# Online Proceedings

## 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.

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### 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.