

ADILENE OSNAYA, Dominican University, River Forest, IL

The Effects of Propranolol on Heartrate in Mice

(Mentors: Dr. Jeffrey Alberts, Paul Meyer)

The autonomic nervous system (ANS) has two components — the sympathetic nervous system (SNS) and the parasympathetic (PNS) nervous system, which are excitatory and inhibitory, respectively. Vagal tone is an integrated measure of heartrate variability that is used to evaluate the contributions of the SNS and PNS to heartrate regulation. Vagal tone is often used to monitor the role of the ANS in stress responses, anxiety disorders, illness, and social disorders such as autism. Remarkably little is known about the development of vagal tone in mice and humans. The two components of the ANS arise sequentially during development. The SNS begins to function before the PNS becomes active. The present study was designed to examine the development of vagal tone in mice by reducing SNS activity at different early ages. Such knowledge can make important contributions to working more effectively with this organism in basic research related to emotional and mental health. We used three age groups of C57BL/6 mouse pups (*Mus musculus*): postnatal days (PD) 6-8, 10-12, and 16-19. Inhibition of the SNS was induced through the use of the beta blocker propranolol. Following injection, heartrate was recorded for a period of 45 minutes. PD6-8 pups in the propranolol condition had significantly slower heartrates than those in the saline condition. Moreover, due to the later maturation of the PNS, we predict that older pups would show slower heartrates than the youngest pups. The delayed onset and maturation of the PNS relative to the SNS demonstrated herein will likely have major impacts on the assessment and treatments of the social and physiological disorders modulated by the PNS.

AIDAN GEISLER, Indiana University, Bloomington, IN

Effects of Testosterone On Longevity In *Junco hyemalis*

(Mentors: Dr. Ellen Ketterson, Samuel Slowinski, Britt Heidinger)

Increased investment in reproduction results in less energy available for biological maintenance. In the Dark-Eyed Junco (*Junco hyemalis*), testosterone implants have been found to decrease lifespan. This project aims to elucidate this unknown pathway. We predict that higher testosterone levels will decrease energy allocation to the immune system resulting in increased haemosporidian parasitism. In turn, we expect this increase in parasitism to accelerate the degradation of telomeres, hereby diminishing longevity. A Nested PCR protocol with primers specific to haemosporidian parasite DNA was performed on blood samples. Gel electrophoresis was then performed on the Nested PCR products to determine infection status. Our collaborator, Britt Heidinger performed a quantitative PCR reaction to determine the length of telomeres in each sample. Our preliminary results yield no significant relationship between testosterone treatment and infection status, or between infection status and telomere loss. However, the results indicate a significant relationship between testosterone implants and increased telomere loss.

ANA D. GONZÁLEZ, University of Puerto Rico at Cayey

**Effects of Frequent Disturbance on the Immune System of a Songbird,
the Dark-eyed Junco**

(Mentors: Dr. Ellen D. Ketterson, Rachel Hanauer)

Many animals have colonized urban environments, and they encounter novel disturbances such as: traffic, humans, artificial lights, and novel predators such as domestic cats. These disturbances can act as a stressor to an animal and cause glucocorticoid levels to increase. Although glucocorticoids are known to affect the immune system, the effects of frequent disturbance on the immune systems of animals colonizing urban environments are unknown. To investigate this, we manipulated frequency of disturbance of a songbird, the dark-eyed junco (*Junco hyemalis*), and measured expression of a pro-inflammatory cytokine, interleukin-6 (IL-6) in the spleen. Male dark-eyed juncos were captured in Bloomington, Indiana. The frequent disturbance group (n=18) experienced 30-minute disturbances four times each day, which were designed to be psychological stressors. The control group (n=18) was disturbed the minimum necessary for animal care. After three weeks of treatment, birds were euthanized and spleens were collected. We examined gene expression at both baseline and during acute stress by euthanizing some birds immediately after capture (baseline) and others 90 minutes after capture (acute stress). qPCR was used to evaluate relative IL-6 expression. We found no significant difference between disturb and control birds at baseline, but during acute stress disturbed birds had higher IL-6 expression. IL-6 expression was negatively correlated with body condition regardless of treatment group. We found that frequent disturbance altered immune activity during acute stress. Further work is needed to determine how this affects disease susceptibility.

DAVID NAVARRO, Washington State University, Pullman, WA

Does Short Term HPG Axis Activation have Longer Term Consequences in Tree Swallows (*Tachycineta bicolor*)?

