

Undergraduate Research Symposium May 17, 2013 Mary Gates Hall

Online Proceedings

SESSION 1E

SENSORIMOTOR NEUROSCIENCE

Session Moderator: Eric Chudler, Bioengineering

234 MGH

1:15 PM to 2:45 PM

* Note: Titles in order of presentation.

Importance of Visually Mediated Abdominal Motion for Flight Stability in *Manduca sexta* and a Biometric Quadrotor Controller

David Julio Colmenares, Senior, Computer Engineering, Bioengineering

Mary Gates Scholar

Mentor: Tom Daniel, Biology

Mentor: Jonathan Dyhr, Biology

Flying organisms achieve flight stability by employing a multitude of control surfaces, most notably the wings. However, airframe deformations, such as abdominal motions in the hawk moth *Manduca sexta*, have recently been shown to play a significant role in stabilizing flight. In my research I have studied the control potential of abdominal deflections using a closed-loop flight arena. Tethered moths controlled the velocity of a projected black bar with their abdominal angle. Image velocity varied according to the difference between the abdominal angle and the set point (relative to the average abdominal angle), scaled by a gain factor. Experimental trials were performed for a ten-fold range of gains at three different set points and consisted of 60s periods during which the moths attempted to stabilize the drifting bar. The moths were capable of stabilizing the image for all experimental conditions, with the highest average performance (50%) occurring at the medium gain and the set point corresponding to the average abdominal angle. Poor performance (<50%) during low gain trials was characterized by steady state error, likely the result of the relatively low image velocities. For high gain trials, the decreased performance (<35%) was characterized by large abdominal oscillations. These results support an active and plastic role for the abdomen in flight control, but also tested the limits of the abdominal control circuit. To continue exploring the role of the abdominal motion I have been working on performing EMG recordings from the abdominal muscles during free flight. For this research the virtual arena serves as a controlled environment to

collect preliminary data and to refine the experimental procedure and animal preparation. Finally, I will present my work developing a biometric controller for the Parrot AR.Drone quadrotor. This project utilized a Kinect and custom software to control the quadrotor with body postures.

SESSION 1G

ONLINE SPACES: THE EPHEMERA AND RITUAL, THE ARTISTIC AND SUBVERSIVE

Session Moderator: Kristin Gustafson, School of Interdisciplinary Arts and Sciences, UW Bothell

242 MGH

1:15 PM to 2:45 PM

* Note: Titles in order of presentation.

The Post(ing) Human

Kyle Kubler, Senior, Religion, French Language and International Affairs, University of Puget Sound

Mentor: Jonathan Stockdale, Religion, University of Puget Sound

Death has been a phenomena that has been dealt with in varying ways throughout human history. How we deal with physical death online, specifically through Facebook, has proved to be an insightful challenge to the current digital age. The use of Facebook as the link between the living and the dead highlights the level at which we appropriate our Facebook profiles as extensions of our physical body due to the desire for reinvention associated with death. While only a few studies exist directly related to death on Facebook, they expose communities of mourners interacting with each other and the deceased on a surprisingly horizontal level, and contacting the dead without necessitating time restraints or religious/spiritual intermediaries. Traditional death rituals usually have temporal limits on liminal periods of mourning, divided between private and public time, but Facebook offers us unlimited access to memories of the deceased. The choice to mourn communally and virtually problematizes not only our personal relationships with the deceased, but also the legal ownership of our feelings and sentiments. The final element of death on Facebook examined in this paper is the spiritual space that deceased profiles occupy. For the secular and religious, these

profiles give a virtually physical body to what might traditionally be called a spirit, which challenges the finality and permanence of death. In studying the posts and stories that decorate the profile walls of the deceased, it is clear that this virtual aspect of ourselves has very real elements, and it is exactly this questioning of reality that death demands of us in the first place.

SESSION 1I

DEVELOPMENTAL NEUROPLASTICITY

Session Moderator: Sheri Mizumori, Psychology
251 MGH

1:15 PM to 2:45 PM

* Note: Titles in order of presentation.

