

CAMI ALBERS, Indiana University Bloomington  
Replay of incidentally encoded episodic memory in rats.  
Mentors: Dr. Jonathan Crystal, Dr. Danielle Panoz-Brown

Understanding how elements of episodic memory differ in non-human animals offers unique insights into the evolutionary history of complex memory systems. Elements of episodic memory that have been found in rats include both replay of episodic memory, which is the ability to play back sequential events in chronological order, and the use of incidentally encoded information to answer an unexpected question. Incidental encoding differs from other aspects of memory in that it occurs when an animal does not know information to be important and is not expecting to be tested on the information in the future. It is not known whether rats can replay incidentally encoded episodic memories to answer an unexpected question. Therefore, we designed this study to evaluate whether rats can replay incidentally encoded information to answer an unexpected question. Rats were initially trained to report the third to last odor in a list of sequential odors. Separately, rats were habituated to an eight-arm radial maze where they were allowed to forage and had no expectation of a memory assessment. To ask if rats can replay incidentally encoded episodic memories to answer an unexpected question, rats were randomly presented with odors in each arm of the radial maze and given the unexpected opportunity to report the third to last item from the maze. We expect the rats to perform above chance and with high-accuracy in the memory assessment if the rats can replay incidentally encoded episodic memories.

AUSTEN EHRIE, Indiana University Bloomington  
Neurogenomic Mechanisms of Parental Care in a Sex-Role Reversed Species  
Mentors: Kimberly A. Rosvall, Sara E. Lipshutz

One percent of bird species are sex-role reversed, meaning males conduct all parental care, and females compete for male mates. Sex-role reversed systems are a unique case of sexual selection, providing an opportunity to examine how evolution shapes diverse male and female phenotypes. A recent study in the Northern Jacana (*Jacana spinosa*) examined the physiological basis of sex-role reversal and found that testosterone levels are lower in parenting males than in courting males. However, testosterone levels are only one of many potential mechanisms regulating mating and parenting. To take a more global approach, we used RNA-Seq to measure transcriptomic differences in the brain, comparing between sexes and breeding stages (i.e. courting vs parenting male jacanas). We hypothesized that sex-biased gene expression could explain sex differences in parental care and aggression. We sampled four regions of the social behavior network, a cluster of steroid-sensitive brain regions that regulate reproductive behaviors including parental care and aggression. If male jacanas regulate parental care using similar mechanisms as species with conventional sex roles, we expect to find sex and stage-specific differences in gene expression of known candidate genes for parental care, including galanin, prolactin receptor, and oxytocin receptor. Alternatively, we may also identify new candidate genes for parental care using this global transcriptomic approach.

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MELISSA JACUINDE,

Analyzing the effect of female broadband vocalizations on male mice ultrasonic vocalizations during courtship interactions.

Mentors: Dr. Laura Hurley, Sierra McAlister

The house mouse (*Mus musculus*) utilizes a combination of vocal signals for both intra- and inter- sexual communication. During opposite sex interactions, male mice emit ultrasonic vocalizations (USVs) to signal sexual interest with female mice. On the other hand, females primarily produce broadband vocalization (BBVs) which are associated with physical rejection. Previous studies have reported that female rejection may be more likely to happen when BBVs occur in the beginning stages of the courtship (Finton et al 2017). Still, little is known about how changes in female vocalizations affect the vocalizations of males. By altering a variety of features in female BBV playbacks, i.e. intensity, rate, and duration, we can measure changes in male USVs (e.g., bandwidth and duration). Our goal is to uncover how female context alters male USV production. We hypothesize that male mice will produce shorter, more narrow bandwidth USVs, when with higher effort BBVs (i.e. higher rate, more intense, and longer duration BBVs). We theorize that males will produce higher energy calls when they are less receptive to female rejection. Therefore, males should also produce more USVs overall.

GABRIEL JIMENEZ, Ursinus College

Facing a familiar foe: familiar male odor disrupts male mouse vocal response to female rejection. Mentors: Dr. Laura Hurley, Lauren Brunner

Male mouse mice who live within social structures have demonstrated significant alteration of behavior in response to social pressures. During courtship, male mice who differ in social rank also differ in reproductive output and effort which is essential for propagating offspring. Therefore, mice who demonstrate more dominance in their reproductive effort regardless of social context, may then be more successful than their subordinate counterparts. In previous studies, female rejection in courtship has shown significant change in male behavior following the playback of BBVs or broadband vocalizations. We also saw that vocal output by male mice would change as a result of the presence of the scent of another male. In this study, by using USVs or ultrasonic vocalizations by male mice as a measure of reproductive effort, we want to know if the presence of hierarchical partner will have effects on the reproductive effort displayed by dominant and subordinate mice. To observe this, we used male house mice and placed them within a model that allows us to observe behavioral changes during female rejection in the presence of different odor cues. To understand how context can manipulate behavior, we used the soiled bedding as the condition that we'd be altering in this experiment. We used the urinated bedding from a female mouse and that of a male mouse that the subject was previously housed with. We had 2 conditions: the female control which was just the bedding from the unfamiliar female and the other consisted of a mixture between female and familiar male bedding. We hypothesize that social pressures like female rejection and familiar male odor will significantly affect the ultra-sonic vocalization output of subordinate male mice during BBV playback more than it will affect dominant mice. Subordinate male mice will take longer to restart USV production after BBV playback than dominant mice. All males, regardless of social status, vocalized less during BBV playback in the presence of a familiar male odor. We also found that 2 out of 3 subordinate males displayed a disruption in calling, in which they vocalized more in the presence of a familiar male odor. Dominant males also showed a sharper decrease in calling rate in response to BBV playback when in comparison with subordinates in the presence of a familiar male odor. This indicates that odor cues convey information that disrupts the behavior of male mice and alters their calling rate. This also shows that courtship interactions are highly-context dependent.

