated measures data analysis with pooled clinical trial data from four randomized controlled trials involving patients with CF. We will employ descriptive statistics to describe the overall population and demographics from individual studies who experienced at least one adverse event and summarize the adverse event rates over all and per study by individual rates. We will also employ repeated multiple variable regression techniques to describe associations of demographic and clinical characteristics with the attribution of AE's. We hypothesize that physicians are not very good at attributing these events when the patient is on the placebo. We currently have available data on 11,974 adverse events in 785 subjects in the four randomized controlled trials. This study could have implications to how clinical trials are conducted in the United States. A future goal would be to clarify the value of attribution of adverse events in clinical trials.

Session 1D

Communitas: Urban Explorations of Experience and Learning

Session Moderator: Rachel Berney, Urban Design and Planning

MGH 234

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Connecting the Pieces: The Importance of Socially and Psychologically Acclimating Transfer Students

Marisol Diaz, Senior, Community, Environment, & Planning
Mary Gates Scholar
Mentor: Christopher Campbell, Urban Design And Planning Group

Lost, confused, lonely, and out of place: these are sentiments felt by many transfer students as they try to acclimate to the University of Washington. Adjusting to a new institution can be a difficult process to undergo alone. For transfer students, the inability to acclimate or the delay in acclimation can result in higher levels of stress, poor academic performance, psychological instability, and unbalanced social well-being. In response to these issues, my senior project investigates how current University of Washington transfer students can help incoming transfer students acclimate to the university. Drawing on the Transfer Students United organization (the first transfer student club at the UW), I conducted surveys and focus group interviews with current UW transfer students in order to better understand their experiences acclimating to the UW and identify their specific needs as incoming transfer students. Based on the results of this research, I then proposed several social and psychological focus areas for the Transfer Students United organization to incorporate as they create resources and services for transfer students.

SESSION 1D

COMMUNITAS: URBAN EXPLORATIONS OF EXPERIENCE AND LEARNING

Session Moderator: Rachel Berney, Urban Design and Planning
MGH 234
12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Looking inside Human Libraries
Wyatt James (Wyatt) Hoffman, Senior, Community, Environment, & Planning
Mentor: Christopher Campbell, Urban Design And Planning Group

"Human Libraries" are interactive, community-based events in which ordinary people gather to share information and discuss ideas face-to-face with members of the community they wouldn't typically interact with. Created in Denmark in 2000, they have since spread around the globe, reaching the U.S. in 2008. This project examines several Human Libraries that have taken place across the U.S. and tries to determine which elements are most responsible for the events' success. Findings for this research are based on interviews with several Human Library organizers, participant observations at a Human Library event in Vancouver, B.C., and an analysis of the commonalities shared between multiple Human Library events throughout the United States. The results of this research will help Human Libraries reach their full potential by providing organizers with a strengthened set of best practices and successful case studies on which to model their own events.

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Activating Alleyways: A Closer Look at the Cleanliness and Safety of Alleyways in the University District
Kurt William (Kurt) Blomdahl, Senior, Community, Environment, & Planning
Mentor: Christopher Campbell, Urban Design And Planning Group

In preparation for the 2021 opening of a new light rail station, the University District community in Seattle has begun to address safety and cleanliness concerns in the alleyways around the station and in the neighborhood as a whole. This project contributes to that effort by identifying areas of particular concern and recommending steps that the community and city can take to address them. Specifically, working with the U District Partnership, a local neighborhood non-profit, I have focused on cleanliness and safety in the alleyways. I then completed a more specific analysis of two alleyways in Seattle identified as being particularly clean and safe. The findings of this analysis were combined with best practices derived from literature on neighborhood safety and used to develop several design and policy solutions for the neighborhood alleys. Finally, these solutions were applied to a single alleyway closest to the future light rail station, providing both a guide for the development of this space as well as a case study for other alley improvements in the University District.

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Planning for the Future: A City Illustrated
Hannah Emily Leigh (Hannah) Keyes, Senior, Community, Environment, & Planning
UW Honors Program
Mentor: Christopher Campbell, Urban Design And Planning Group

One of the central tenants of modern urban planning is that communities and citizens should be involved in the planning process, in part so that planners can focus on problems and solutions that people care most about. However, one group that is often missing from these conversations is children, even though children often have specific needs, experiences, and ways of interacting with the built environment that are quite different from adults. To help fill this gap in planning knowledge, this project uses an age-appropriate method to

uncover children's perceptions of and experiences with the city. Specifically, this project worked with students from two local elementary schools to produce drawings of their streets and neighborhoods as they see them now, and envision them changing for the better. These drawings were then analyzed for common patterns, elements, and themes, and used to develop recommendations of child-centric items that planners can further focus on. Additionally, the maps were collected in a bound book that was provided to the children to reinforce the value of their own experiences and perceptions of the built environment, and to demonstrate to planners that children's views of the city also matter.

