

Undergraduate Research Symposium May 17, 2013 Mary Gates Hall

Online Proceedings

POSTER SESSION 1

Commons East, Easel 56

11:00 AM to 12:30 PM

Identifying the ZVM10 Mutation that Causes Early Complete Blindness in *Danio Rerio*

Gail Stanton, Senior, Biochemistry

Mentor: Susan Brockerhoff, Biochemistry

Blindness is a condition that impacts people across the globe. Some of these people are born blind due to a genetic defect, while others become blind through an accident or as the result of disease. Thus dissecting the underlying molecular causes of blindness is a critical component in improving the lives of many people. To study causes of blindness, we are analyzing disease causing mutations in the model organism *Danio Rerio*, or zebrafish. The recessive ZVM10 mutation causes very early degeneration of both rod and cone retinal photoreceptors, causing complete blindness. To study this mutation we have determined the identity of the mutated gene. I helped in this endeavor by first determining the position of the mutation within the zebrafish genome (i.e. map the mutation). This was done by mating the ZVM10 AB fish with a polymorphic fish strain. The crossovers between the different DNAs were traced, and used to identify the area homozygous for the AB allele. By continually reducing this region we specified a small group of genes that potentially were mutated. I then helped sequence these genes. A single base pair mutation that introduces a premature stop codon was identified in the gene encoding N-ethylmaleimide-sensitive attachment protein, beta (NAPB). I am currently working on a reliable genotyping protocol based on this mutation to sort mutated from non-mutated fish. The mechanism of photoreceptor degeneration in this mutant will further be studied by examining the role of this gene in wild type cells. The identification of this mutation will permit the identification of people who are blind due to this genetic mutation, through genetic screening of the patient. Finally, if this gene is also involved in human blindness, it will become a candidate for rescuing blindness through gene therapy.

Multiple Applications of Botulinum Neurotoxin and Masseter Muscle Activity in Rabbits

Michael Christopher (Michael) Gross, Senior, Biochemistry, Microbiology

Mentor: Zi-Jun (Zee) Liu, Orthodontics

Mentor: Susan Herring, Orthodontics

Mentor: Katherine Rafferty, Orthodontics

Botulinum neurotoxin type A (BoNT/A) has been extensively used in human masticatory muscles for cosmetic reduction of large masseter muscles, relaxing the muscles and reducing pain in temporomandibular joint and muscle disorders, and decreasing loading on the mandible. Multiple applications of BoNT/A over time is a clinically routine practice to reach the treatment goal. However, it is unknown how the muscle responds to multiple neuromuscular blockages by BoNT/A, and whether or not the injected muscle shows functional recovery differently after each application. This study was designed to answer these questions. Adult New Zealand rabbits were injected 3 times either with BoNT/A (n=13) or saline (n=5) in one masseter at week 0, 12, and 24. Non-invasive surface electromyography (EMG) of bilateral masseter muscles was recorded during natural mastication 1 week before the first injection and every two weeks thereafter up to week 35. Jaw movement was video-taped and synchronized with EMG recording for identifying the chewing side. Body weight was tracked weekly to examine the effect of BoNT/A on general health. From each of these recordings, 15-20 consecutive chewing cycles from each chewing side were sampled and analyzed for chewing cycle length, muscle mean and integral activity, and durations. The preliminary results indicate that the recovery patterns of the 11-12 weeks after each BoNT/A injection differed significantly, and both the chewing frequency and muscle activity 11 weeks after the 3rd injection (week 35) were close to those of saline animals and the baseline recorded before injection. These findings provide new information about the consequences of multiple applications of BoNT/A on masticatory muscles, and may lead to the better understanding and use of BoNT/A in clinical dentistry.

POSTER SESSION 2

Commons East, Easel 59

12:45 PM to 2:15 PM

SESSION 2R

EVOLVING SYSTEMS IN BIOLOGY: FROM MOLECULES TO MARSUPIALS

Session Moderator: Billie J. Swalla, Biology

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3:45 PM to 5:15 PM

* Note: Titles in order of presentation.

