

## Undergraduate Research Symposium May 18, 2018 Mary Gates Hall

### Online Proceedings

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#### POSTER SESSION 1

MGH 241, Easel 131

11:00 AM to 1:00 PM

##### **Development of a Noninvasive Method to Enhance Cortical Plasticity Based on Vagus Nerve Stimulation**

*Hayley Michelle Boyd, Junior, Bioengineering*

*Mary Gates Scholar*

*Mentor: Eberhard Fetz, Physiology & Biophysics*

*Mentor: Irene Rembado*

Cortical plasticity is the substrate for learning and memory. It is the basis of an organism's ability to adapt in response to a changing environment and is central to functional recovery after an injury involving the nervous system. Vagus nerve stimulation (VNS) has already been shown to be effective in altering neuroplasticity. Most VNS research has been conducted on epileptic animals and thus offers little information on how VNS may affect a healthy human brain. The final goal of this project is to establish a minimally invasive VNS protocol aiming to augment neuroplasticity and enhance behavioral performance in a cognitive task. Non-human primates are implanted with cortical electrodes and also receive a stimulating cuff electrode around the vagus nerve in the neck. By delivering current through the cuff, vagal evoked potentials (VEPs) are elicited on the cortex. In order to measure how VNS affects cortical excitability, we pair the stimulation of the vagus nerve with stimulation of a somatosensory nerve (i.e. median nerve) and we quantify the effects on the cortical activity by measuring the magnitude of the evoked responses generated on the cortex. Preliminary results from one animal showed a suppression of cortical activity in the primary motor area (M1) when the delay between the vagus stimulation and the median nerve stimulation ranges between 100 and 150 msec. Four additional animals have received vagus nerve cuffs and neural implants targeting multiple cortical areas. These neural implants give us access to recording not only from M1, but also from prefrontal, premotor, supplementary, and parietal cortical areas. In this way we will be able to characterize the physiological effects of VNS on the cortical excitability of different brain areas, generating data and insights never before obtained and directly applicable to the development of neuromodulation technology in humans.

#### POSTER SESSION 1

MGH 241, Easel 132

11:00 AM to 1:00 PM

##### **Comparing Ipsilateral and Contralateral Effects of Invasive and Noninvasive Vagus Nerve Stimulation Protocols in Non-Human Primates**

*Camille Isabella Birch, Senior, Bioengineering, Computer Science*

*Levinson Emerging Scholar, Mary Gates Scholar, UW*

*Honors Program*

*Mentor: Eberhard Fetz, Physiology & Biophysics*

*Mentor: Irene Rembado*

Vagus nerve stimulation (VNS) involves the delivery of electrical stimuli to the vagus nerve, which is associated with several brain regions and functions. VNS is currently used as auxiliary treatment for some types of epilepsy and there is significant interest regarding its potential in the treatment of other illness as well as for cognitive augmentation and promoting plasticity. The goal of this project is to investigate the differences in ipsilateral and contralateral cortical responses to different vagus nerve stimulation protocols, as well as to compare the responses to invasive versus noninvasive VNS delivery methods. Data was collected from a non-human primate using dual electrodes (with epicortical and intracortical contacts) placed in the prefrontal, premotor, supplementary and primary motor and parietal cortical areas, as well as a nerve cuff placed on the left trunk of the vagus nerve. Data analysis focused on the cortical evoked potentials elicited by VNS and recorded at cortical sites both ipsilateral and contralateral to the VNS. VNS was delivered to both the auricular branch of the vagus nerve in the noninvasive protocol and through a nerve cuff on the left vagus nerve trunk for the invasive protocol. This work is related to a larger project focused on establishing protocols for noninvasive VNS to augment targeted neuroplasticity and enhance cognitive performance in normal nonhuman primates. This nonhuman primate study will be directly applicable to the development of noninvasive VNS technology that can be used to enhance neuroplasticity and cognitive performance in healthy adult humans.

#### POSTER SESSION 2

Commons West, Easel 23

1:00 PM to 2:30 PM

### **Sex Differences in Marijuana-Related Consequences in Polysubstance-Using College Aged Populations**

*Ha Yoon Lee, Senior, Psychology*

*Mentor: Nicole Fossos-Wong, Psychiatry and Behavioral Sciences*

*Mentor: Irene Geisner, Psychiatry and Behavioral Sciences*

With the recent legalization of recreational marijuana use in states spanning the country, rates of marijuana use among college students are climbing. Marijuana is one of the most heavily used drugs among young adults and the literature on sex differences in consequences of marijuana use is sparse. This study examined sex differences in marijuana-related negative consequences among college students. Data were collected from students across 9 campuses who indicated past year non-medical use of prescription stimulant medication as part of a larger web-based study. Participants (n=341) reported past year frequency of marijuana use and related consequences using the Rutgers Marijuana Problem Index. Results revealed a main effect of sex on "feeling down about yourself" as a consequence of marijuana use, indicating that men were more likely to endorse this consequence than women. Results also revealed a main effect for marijuana use frequency; indicating heavier users were more likely to report feeling down about themselves, trouble managing their time, and making decisions they later regretted. Two-way interactions between marijuana use frequency and sex were also explored. A marginally significant interaction revealed that male, but not female, frequent users reported feeling down about themselves because of their marijuana use more than less frequent users. We also found a marginally significant interaction among lower frequency users, where men report having trouble managing their time more than women, but this was reversed when looking at higher frequency marijuana users, with women indicating greater endorsement. Lastly, we found that among women, marijuana use frequency was unrelated to making decisions they later regretted. Conversely, among men, more frequent marijuana users reported this consequence more than all other groups, whereas less frequent male marijuana users reported this consequence the least. Differences in consequences associated with marijuana use have implications for intervention efforts for male and female students.

### **Bioremediation Using Mushrooms**

*Alyssa Liming, Freshman, Biology Chemistry, Bellevue College*

*Navya Garimella, Sophomore, Biology, Bellevue College*

*Tara Ghazanfari, Sophomore, Biochemistry, Biology, Oceanography, Bellevue College*

*Mentor: Michael Hanson, Life Science, Bellevue College*

*Mentor: Irene Shaver, RISE, Bellevue College*

Oil-spills are a widespread hazardous environmental issue, often caused by mistakes when drilling or transporting crude oil. The effects are devastating to the ecosystem. There are very few ways to quickly clean up an oil spill efficiently, at low cost and without additional environmental damage, as often they are cleaned by using expensive chemical dispersants. We conducted research on an environmentally friendly and inexpensive solution to this problem by using pearl oyster mushroom mycelium. The pearl oyster mushroom has a lignin decomposing basidiomycotina that produces a set of extracellular ligninolytic enzymes that have bioremediation properties. Our hypothesis is that, oyster mushrooms can be used to clean oil spills. We cultivated the mushroom mycelium in straw on trays with different amounts of oil on them. We grew this in a greenhouse with controlled temperature and allowed 4-6 weeks for the mycelium to eat the oil. We are currently observing the results. After 6 weeks, we will filter out the remaining hydrocarbons with a solvent and determine if the mycelium reduced the amount of hydrocarbons or consumed them entirely. Our anticipated results are that the mushroom will clean up the oil in six weeks. For future work, we plan on conducting this same experiment but in a salt water environment to explore applications for mycoremediation in a simulated ocean environment.

## **POSTER SESSION 3**

**Commons East, Easel 64**

*2:30 PM to 4:00 PM*