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MGH 234
12:30 PM to 2:15 PM

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Closing the Gender Gap of Seattle Cyclists
Rachel Laura (Rachel) Edlund, Senior, Community, Environment, & Planning
Mentor: Christopher Campbell, Urban Design And Planning Group

In the United States today, biking is a gendered activity. Nationwide, far fewer women bike commute or ride their bikes in urban areas than men. This gap holds true even in bicycle-oriented cities such as Seattle, where the majority of people who ride their bikes in the city identify as male. This research investigates the cause of this gap and identifies steps that cities and communities can take to encourage more women to cycle. The research includes a review of the literature on bicycle commuting, with a focus on known barriers to and attitudes about bicycle commuting; in depth interviews with leaders in Seattle's bike community; and an analysis of other American communities known for strong bike infrastructure. Findings from this research are then used to inform several policy, practice, and design recommendations aimed at closing the gender gap by increasing the number of women who regularly commute or bicycle in urban areas.

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Love Thy Neighborhood Alliance: A Case Study in Lake City (Seattle, Washington)
Ina Dash Stap, Senior, Community, Environment, & Planning, Biology (General)
Mentor: Marty Curry, Urban Design and Planning
Mentor: Christopher Campbell, Urban Design And Planning Group

As a result of rapid urbanization, Lake City, a neighborhood in north Seattle, has experienced a significant shift in its demographics, local socio-political dynamics, cultural values, economic conditions, and spatial boundaries. As an effort to better represent and improve the Lake City area, residents created the Lake City Neighborhood Alliance (LCNA), a network of 28 neighborhood organizations, including multiple neighborhood associations, a parent teacher association, a food bank, and a safe-street advocacy program, among others. Such alliances are often championed by neighborhood planning advocates as an effective way to increase citizen participation, enhance community representation, and improve neighborhood conditions. However, very few studies have looked closely at the challenges and internal dynamics of such alliances. This research fills that gap by understanding the benefits and difficulties that come with a parent organization, such as the LCNA, working to improve a community through collaboration between member organizations. Through a series of in depth interviews with LCNA members and participant observations, this project uses the LCNA as a case study to explore why organizations and their representatives continue to be a part of such coalitions, and how the structure of a neighborhood alliance can influence its ability to effectively address local problems and strengthen the community overall.

SESSION 1G

IDENTITY CONSTRUCTION, POWER, AND REPRESENTATION: A MULTIDISCIPLINARY APPROACH TO ACTIVISM

Session Moderator: Juliana Villegas, English
MGH 251
12:30 PM to 2:15 PM
* Note: Titles in order of presentation.

Lessons from Immigration: Acculturation through Art
Stefanie Menjivar, Senior, Community, Environment, & Planning
Mentor: Christopher Campbell, Urban Design And Planning Group

For many immigrants to the United States, the process of acculturation, adapting to the ideals, values, and behaviors of a new culture and balancing them with those of a culture of origin, can be mentally and emotionally challenging. One potential response to these problems is art therapy. In the west, art therapy has been used as a successful intervention for a range of mental, emotional, and social problems, however there is little research on how making and sharing art may specifically affect immigrants. This research aims to examine the effectiveness of art making and sharing as a coping mechanism for acculturation. After reviewing the literature on the impacts of immigration and the benefits of art making, I interviewed seven immigrant artists from different countries, focusing on the role that art plays in their personal acculturation process. The results of my interviews provide a deeper insight into the effectiveness of using art as an individual and community coping mechanism and suggest several lessons that recreational or community-based art programs could use to ease the difficulty of acculturation for other immigrants.

SESSION 1P

PAST, PRESENT, AND FUTURE: MEASUREMENTS TO UNDERSTAND EVOLUTION AND CLIMATE CHANGE

Session Moderator: Bonnie Becker, Environmental Science (Tacoma)
JHN 111
12:30 PM to 2:15 PM
* Note: Titles in order of presentation.