Quantifying Microglial and Macrophage Cells in Cortex Ischemic Preconditioning Pulse

Ryan Edward (Ryan) Dodge, Senior, Neurobiology
Mentor: Jonathan Weinstein, Neurology

Ischemic preconditioning (IPC) is a robust neuroprotective phenomenon in which a brief ischemic exposure increases resistance to the injurious effects of subsequent prolonged ischemia. Characterizing the cellular and molecular mechanisms of IPC is an active area of investigation in stroke research. Microglia are the resident immune cells of the central nervous system and are the primary cell type responsible for post-stroke neuroinflammation in the brain. Several lines of evidence support a role for microglia in IPC. Previous research from the Weinstein laboratory has demonstrated using ex vivo flow cytometry that IPC induces a robust increase in the number of microglia/macrophages that can be identified and sorted from the preconditioned (ipsilateral) cortex. However, it is uncertain if this increase reflects a true change in cell number (due to proliferation or migration) or if it reflects a novel characteristic of the preconditioned microglia to better survive the enzymatic and mechanical tissue digestion that precedes the flow cytometry processing. In order to address this question, we are carrying out quantitative immunofluorescent microscopy on tissue sections from preconditioned or naïve mouse brains that have been stained with a fluorochrome-conjugated antibody (anti-Iba1) specific for identifying microglia/macrophages. My contribution to this work will include tissue preparation and sectioning, antibody staining, microscopy image capture and cell quantification using custom calibrated image analysis software. Answering this initial yet fundamental question will be an important starting point for additional investigations into the function and phenotype of microglia/macrophages in the preconditioned brain and may shed light new light on the mechanism of IPC.

SESSION 1J

INTERNATIONAL PERSPECTIVES ON COMMUNITY EMPOWERMENT: RIGHTS, RESOURCES AND POLITICAL ACTION

*Session Moderator: Arista Cirtautas, Jackson School of
International Studies*
254 MGH

1:15 PM to 2:45 PM

* Note: Titles in order of presentation.

Violence Reduction in Rio de Janeiro

*Elise Marie (Elise) Butterfield, Senior, Dance: Creative
Studies, International Studies*

Mary Gates Scholar

Hallie Scott, Senior, International Studies, Dance

*Chloe Tatiana Kachscovsky, Senior, International Studies,
Political Science*

Sara Jane Alstrom, Senior, International Studies

Mary Gates Scholar

*Grace Athena (Grace) Flott, Senior, International Studies,
French*

Kika Kauri, Junior, International Studies

John Benjamin O'meara, Senior, International Studies

*Ramiro Antonio (Ramiro) Reyes, Senior, International
Studies, International Studies: Latin America*

*Mentor: Jonathan Warren, Jackson School of International
Studies*

Rio de Janeiro is infamous for violence. In the city's large, informal shantytowns known as favelas, violent drug gangs rule with impunity while a corrupt and murderous police force contributes to distrust of formal government. With Rio scheduled to host the World Cup in 2014 and the Olympics in 2016, pressure to tame the favelas and reduce violent crime is high. Facing the need to try something new, in 2008 Rio's leadership introduced an innovative, community-oriented policing program known as UPP in an attempt to "pacify" the favelas. The program represents a paradigm shift in policing methods, focused on breaking down the adversarial relationships between favela residents and police and encouraging community involvement and integration. It has shown impressive progress: in favelas that have received UPPs, murder rates have fallen to nearly zero. However, much remains to be done—the UPPs are an expensive fraction of the police force, and skeptics worry that if the UPP's leave, all progress will be lost. The challenge, then, and the focus of this Task Force, is to ensure that the favelas are integrated and supported in a way that preserves the progress that has been made and fosters permanent change. Each of the 11 chapters within this Task Force presents policy recommendations prepared for the

Public Security Secretary of Rio de Janeiro José Beltrame, and as such, are tailored to his position and responsibilities. Subjects include reforms within the police force, such as improvements in police training, organization, and working conditions, as well as policies intended to promote integration of the favelas into the formal city, including methods to improve education and access to healthcare, implementing programs to target at-risk youth, and providing economic opportunities for favela residents.