(Dr. Kimberly Rosvall, Elizabeth George)

Steroid hormones are widely studied for their role in trait expression in many species. In vertebrates, Testosterone (T) is known to play a significant role in mediating sexual behavior, aggressive behavior, and spermatogenesis, and this hormone also can suppress parental care and immune function. Researchers commonly use injections with Gonadotropin-releasing hormone (GnRH) as an assay to measure maximum levels of T by causing individuals to temporarily elevate T. Unlike T implants which purposefully cause prolonged elevations, GnRH-challenged individual have been shown to return to baseline circulating T within a couple of hours. However, there is evidence to suggest that the GnRH challenge may cause a change in phenotype that persist even after T levels have returned to baseline. If a long term effect exists, it may be influencing different behaviors associated with T levels, such as parental behavior. To address this question experimentally, we injected 29 male tree swallows (*Tachycineta bicolor*) with either GnRH or Saline and quantified growth in their chicks as an indirect proxy of male provisioning over the next 24-hour. Treatments were balanced by brood size and chick age. GnRH males did elevate T more than control, but contrary to what we expected, offspring of experimental males gained *more* mass than those of the control. Even within the GnRH group, the degree of male T elevation was positively correlated with the rate of chick growth. We hypothesize that negative feedback or over- compensation by mates may account for these effects, which should be investigated in the future. This study opens the door to the use of GnRH challenges as a naturalistic testosterone treatment, although more studies need to be conducted to fully understand its potential.

FATIMA RAMIS, Stetson University, Deland, FL

**Male CBA/J and Autistic Model Balb/c Mice Interpret Dismissive Female Repertoires;
Sociality Affects Response**

(Mentors: Dr. Laura Hurley and Kayleigh Hood)

Laboratory mice are a growing model for the study of context-dependent sender-receiver interactions and communication. Mouse ultrasonic vocalizations vary in structure and timing according to individual as well as the receiver in the interaction. It is known that male mice increase production of ultrasonic vocalizations during courtship interactions. Although there is a growing body of knowledge regarding male ultrasonic vocalizations, little is known about female vocalizations and their modulation of male behavior. In this study, we examined the behavioral effects of dismissive female calls on socially contrasting mice: CBA/J(n=3) and BALB/C (n=3). We measured the total number of ultrasonic vocalizations produced and harmonic calls, which are positively correlated to mounting. While interacting with a female through a barrier, males were exposed to two acoustically varying treatments: a playback of a dismissive female vocalization, and no auditory stimulus. We predicted that males would reduce ultrasonic vocalization production in the auditory stimulus treatment. Additionally, that response to stimulus would vary by strain. These manipulations produced several findings: 1) BALB/C mice on average produce longer calls, 2) Both strains reduce production of total ultrasonic vocalizations when exposed to playback, 3) CBA/J strain reduces production of harmonic vocalizations, while BALB/C does not. This study shows that female vocalizations modulate number and type of male vocalizations, demonstrating a method for the study of perception in laboratory mice.

LYAN PADILLA VELEZ, University of Puerto Rico, Cayey, PR

Influence of Multisensory Systems on Behavior of Social Groups

(Mentors: Drs. Emilia P. Martins, Piyumika S. Suriyampola)

Most animals use multiple senses to interact with their environments. Aquatic organisms, for example, use both vision and tactile senses to move about in flowing water. When multiple sensory cues act simultaneously, animals may either increase behavioral responses via integration of cues or focus primarily on a single, dominant, sense. Here, we tested the impact of visual and tactile stimuli on rheotaxis (movement with respect to water flow) of zebrafish (*Danio rerio*). In a fluvial tank, we tested the rheotaxis of adult zebrafish collected from an irrigation channel in West Bengal, India. We exposed groups of four fish to a series of water flow rates, while varying a visual stimulus (dark vertical bars moving in the same and opposite directions of the flow). As a measure of rheotaxis, we used the number of fish orienting towards the flow and maintaining position within the test arena. It was found that rheotaxis decreased when a visual stimulus was present, particularly when the visual stimulus was conflicting with water flow. These findings suggest that although tactile stimuli plays a major role in triggering rheotaxis, the influence of visual cues is also important in mediating rheotactic behavior and thus provide insight to better understand the impact of multisensory systems in shaping behavioral responses.