Power of Expertise: The Effect of Expert Knowledge on the Promotion of Education and Attitude Change
Hyojung (Halie) Kim, Senior, Community, Environment, & Planning
Mentor: Keith Harris, Built Environments
Mentor: Christopher Campbell, Urban Design And Planning Group

The scope of this project is to invite an expert to make a speech focused on water mismanagement and global climate change and to conduct pre-speech and post-speech surveys to explore the effects of the speech on knowledge and attitude change regarding these two issues. One common assumption among those combating climate change is that providing the public with expert knowledge on the subject will change their opinions and behaviors. This project tests whether that assumption is correct by measuring the impact of a single speech on the knowledge and attitudes of college-aged students. For the application of my research, I planned and organized the event inviting 300 students to listen to a 1-hour speech delivered live by a Senior member of the United Nations on climate change and global water issues, and conduct pre-speech and post-speech surveys that were administered to determine what effect, if any, the speech had on the students' knowledge and attitudes about the topics. 197 pre-surveys were completed while 130 attendees were present at the event and 60 attendees completed the post-survey. The post-survey results are in the process of cross comparison with the initial pre-survey. I hypothesized that the results speech measured by the pre-surveys and post-surveys will show significant positive change in both knowledge and attitude change. The implications of my research results will be used to suggest broader implications for scientific and policy communication to a lay audience in order to continuously educate and successfully convey knowledge and information while advocating for positive change in attitude to further advance our efforts in solving the global threat of climate change and water management.

POSTER SESSION 2

MGH 241, Easel 143
1:00 PM to 2:30 PM

Improving SUMO: Making a Powerful Biotechnical Tool for Protein Expression Even Better
Kara Lau, Junior, Pre-Sciences
Tessa Anne (Tessa) Howard, Senior, Public Health-Global Health
UW Honors Program
Mentor: Christopher Bahl, Biochemistry

Proteins are the executors of life's most essential processes, and the ability to express and purify proteins of interest is critical to studying their structure and function. Genetic fu-

sions to small ubiquitin-like modifier (SUMO) tags generally increase the solubility and stability of target proteins during recombinant expression. Following purification, the fusion protein can be cleaved by the highly specific SUMO protease, leaving the target protein intact and unmodified. This specificity attests to the use of the SUMO protease as a powerful biotechnical tool. The current SUMO system relies on the *Saccharomyces cerevisiae* protease Ulp1. However, this protein has considerable limitations in that it is temperature sensitive and requires detergent to maintain stability, which can interfere with downstream applications. Furthermore, Ulp1 instability often leads to incomplete digestion of SUMOylated constructs and can nucleate aggregation of target proteins. We sought to improve the current system by two orthogonal approaches. First, we mined genomic information from thermophilic organisms for homologous proteins. We have identified and experimentally characterized a novel SUMO-protease system from, *Chaetomium thermophilium*, a eukaryote that can grow in compost up to 60C. Second, we used computational protein design with Rosetta to reengineer *S. cerevisiae* Ulp1 to enhance the stability and solubility of this protein. Using a novel fluorescence resonance energy transfer (FRET) based reporter assay that we have developed to monitor protein cleavage, we can characterize the SUMO systems and evaluate their efficacy. This assay allows for assessment and optimization of protease digestion in varying temperature, pH, and salinity conditions. These SUMO protease systems that we have uncovered and redesigned allow for the ability to circumvent many of the issues associated with the current Ulp1 system by offering an alternative, enhanced tool for the purification and expression of recombinant protein in laboratory research settings.

POSTER SESSION 2

Commons East, Easel 71

1:00 PM to 2:30 PM

Controlling 4D Stem Cell Differentiation in Hydrogels using Site-Specifically Modified Growth Factors

Gabrielle Myung Hui (Gabby) Benuska, Junior, Bioengineering

NASA Space Grant Scholar, Washington Research Foundation Fellow

Mentor: Cole DeForest, Chemical Engineering & Bioengineering

Mentor: Jared Shadish, Chemical Engineering

Mentor: Christopher Arakawa, Pathology/ Bioengineering

The ability to recapitulate the dynamic presentation of signals in a stem cell's microenvironment remains a major hurdle in tissue engineering. Controlling cell growth and differentiation in 4 dimensions (i.e., time and 3D space) would allow for heterogeneous synthetic tissues to be produced that match the complexity of their native counterparts. Combining strategies in both light-programmable hydrogels and recombinant protein engineering, we control the cellular microenvironment using proteins site-specifically modified with a bioorthogonal handle and able to covalently bind to a photocaged reactive group in the hydrogel. Previously we've demonstrated the ability to photopattern gels with fluorescent proteins that excite at different wavelengths, and have shown that multiple proteins can be patterned independently within the same material with 4D control. These techniques have many potential applications, including improving joint replacement. Current joint replacement therapies often involve use of metals, plastics, and ceramics, and commonly require future revision surgeries. We propose that through our techniques, we can generate a patterned bone/cartilage interface to improve joint replacement, creating a longer-term option for joint replacement. Towards this, we have generated two photopatternable recombinant growth factors, BMP-2 (bone morphogenic protein 2) and TGF-β (transforming growth factor β), known to direct human mesenchymal stem cell (hMSC) osteogenesis and chondrogenesis. I will encapsulate hMSCs in a hydrogel and direct cell differentiation and growth in 4D using a combination of photopatterned BMP-2 and TGF-β proteins. This research will have significant impact in tissue engineering, as it will enable recreation of complex physiological structures, grown outside the body with the patient's own cells, that can be used for personalized medicine. Our approach is unique in that it allows for unprecedented control over microscale tissue structures, ultimately matching the complexity of native tissue.