Finite Element Analysis of Teeth and Alveolar Bone, Linking Mammal Chewing Patterns to the Form and Function of the Periodontal Ligament

Rebecca Anderson, Senior, Biology (Physiology)

Mentor: Susan Herring, Orthodontics

Mentor: Casey Self, Biology

Relatively little is known about the periodontal ligament (PDL), a fibrous collagen structure which anchors teeth to the jaws and is thought to be a key factor in redistributing stress from teeth during mastication. However, to date the nature of this redistribution has not been established, hampering efforts to understand how best to regenerate a PDL that has been damaged. The goal of this project was to determine whether chewing patterns in mammals are correlated with the arrangement and direction of collagen fibers in the periodontal ligament. Specifically, I hypothesized that carnivorans, which chew in an up-down motion with high force, should maximize fiber number. In order to do this, fibers should be arranged radially at an average angle of 90 to the root. Stress should be greatest at the apex of the root. I embedded and sectioned mandible (lower jaw) samples from American mink (*Mustela vison*) into 7-micrometer slices, and examined the stained slides under a microscope to determine fiber angles. Samples were sliced in both horizontal and coronal planes. To assess stress, I created a finite element analysis (FEA) model of a single-rooted tooth using MSC Patran and Nastran, to which I can apply loads in various strengths and directions to simulate the response of the PDL under many different conditions. Due to lack of studies on the PDL in general, this is an isotropic model using material properties from the literature. Although this model is based on idealized geometry it should still show the correlation between stress and fiber angle for a given chewing direction. Preliminary results confirm the expectation of 90 fibers in carnivorans (86 ± 5). These data can now be incorporated into the FEA model. Future work will examine mammals with different chewing directions, such as rabbit (sideways motion) and mouse (forward motion).

POSTER SESSION 3

Commons West, Easel 32

2:30 PM to 4:00 PM

College Students' Self-Reported Advantages and Disadvantages of Drinking

Emily Taylor, Senior, Psychology

Jessica Holttum, Senior, Psychology

Laura Haelsig, Junior, Psychology

Ami Kanagawa, Senior, Psychology, Mathematics

Mentor: Susan E. Collins, Psychiatry and Behavioral Sciences, Harborview Medical Center

Most of the questionnaires used to assess college students' thoughts about their drinking are developed by researchers and are passively responded to by participants. Such researcher-generated measures, however, may not accurately reflect college students' thoughts about their drinking. In contrast, the current study used participants' own words in response to an open-ended measure to evaluate advantages and disadvantages college students perceive in maintaining their current drinking behaviors. Participants were college students (N=760) at the University of Washington who reported at least one heavy drinking episode in the past thirty days. The Decisional Balance Worksheet (DBW), an open-ended measure of motivation to change, was used to record the pros and cons of current drinking behaviors. Conventional content analysis methods were used to extract common themes. Findings indicated that social, "fun," and psychological effects of drinking were the most commonly mentioned advantages of drinking, whereas physical side effects, money, and calories/weight gain were the most commonly mentioned disadvantages of drinking. These findings show that college students use alcohol to achieve certain kinds of psychological states, enhance social interactions, and ease day-to-day stress. Further, many college students report experiencing physical side effects of drinking as well as more minor inconveniences, such as concerns about calories. In contrast, previous researcher-generated decisional balance measures have emphasized very different categories for advantages (e.g., coping, social, and excitement) and disadvantages (e.g., health effects, lack of control, and legal problems) (Migneault et al., 1997). Our findings therefore suggest that using open-ended questionnaires may result in a more accurate representation of what college students perceive as advantages and disadvantages to drinking.

POSTER SESSION 4

Commons West, Easel 20

4:15 PM to 5:45 PM

Verbal Working Memory and Communication Among High Functioning ASD Children

Gabriella (Gabby) Greco, Junior, Psychology

Mentor: Susan Faja, Developmental Medicine/Labs of Cognitive Neuroscience, Boston Children's Hospital

Mentor: Sara Jane Webb, Psychiatry & Behavioral Sciences, Seattle Children's Research Institute

Among individuals diagnosed with autism spectrum disorder (ASD), a delay or diminishment of the development of language and communication is found to be a core feature of the disorder. Children with ASD are also found to have more difficulty with verbal working memory tasks when compared to typically developing individuals, although findings have been mixed. In other clinical populations in which communication is impaired, one aspect of language that has been found to be related to verbal working memory is narrative ability, though this has not been thoroughly tested among children with ASD. Previous work has shown that verbal working memory relates to communication skills in children with ASD, albeit this study did not investigate narrative ability specifically. The current study had the goal of investigating the relation between verbal working memory and narrative ability in children with ASD. Data was collected from 21 participants. Participants were children from 6 to 11 years of age with autism spectrum disorder and average or above average IQ. Working memory was measured with the Children's Memory Scale Numbers subtest, and narrative ability was coded from a speech sample obtained during the Autism Diagnostic Observation Schedule. The planned analysis was a partial correlation between verbal working memory and narrative ability controlling for IQ. Our prediction was that better verbal working memory would be a predictor for stronger narrative ability above and beyond IQ.