POSTER SESSION 2

Commons West, Easel 35

12:45 PM to 2:15 PM

Pushing Limits: Self-Mutilation and Spiritual Body Modification as Functions of Taught Bodies

Rowan Carrick, Junior, Religion, University of Puget Sound
Mentor: Jonathan Stockdale, Religion, University of Puget Sound

Contemporary US society has in many ways written off self-mutilation, the deliberate damage or modification of one's body tissue without intention of suicide, as a pathological act whose roots lie in mental illness and destruction beyond any sort of rationality. Often, self-mutilation is linked to suicidal behavior, but even when it isn't it bears a transgressive nature and is frequently met with repulsion. In order to understand and examine the effects of the transgression of self-mutilation on individuals and larger communities, I took into account some ways in which individuals in specifically religious contexts have been marginalized by these practices. Parts of the Lakota Sun dance involving self-mutilation were banned in the US between the years 1895-1978 and the Modern Primitives, a group that emerged in the late 1960s and 70s seeking to reclaim self-mutilating religious rituals were met with extreme ostracism. In my research I explored spiritual self-mutilation as a vehicle for connection to something beyond an individual's bodily limits, examined the physical and psychological capacities humans have to endure intense physical sensation, and looked at the implications of the process of physical healing as a powerful and direct metaphor for spiritual healing. Taking all of these into consideration, with the help of the narrative of the Modern Primitives, I sought to understand the way in which, for many individuals, the brutal destruction and modification of skin and flesh becomes an act of creation, of reconstruction and life-affirmation. If we allow ourselves to reconsider our cultural taboos surrounding self-mutilation in a religious context, we begin to see that there may be a stronger, deeper connection between spiritual self-mutilation and pathological self-harm than we can realize, without taking a closer look at the roots of both.

POSTER SESSION 3

Balcony, Easel 99

2:30 PM to 4:00 PM

Analyzing the Affects of Different Treatments on Below Ground Processes on Prairie Restoration Plots

Korena K (Korena) Mafune, Senior, Environmental Science & Resource Management (Restoration Ecology & Environmental Horticulture)

Mentor: Jonathan Bakker, Environmental and Forest Sciences

Washington State is home to many diverse prairie ecosystems, which have severely been degraded or converted to agriculture/farmland. Due to the impact over the last several decades, it is crucial to research Washington's native prairie ecosystems and work towards preservation, conservation, and restoration of these areas. There are many ongoing projects on these prairies, in efforts to gain more knowledge about the growth, development, and interactions of rare prairie species. It is very important to determine underground processes because these processes could affect the long-term success of restoration. I compared microbial metabolism and nitrogen mineralization among three restoration treatments: burning, herbicide, or solarization, at Glacial Heritage Preserve in Olympia, WA. Plots were seeded with a diverse mix of native prairie species 2, 3, or 4 years before this study. The goal of the project is to determine if soil processes differ among plots, and if it is a result of treatment or year seeded. Soil samples were collected from replicates of each treatment plot from each year, and extracted and inoculated into *Biolog Ecoplates*^T M. The amount of Nitrogen available for mineralization was also measured. Preliminary results display that there is some difference between treatments and years, and available Nitrogen varies greatly among treatment plots. The results of each experiment are being further investigated.

POSTER SESSION 4

Commons East, Easel 78

4:15 PM to 5:45 PM

Variation in the Shape of the Molars of Modern Gophers as a Basis for Differentiating Taxa in the Fossil Record: A Geometric Morphometrics Investigation

Jennifer W Glusman, Senior, Biology (Physiology)

Mentor: Gregory Wilson Mantilla, Biology

Mentor: Jonathan Calede, Department of Biology

The late Oligocene-early Miocene fossil record (30-18.8 million years ago) of North America includes an abundant fauna of entoptychine gophers (Rodentia: Geomyidae: Entoptychinae). These burrowers make up as much as 20% of the mammalian individuals of the faunas they are part of, and can be

involved in habitat partitioning or competition with other burrowing herbivores. The wide geographic range of these animals and their use in constraining the age of the fossil assemblages of the Cabbage Patch beds (western Montana) and John Day Formation (eastern Oregon) makes them critical to understanding the biogeographic relationships among these fossil faunas. To understand these spatiotemporal patterns, I am evaluating the taxonomic richness of entoptychine gophers. Previous studies have discriminated among these gopher species by using morphological features of skulls and dentaries. However, anatomical elements are rarely preserved in fossil assemblages, and isolated teeth are commonly the only material available for identification. Since the occlusal surfaces of the cheek teeth are usually worn down as a consequence of feeding, they lack discrete features for species identification. Instead, some researchers have hypothesized that the more continuous variation in the enamel outline of select cheek teeth could be used for discrimination. Here, I use semi landmark-based geometric morphometrics (an arithmetical comparison of geometric coordinates) on the upper last premolar and molar. Applying this method to 98 modern geomyine gopher specimens (Geomyidae: Geomyinae), representing 10 taxa, helps quantify intra- and interspecific tooth shape variation and offers guidelines for recognizing fossil gopher species. Preliminary analyses indicate that tooth shape is species-specific in modern gophers, supporting the use of this method to differentiate fossil gopher taxa. Applied to 96 specimens of fossil gophers, I found a strong overlap of fossil taxa in the morphospace, suggesting that previous researchers may have overestimated the species diversity of some fossil gophers.