PATRICIA BAEZ RAMOS, University of Puerto Rico at Mayagüez

Effects of Postnatal Sickness on Reproductive Development and Function in Siberian Hamsters (*Phodopus sungorus*)

(Mentors: Dr. Gregory Demas, Kristyn Sylvia)

Animals are constantly exposed to different kinds of stressors, and they must respond to such stressors in an effective manner in order for them to survive and reproduce. Previous studies in our lab and in others have shown that life stressors, such as immune challenges (e.g. lipopolysaccharides), can affect reproductive function and behavior in a number of different species. Kisspeptin, a peptide shown to be part of the regulation of reproductive hormones, may be a potential mechanism that mediates the interaction between the immune and reproductive systems during the early stages of life. However, the exact role that kisspeptin may play in regulating reproductive physiology and behavior in animals faced with an immune challenge is yet to be determined. We addressed this question by injecting Siberian hamsters (*Phodopus sungorus*) with either lipopolysaccharides (LPS, a part of the bacterial cell wall) (experimental group) or saline (control group), measuring reproductive growth and physiology throughout the adolescent and early adult life, and challenging animals with either exogenous kisspeptin or saline in adulthood. Body mass and food intake were measured throughout the study, and blood samples were taken at two time points (pnd45 and pnd75) to measure steroid hormone levels in circulation via enzyme linked immunosorbent assays (ELISAs). By comparing the results of the animals treated with either kisspeptin or saline as adults, we determined the potential role of kisspeptin in regulating reproductive development and physiology. Results showed no significant difference in body mass, organ mass, and food intake between LPS and saline treated animals, although LPS treated animals had smaller immune organ mass and larger reproductive organ mass. After the kisspeptin/saline injection, kisspeptin-treated animals had higher steroid hormone levels than saline-treated animals. Organ mass results indicate a possible energy allocation to reproduction in animals faced with an immune challenge early in life.

SABRINA SERRANO, Kenyon College, Gambier, OH

Characterization of Communication Signals in the Weakly Electric Fish, *Eigenmannia*

(Mentors: Dr. G. Troy Smith, Misty Proffitt)

Weakly electric fish have a specialized electric organ to produce continuous electric organ discharges (EODs) for communication. They also produce short-term frequency modulations of this continuous EOD signal, called chirps. Chirps are often produced in social interactions and are hypothesized to be signals of aggression or submission. We decided to investigate chirping behavior within a species of *Eigenmannia*, a social South American knife fish where parameters of their communicational signals are poorly characterized. *Eigenmannia* often display lower chirp rates than other knife fish in traditional paradigms. Since literature suggests that *Eigenmannia* can distinguish between different waveforms, we presented *Eigenmannia* with a stimulus used in traditional paradigms (constant amplitude sinusoidal electrical stimuli, which does not simulate the species appropriate waveform) and more naturalistic stimuli (from a previous recording of an *Eigenmannia*, to simulate the species appropriate waveform and movement envelope) in order to investigate chirp parameters (such as chirp rate) in *Eigenmannia*. In order to investigate patterns of chirping in social interactions in *Eigenmannia* we examined possible relationships between chirp parameters and physical parameters for each individual by measuring individual body mass, body length, baseline EOD frequency and chirp rate to the different stimulus frequencies. Based on preliminary data, we have found that *Eigenmannia* respond with a greater chirp rate to a more naturalistic stimulus and smaller fish (lower body mass) will produce more chirps. Further analysis of this dataset will examine correlations between chirp rate and physical parameters of *Eigenmannia* to characterize the role of chirps in social dominance interactions.

SEVERINE HEX, Cornell University, Ithaca, NY

Testing for Episodic Replay in Rats

(Mentors: Dr. Jonathon Crystal, Danielle Panoz-Brown)

Episodic memory is the ability to replay in sequential order unique events or items in context. While there is evidence of episodic memory in other animals, it is yet unknown whether episodic memory replay exists in other species. Neurophysiological evidence suggests to episodic replay capabilities, but it is unknown if this ability exists in the rat. Our challenge in order to assess if rats are able to remember items in sequence was to construct a question that could only be answered using episodic replay. To breach this difficulty, we constructed an N-back memory assessment paradigm, using odours as the stimuli in order to exploit rat's well known olfactory capabilities. Rats were presented a list of odours of unpredictable length in a neutral context to memorize. Immediately after, they were unpredictably placed in one of two test contexts, where they were presented with two odours from the list, either the 2-back or 4-back depending on the context, and a foil. To answer the question correctly, the rats needed to remember the items in the sequence they were presented. Our preliminary findings suggest that rats are able to learn the task, with performance significantly above chance in both the 2-back and 4-back conditions of the N-back assessment task. Our findings suggest that rats have episodic memory and are able to remember a sequence of events using episodic memory replay. Our findings further support the value of using rats as a model of episodic memory in preclinical work, which could further the study of biological underpinnings of disorders of memory such as Alzheimer's disease, enabling development of more effective medications and treatments.