UNIVERSITY of WASHINGTON

Undergraduate Research Symposium May 17, 2013 Mary Gates Hall

Online Proceedings

Poster Session 1

Commons East, Easel 72

11:00 AM to 12:30 PM

Acoustic Evaluation of Hepatic Steatosis

Ameen Tabatabai, Sophomore, Bioengineering
Mentor: Wayne Kreider, Applied Physics Laboratory
Mentor: Yak-Nam Wang, APL
Mentor: Michael Bailey, APL
Mentor: Adam Maxwell, Urology

Liver transplantation is a widely performed treatment for patients with end stage liver disease. Each day, the liver transplant waiting list grows longer due to a shortage of acceptable organs. Hepatic steatosis in donor livers is an increasing problem that contributes to discarding otherwise-transplantable livers. Numerous studies and surgeries have shown that high fat content in livers correlates with poor graft function and lower patient survival. Longer waiting lists are causing transplant centers to consider moderately steatotic livers as a part of extended donor criteria. However, a method is needed to objectively quantify fat content in livers in order to select suitable organs. Many studies over the past 30 years have characterized a correlation between fat content of livers and acoustic properties such as sound speed and attenuation. This research seeks to employ an acoustic caliper device to acquire acoustic measurements that can be used to quickly, accurately, and noninvasively evaluate the fat in transplant donor livers. Sound speed and attenuation were measured by transmitting short pulses of ultrasound at frequencies from 1-10 MHz through excised pig and cow livers. Liver thicknesses were measured with a dial caliper to permit sound speed estimates, and reference measurements were taken in water to calculate the additional attenuation created by the presence of the liver. In addition, a thermocouple was used to take precise temperature measurements in liver and water, since sound speed varies with temperature. Although fat content was not quantified, sound speed and attenuation did correlate with the presence of visually observable fat. However, significant variabilities between measurements were also found with regard to the preparation of the liver samples and tissue inhomogeneities. This work has led to ideas for an improved acoustic caliper device and for testing lipid emulsions as tissue phantoms for evaluating measurement capabilities.

Session 1D

Medical Therapeutics and Endocrinology

Session Moderator: Ian Sweet, Medicine

231 MGH

1:15 PM to 2:45 PM

* Note: Titles in order of presentation.

Expression of Costimulatory Molecules in Juvenile Idiopathic Arthritis versus Severe Gingivitis

Megan Christine Yuasa, Senior, Biology (Physiology)
Mentor: Anne Stevens, Pediatrics

The most common rheumatological disorder found in children is juvenile idiopathic arthritis (JIA), a disabling disease of unknown etiology and with no cure to date. Previous studies have suggested autoantibodies of adult rheumatoid arthritis (RA) cross-react with oral pathogens, suggesting that oral infection could trigger arthritis. Severe gingivitis, an inflammatory disease of the gums, is present in 50-100% of adolescents, and may exhibit this same interaction with JIA. Costimulatory molecules on antigen presenting cells are induced during an inflammatory response to regulate T lymphocytes. Specifically, programmed death ligand-1 (PD-L1) known to be expressed during infection, is also highly upregulated in JIA. To test the hypothesis that PD-L1 expression is induced by oral pathogens associated with gingivitis, peripheral blood cells were isolated from JIA patients and healthy children. Gingivitis was scored by oral examination. PD-L1 expression was assayed on myeloid DCs and monocytes by flow cytometry. Preliminary data on a subset of subjects (n=7) showed a higher percentage of monocytes with PD-L1 in JIA patients compared to controls; however JIA patients had a lower density of PD-L1 per cell. There was no association between extent of gingivitis and PD-L1 expression. The results of this study could contribute to a new field of JIA therapy targeted at costimulatory molecules and oral hygiene.

SESSION 1E

SENSORIMOTOR NEUROSCIENCE

Session Moderator: Eric Chudler, Bioengineering
234 MGH
1:15 PM to 2:45 PM
* Note: Titles in order of presentation.