POSTER SESSION 4

Commons West, Easel 15

4:15 PM to 5:45 PM

Post-Analysis of the First Web-Based Acceptance and Commitment Therapy for Smoking Cessation: Focus on Smokers with Depressive Symptoms

Helen Alex (Helen) Jones, Senior, Neurobiology, Psychology
Mary Gates Scholar

Mentor: Jonathan Bricker, Psychology

Cigarette smoking is the leading cause of preventable death in the United States. The adverse health effects from tobacco use account for about one of every five deaths each year in the United States. Moreover, smokers with depressive symptoms have lower cessation rates and more difficulties while quitting than the general population of smokers. Treating smokers with depressive symptoms effectively is challenging and new smoking cessation interventions are always needed. In order to determine how recent smoking cessation treatments are benefiting smokers with depressive symptoms, the present study examines an existing web-

based treatment using the innovative Acceptance and Commitment Therapy (ACT). ACT provides mindfulness-based techniques that help smokers dealing with the urges, thoughts and negative feelings associated with smoking while quitting. The study aimed to determine the users: (1) willingness to experience smoking cues, and (2) 3-months post randomization smoking status. Adult participants were recruited nationally into the double-blind randomized controlled pilot trial which compared web-based ACT for smoking cessation (webquit.org) with smokefree.gov—the national standard for web-based smoking cessation interventions. The present study will report the outcomes for smokers with depressive symptoms. Data analysis is ongoing. Based on previous research, we expect the web-based ACT intervention to be more effective than the standard treatment (smokefree.gov). This trial will provide insights for ongoing research in smoking cessation interventions to help smokers with depressive symptoms to quit smoking.

POSTER SESSION 4

MGH 241, Easel 160

4:15 PM to 5:45 PM

The Role of Interferon Signaling in Microglia in Ischemic Preconditioning-Mediated Neuroprotection

Erwin Lanier Odongo, Senior, Biology (Molecular, Cellular & Developmental)

Mentor: Jonathan Weinstein, Neurology

Mentor: Shahani Noor, Neurology

Ischemic preconditioning (IPC) refers to the neuroprotective phenomenon in which a brief ischemic exposure in the brain increases resistance to injurious effects of subsequent prolonged ischemia. Ischemia is the restriction of blood to tissues. Interferons (IFNs) are cytokines released during ischemic exposure to activate the Interferon alpha receptor (IFNAR) complex and trigger the transcription of interferon stimulated genes (ISG). ISG gene products may contribute to IPC-mediated neuroprotection. However, IFN receptors are expressed on myeloid cells as well as neural cells; the cell type-specific contribution of IFN signaling in IPC is not established. Microglia are the resident immune cells in the brain and are central in the inflammatory responses to stroke. Data from our lab strongly suggest that microglia exposed to ischemia both *in vitro* or *in vivo* demonstrate a robust expression of ISGs. We hypothesize that expression of IFNAR1 and intact IFN signaling on microglia is required for IPC mediated neuroprotection. Thus, the administration of IFN β prior to stroke will mimic IPC in the wild type (WT) but not in myeloid cell targeted IFNAR1 (Cre/loxP) knockdown mice. We obtained IFNAR1 $^{fl/fl}$ strains through collaboration and purchased LysM-Cre. We then used selective breeding and PCR genomic strategies to generate mice that are combined for homozygous IFNAR1 $^{fl/fl}$ and heterozygous for LysM-Cre

and wild type (WT) genes. We are also currently optimizing our method to administer IFN β using a stereotactic injection system through the lateral ventricle of the brain. We have recently confirmed the appropriate positioning of the intracerebroventricular (ICV) injection and plan to carry out ICV injection of IFN β on the WT and IFNAR1fl/fl /LysM-Cre strains. After inducing stroke, we will quantify and compare the infarct volume and neurobehavioral outcomes. This study will demonstrate the cell-type specific contribution of microglia in IFN-mediated neuroprotection. If successful, our findings can be used to develop pharmaceutical therapies for stroke and gene therapy remedies.