POSTER SESSION 4

Commons West, Easel 21

4:15 PM to 5:45 PM

Does Skin Conductance During a Cognitively Demanding Task Relate to Internalizing Behaviors in Children with Autism?

*Nikita Nayudu, Senior, Biology (Physiology), Psychology
Christine Sonners, Junior, Neurobiology*

*Mentor: Susan Faja, Developmental Medicine/Labs of
Cognitive Neuroscience, Boston Children's Hospital*

Autism is a neurodevelopmental disorder, with symptoms related to social communication and repetitive behavior. In addition to these symptoms, a significant number of children with autism exhibit anxiety. One way to understand the biological underpinnings of anxiety is to measure responses of the autonomic nervous system. Children with autism spectrum disorders (ASD) have shown hyper sympathetic responses to some tasks, while showing hypo sympathetic responses to others. In this study we examine two questions. The first objective of our study is to compare the behavior and skin conductance of typically developing children and children with ASD during a working memory task. Our second objective is to test whether individual differences in skin conductance within the group with ASD correlate to internalizing behaviors. Twenty-one 6 and 7 year old chil-

dren with idiopathic ASD and 21 typically developing children participated. There were no group differences in age, IQ, or sex ratio. Continuous recordings of the skin conductance response (SCR) signals were collected during the digit span task for both groups of children. Internalizing behaviors were assessed via the Behavior Assessment System for Children, second edition. We expect to find higher level of SCR for the group of children with ASD, given previous reports of increased SCR among children with ASD in tasks that were cognitively or socially demanding. For the second part of the study we predict that there will be a positive correlation between the level of SCR and internalizing behaviors. Our results may illuminate what biological features correlate with these challenging internalizing behaviors. This could identify a subgroup of children with higher levels of anxiety and increase our understanding and treatment of anxiety in individuals with autism spectrum disorders.

POSTER SESSION 4

Commons East, Easel 80

4:15 PM to 5:45 PM

First Encounters in a Warming World: Floral Constancy, Generalist Pollinators, and Shifting Plant Phenology

Wei Ling (Cherry) Chen, Senior, Biology (Molecular, Cellular & Developmental)

Mary Gates Scholar

Mentor: Susan Waters, School of Interdisciplinary Arts & Sciences

Mentor: Janneke Hille Ris Lambers, Biology

Individual bees often show flower constancy, specializing on a floral resource while avoiding switches to newly available resources. The familiar plant species benefits by receiving high rates of visitation even when competing floral resources become available. However, the phenology of some plants is shifting more rapidly than others in response to climate change, resulting in a changed sequence of floral resources bees encounter. To determine whether this affects plant fitness, we asked how pollinator visitation to competing plant species depends on the order in which those species bloom. We used two plant species with overlapping phenology and a common pollinator, *Hypochoeris radicata* and *Campanula rotundifolia*. We allowed *Bombus impatiens* to forage in floral arrays representing three phenological progressions: (1) CR Early, with *C. rotundifolia* decreasing from 100% to 0% while *H. radicata* gradually increased from 0% to 100%; (2) HR Early, with *H. radicata* decreasing from 100% to 0% while *C. rotundifolia* gradually increased from 0% to 100%; and (3) a Control with both species at 50% throughout. We quantified visitation rate to both species, and seed production by *H. radicata*. Overall, the number of bee visits received by both species was significantly higher when that species was introduced first than when it was introduced after its competitor.

In treatments where the proportion of the early species decreased over time, the visitation rate per flower to that species increased, for both species and across all stages of experimental treatments. Seed set for *H. radicata* showed a similar pattern to visitation. Our results corroborate other work suggesting that individual bees learn and become specialized on a single floral resource and are slow to switch to a newly emerging resource. As a result, the flower species that blooms first can benefit from higher bee visitation and thus, potentially higher reproductive success.