A Behavioral Analysis of Visual-Motor Processing in *Drosophila melanogaster*
Samantha Ann (Sami) Williams, Senior, Chemistry
Mary Gates Scholar
Mentor: Michael Dickinson, Biology
Mentor: Max Sizemore, Biology

Visual-Motor processing provides a mechanism for animals to translate visual cues into useful information for locomotion. My research aims to investigate this mechanism by analyzing the responses made by fruit flies to certain visual stimuli. I accomplish this by first tracking and quantifying fruit fly locomotion when two flies are present. By quantifying this behavior I can create a behavioral map of fly responses in relation to other fruit flies. I can then replace one of the flies with a cylindrical, fly-sized magnet that is readily controlled by me. This step is important because by controlling the magnet it is possible to reproduce large amounts of a specific behavior, instead of watching two flies interacting randomly and waiting for relevant interactions. It also will allow me to investigate the affects of object speed and angle of approach and create a behavioral map of the fly's locomotor response. Once this is accomplished it will then be possible to test fruit fly responses to visual stimuli presented on an LED screen surrounding the fly and to measure brain activity in the flies while these stimuli are displayed. Ultimately we hope to identify the neurons that are responsible for visual-motor processing and how they accomplish the transition from visual input to locomotor response.

SESSION 2O

SENSORY INPUT IN MUSIC, SPEECH, AND THE VESTIBULO-MOTOR SYSTEM

Session Moderator: Ludo Max, Speech & Hearing Sciences
288 MGH
3:45 PM to 5:15 PM
* Note: Titles in order of presentation.

Speech Adaptation to Formant-Shifted Auditory Feedback in Stuttering Versus Non-Stuttering Children
Wai Ying (Cathy) Cho, Senior, Speech and Hearing Sci (Com Disorders)
Mentor: Ludo Max, Speech & Hearing Sciences

Stuttering is hypothesized to be a disorder resulting from underlying sensorimotor deficits. Here we investigate whether children who stutter (3-9 years of age) differ from their nonstuttering peers in the integration of auditory feedback in the planning of speech movements. Studies with nonstuttering speakers have shown compensatory adaptation when the formant frequencies in the auditory feedback signal are shifted up or down with an effects processor. Our laboratory has found a lack of such sensorimotor adaptation to formant-shifted feedback in adult stuttering subjects. We have also found reduced adaptation in stuttering children's arm movements when performed with altered visual feedback. In the present study, we investigate speech adaptation in response to formant-shifted feedback in stuttering vs. nonstuttering children. Subjects spoke monosyllabic consonant-vowel-consonant words in baseline (unaltered feedback), perturbed (formants in the feedback signal shifted 2.5 semitones up), and after-effects (unaltered feedback) phases of two conditions. In an "abrupt" condition, the formant perturbation was introduced suddenly at full strength. In an "incremental" condition, the formant perturbation was gradually ramped up over several minutes. Subjects heard the auditory feedback in real-time through insert earphones. Data collection and analysis are ongoing at the present time. Our hypothesis is that children who stutter will show reduced adaptation as compared with children who do not stutter. Findings from this work may have important implications for typical speech development as well as developmental speech motor disorders such as stuttering.

POSTER SESSION 4

Commons East, Easel 65
4:15 PM to 5:45 PM

Sensorimotor Adaptation in Persons Who Stutter: Generalization and Interference
Adam Wilber (Adam) Redmond, Fifth Year, Speech & Hearing Sciences
Mentor: Ludo Max, Speech & Hearing Sciences