POSTER SESSION 4

MGH 241, Easel 135

4:15 PM to 5:45 PM

Microglia Toll-like Receptor and Interferon Signaling in Ischemic Preconditioning

Dorender Appiah (Dorender) Dankwa, Senior, Psychology, Neurobiology

Mary Gates Scholar

Mentor: Jonathan Weinstein, Neurology

Ischemic Preconditioning (IPC) is a neuroprotective phenomenon in which a brief ischemic exposure increases resistance to serious injury from subsequent ischemia. Understanding the basic mechanisms of IPC and taking advantage of this knowledge may provide better treatment options for those at high risk for stroke. We hypothesize that ischemia induces brain tissue release of endogenous Toll-like receptor (TLRs) agonists (sometimes referred to as damage association molecular patterns (DAMPs)) that stimulate microglia Toll-like receptors, thus releasing interferon (IFN) α/β to trigger the transcription of neuroprotective interferon stimulated genes (ISG). Our objective was to culture mouse microglial cells and stimulate the various microglia TLR receptors with their respective agonists to identify the receptors that mediate ISG release. We also wanted to demonstrate TLR-agonist induced release of IFN α/β , especially because IFNs are already effective FDA-approved treatments for Multiple Sclerosis and could serve to increase ischemic tolerance for patients at high risk for strokes. Due to results from previous experimental paradigms strongly suggesting that IPC-mediated neuroprotection is TLR4-dependent, we proposed that stimulation of TLR4 generates release of IFNs that in turn induce transcription of ISGs. Our preliminary results revealed that activation of multiple TLRs (TLR 3, 4, and 9) could mediate the release of ISG chemokines, with notable ISG release following TLR3 and TLR4 activation. IFN release was not detected through TLR4 but instead TLR3. We are currently exploring the possibility of a synergistic relationship between TLR3 and TLR4 in regulating IPC-mediated neuroprotection.

POSTER SESSION 4

MGH 241, Easel 159

4:15 PM to 5:45 PM

What's the Matter: Effects of Ischemic Preconditioning in White Matter

Thu Le, Senior, Korean, Biology (General)

Mentor: Jonathan Weinstein, Neurology

Ischemic preconditioning (IPC) is a neuroprotective phenomenon in which a short ischemic episode confers resistance to prolonged subsequent ischemic attacks, and is dependent upon functional Toll-Like Receptor 4 (TLR4) and possibly downstream interferon (IFN)-related signaling. Understanding this mechanism and being able to mimic it pharmacologically may lead to better stroke therapy and treatment. In our current study, we use the optic nerve—a pure axonal tract—as our model in determining the effects of stroke in white matter. Roughly half the human brain is composed of white matter—the myelinated axons and supporting cellular milieu that connect neurons into networks. In our experimental paradigm, we induce IPC in vivo by performing common carotid artery occlusion (CCAO) and then expose ipsilateral (IPC-induced) and contralateral (control) optic nerves to ex vivo oxygen-glucose deprivation (OGD) (in order to model ischemic or “stroke” related injury). We then characterize electrophysiological properties and axonal integrity of the isolated optic nerves. In addition, we characterize glutamate receptor isoform expression and interferon stimulated gene induction. IPC-exposed optic nerves showed improved compound action potential (CAP) recovery following OGD in wild-type versus TLR4^{-/-} mice. Using immunohistochemical techniques we show that oligodendrocytes are protected from OGD-induced death. Likewise, axonal integrity is maintained better in IPC-treated optic nerves as shown by immunohistochemistry of phosphorylated neurofilaments. Glutamate receptor (GluR) isoform variants flip and flop can exhibit different channel opening kinetics by affecting rates of receptor desensitization—possibly influencing how CAPs respond following IPC. However, our data indicated little regulation of GluR mRNA transcript isoforms. We did however observe upregulation of several interferon-stimulated genes (ISGs) following IPC in optic nerve, which may contribute to the mechanism by which IPC can mitigate the injurious effects of stroke. Studying IPC and stroke pathophysiology in the optic nerve may lead to potential therapeutics specific to white matter.