SESSION 2M

CELLULAR MECHANISMS MEDIATING DISEASE

Session Moderator: Ian Sweet, Medicine

MGH 389

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Metabolic Regulators of the Pentose Phosphate Pathway

Kathlyn Acosta, Senior, Biology (Molecular, Cellular & Developmental)

Mentor: Matt Kaeberlein, Pathology

Mentor: Christopher Bennett, Molecular and Cellular Biology

The mitochondrial unfolded protein response (UPR^mt) is a key cellular mechanism for maintaining mitochondrial function in the face of oxidative and proteotoxic stress. This pathway upregulates mitochondrial chaperones and proteases that aid in folding and degradation of aberrant proteins. Induction of the UPR^mt was observed to correlate with increased longevity in the nematode worm *Caenorhabditis ele-*

gans, a model whose genetic system is widely used to study the molecular mechanisms of aging. Through a genome-wide RNAi screen for regulators of the UPR^mt, we found that deficiency in the transaldolase *(tald-1)* resulted in activation of the UPR^mt. TALD-1 is responsible for the production of NADPH in the oxidative phase of the pentose phosphate pathway (PPP). In subsequent studies, we have found that knockdown of transaldolase reduces *in vivo* mitochondrial respiration, changes the overall metabolism of lipids, and affects the activity of transcription factors that regulate a starvation response and expression of metabolic genes. Among the genes transcriptionally altered by transaldolase knockdown is the flavin-containing monooxygenase-2 *(fmo-2)* gene, which has been previously found to be regulated by starvation. Like starvation, *tald-1(RNAi)* induced nuclear localization of HLH-30, a transcription factor responsible for the expression of autophagy genes. HLH-30 is also required for *fmo-2* up-regulation. Epistasis lifespan analyses using *tald-1 (RNAi)* and deletion mutant strains of *C. elegans*, quantitative gene expression studies, and fluorescence reporter assays were used to determine the mechanistic relationship between *tald-1*, *hlh-30*, and *fmo-2* as regulators of longevity in *C. elegans*.

SESSION 2M

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Session Moderator: Ian Sweet, Medicine

MGH 389

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Investigating the Roles of the Pentose Phosphate Pathway and Mitochondria in Aging

Christine Lai (Christine) Chen, Senior, Biology (General)
Mary Gates Scholar
Mentor: Matt Kaeberlein, Pathology
Mentor: Christopher Bennett, Molecular and Cellular Biology

As the primary producers of energy (ATP) in a cell, the mitochondria are key players in controlling cell aging and death. Interestingly, mild oxidative stress, derived from mitochondrial dysfunction or exogenous agents, evokes adaptive stress response pathways that can increase healthspan and lifespan in the nematode worm *Caenorhabditis elegans*. One of the pathways that responds to mitochondrial stress is the mitochondrial unfolded protein response (UPR^mt). The UPR^mt responds to stress from unfolded proteins or oxidative damage by upregulating expression of chaperones that stabilize and assist folding of unfolded proteins as well as proteases that can degrade proteins within the mitochondria. To search for genes that regulate the UPR^mt, we performed a genome-wide RNAi screen and found that knockdown of the *tald-1* gene activates the UPR^mt. The *tald-1* gene encodes transaldolase, an enzyme in the pentose phosphate pathway (PPP). One role of the PPP is to generate NADPH, which is required for cellular redox homeostasis. Although transaldolase deficiency has been linked to mitochondrial dysfunction in humans and mice, how the PPP controls mitochondrial function is not well understood. The focus of our study was to determine the relationship between PPP inhibition, mitochondrial function, and longevity by investigating the role of transaldolase in redox homeostasis and regulation of redox sensitive signaling pathways. Here we report that transaldolase deficient worms induced a starvation-like metabolic response that requires JNK MAPK signaling, a pathway that is directly activated by oxidative stress, to increase lifespan. Since the UPR$^mt$and PPP are correlated with several age-related diseases such as cancer and neurodegenerative disease, understanding the underlying genetics and molecular mechanisms of these pathways and their role in aging is likely to be relevant for human health.