Stuttering is a high-prevalence speech disorder that often develops into a chronic, life-long problem with severe social implications. The ultimate causes are unknown, but recent studies have revealed structural and functional neural deficits that impact sensorimotor functioning, the interaction between motor control and sensory feedback. Our laboratory has shown that stuttering adults differ from nonstuttering adults in their ability to adapt to conditions with novel sensorimotor

mappings. We suggest that individuals who stutter may have difficulties with the learning of stored neural representations of the mapping between motor commands and sensory consequences. We investigate whether stuttering individuals' difficulties in sensorimotor adaptation tasks are associated with (a) increased interference by competing sensorimotor mappings and/or (b) an impaired ability to generalize learned sensorimotor mappings to unpracticed movements. We used a design that allows an examination of anterograde interference (learning task B interferes with the subsequent learning of task C), retrograde interference (learning task C interferes when re-tested on task B), and generalization (adaptation transfers to an unpracticed task). In this design, groups of stuttering adults and nonstuttering adults produced monosyllabic words in different conditions of formant-shifted auditory feedback and a non-shifted control condition. Additionally, in each condition, all subjects produced 4 different words without altered auditory feedback but in the presence of masking noise. All productions were recorded for offline acoustic analyses. We will present descriptive and inferential statistical data comparing stuttering and nonstuttering subjects with regard to retrograde interference, anterograde interference, and generalization in this speech sensorimotor adaptation task. We will present these findings in light of previous suggestions that individuals who stutter may have difficulty with the learning, updating, or activation of internal models used in the planning and execution of speech movements. The results will motivate improvements and adjustments in our current model of the sensorimotor mechanisms underlying stuttering.

POSTER SESSION 4

Balcony, Easel 86

4:15 PM to 5:45 PM

A Web-Based Community Firn Model

Paul Daniel (Paul) Harris, Senior, Applied & Computational Mathematical Sciences (Scientific Computing & Numerical Algorithms)
Mentor: Edwin Waddington, Earth And Space Sciences
Mentor: Jessica Lundin, Earth and Space Sciences
Mentor: Max Stevens, Earth and Space Sciences

The distribution of temperature and precipitation on our planet (i.e. our climate), affects plant growth, animal habitats, and the livability of Earth's varied regions. In order to predict future climate we need to know about our past climate. This is important to better understand how temperature and weather conditions change when the radiative forcing (e.g. CO2 greenhouse effect) on our atmosphere increases. The best way to predict these changes is researching past radiative forcing increases and how these events impacted Earth's climate. Some details of our past climate are discovered by analyzing polar ice and the gas bubbles trapped within. Firn is fallen snow that compacts and eventually turns into glacial ice. During this process gas can move relatively freely throughout the firn. When the firn densifies enough to block the air passageways, young gases are trapped in significantly older ice. This work is building a web-based community firn densification model that allows the user to accurately determine the difference between the age of a gas sample and the age of the ice surrounding it. Our transient model determines this delta age more accurately than current steady-state models by accounting for changing conditions as the firn turns into ice, instead of assuming conditions remain static throughout the firn evolution. This model is open-source, and written using the Python programming language, along with the NumPy library, allowing the model to be free and usable by anyone. Because the model is modular, users can easily change it to fit specific conditions or to incorporate different physical processes. Our goal is to provide a model that is simple to use, freely available, and helpful for developing a more accurate understanding of our past climate.

POSTER SESSION 4

Balcony, Easel 97

4:15 PM to 5:45 PM

Firn Model Inter-Comparison

William Procter (Will) Leahy, Senior, Interdisciplinary Visual Arts
NASA Space Grant Scholar
Mentor: Edwin Waddington, Earth And Space Sciences
Mentor: Jessica Lundin, Earth and Space Sciences
Mentor: Max Stevens, Earth and Space Sciences

Our 800,000-year climate record is dependent primarily on data obtained from ice cores. Analyzing and dating the ice, gas, and sediment in these cores allows us to construct a remarkably accurate historical record of Earth's climate and atmosphere. However, the dating and chronology of the ice record is not as exact as we would like it to be, especially deeper in the ice. Our ability to date ice cores with accuracy depends on our understanding the evolution of glacial firn, fallen snow that gradually compacts into ice. Researchers have developed many different models of firn evolution. The aim of this project is to run these models against each other under the same boundary conditions, so that we may compare their responses and determine the strengths of each model. Participants have submitted their model output and our results have been returned to them. A second inter-comparison will be organized to address issues brought up by our initial results. These comparisons will improve future efforts in firn-modeling, ultimately leading to a better understanding of our climate record.