JASMEEN KAUR, Indiana University Bloomington

How and why aggression varies within and among contexts in the wild.

Mentors: Dr. Kimberly Rosvall and Elizabeth Aguilar

Aggression is an important behavior used by animals in different contexts, like defending territories or deterring predators. This behavior has many costs and benefits, which may influence individual variation within populations, where some stay at higher levels of aggression than others. Body quality, such as having smaller or larger mass, is one factor that may influence behavioral variation or consistency. Lower body quality animals may not be able to invest in high aggression in multiple contexts, and evolution might favor aggression in just one context versus the other. Individuals have been shown to be consistent in their aggression in a territorial context, but how this relates to an anti-predator context is not yet known. I will fill this gap in knowledge using free-living female tree swallows (*Tachycineta bicolor*). These songbirds use aggression to acquire breeding resources and defend against nest predators. I hypothesize that aggression will remain consistent and maintained within or across territorial and anti-predator contexts and consistency in aggression will be influenced by body quality. Behavioral assays were used to measure territorial and anti-predator aggression, and females were captured to measure body mass, wing length, and age. I found that aggression is maintained within an anti-predator context but not across contexts. Body quality does not relate to variation in aggression, but it does explain consistency, potentially in an age dependent way. These age dependent relationships suggest that life history affects one's behavioral consistency. Therefore, consistency of aggression across contexts might be a relevant behavioral trait worth further investigation.

KIRA LANIER, Winston-Salem State University  
Rats' Reliance on Episodic Memory and Familiarity.  
Mentors: Dr. Jonathan Crystal, Dr. Danielle Panoz-Brown

Episodic memory is the ability to remember back in time to an earlier event or episode. Episodic memory was initially thought to be unique to humans (Tulving, 2002) but is now believed to be possessed by nonhuman animals (Allen & Fortin, 2013). It is important to explore episodic memory in other species because it could help obtain a better understanding of the neural basis of memory and possibly aid in the development of treatments for diseases of memory in people. In previous studies that claimed to study episodic memory, familiarity was present. Familiarity is the vague sense that a stimulus was presented earlier. It is devoid of recollection, which means the stimulus is remembered but without certainty of details. Because previous studies did not always separate episodic memory and familiarity, it is possible that high accuracy was achieved through familiarity in the absence of episodic memory. The goal of this study was to evaluate accuracy in diagnostic (familiarity and episodic memory unconfounded) and nondiagnostic (familiarity and episodic memory confounded) memory assessments in order to investigate contributions of episodic memory and familiarity. Rats were trained using an item in context approach (Panoz-Brown et al., 2016). Here we show that both diagnostic and non-diagnostic trials have above chance and equivalent levels of accuracy. This suggests that when episodic memory and familiarity are confounded, they contribute equally to performance.

JONATHAN ENRIQUEZ MADRID, Northern New Mexico College  
Circulating hormone concentrations in relation to diet in primates.  
Mentors: Dr. Michael Wasserman, Tessa Steiniche

Man-made endocrine disrupting chemicals (EDCs) can affect endocrine function in organisms leading to decreased fertility and low offspring viability. Man-made EDCs can also travel long distances, with significant concentrations having been found in the remote jungles of Costa Rica and Uganda. One way of understanding how EDCs may affect primates is by considering co-evolution between plants and herbivores. Many plants produce endocrine-active phytochemicals (EAPs), capable of altering endocrine function when ingested. As a result, herbivores are expected to have adaptations to help mitigate negative fitness effects of EAP consumption. One proposed explanation for herbivore ingestion of EAPs with minimal fitness effects is that herbivores have higher basal hormone concentrations compared to non-herbivores, leading to any negative effects of EAPs being “watered down”. To test this hypothesis, our research consists of conducting fecal enzyme immune assays to measure four hormones in different primate species consisting of different diets to profile their basal hormone concentrations in relation to diet, and of a meta-analysis where we search through the literature to record the basal hormone concentrations of different species consisting of different diets. For both our fecal data and meta-analysis data, we hypothesize that an herbivorous diet will positively correlate with higher basal hormone concentrations. If this is the case, it leads to implications for whether herbivores are better at combating negative effects of ingested man-made EDCs.

KAITLYN ROSS, Indiana University Bloomington

Do higher circulating testosterone levels and higher plasmodium parasite load correlate to shorter sperm telomere length in Indiana-breeding songbirds?

Mentors: Dr. Ellen Ketterson, Katie Talbott

Parental effects are important because they are ways parents influence the phenotype of the offspring other than passing on a specific allele. One potential but understudied parental effect is telomere length in the sperm. Telomeres are the bits of DNA on the end of the chromosome that provides protection and stability. Telomeres in sperm could be a potential mechanism for paternal effects because the sperm is directly contributed from the father to the egg. The length of an individual's telomeres represents the overall health of the organism and is determined by many factors, possibly including baseline testosterone levels and parasite load. In order to see if there is a correlation between the condition of an individual and their sperm telomere length we ask the question, "Do higher levels of circulating testosterone and *Plasmodium* Parasite load correlate to shorter telomeres in the sperm of Indiana Breeding Songbirds." In order to test this question, we collected blood and sperm samples from 51 birds from a range of species. Our target species were Eastern Towhees and Song Sparrows. We collected a total of 29 sperm samples using a cloacal massage technique. We used qPCR to determine the length of the telomeres in DNA extracted from the sperm. Microscopy will be used to determine parasite load, and an Enzyme-linked immunosorbent assay will be used to determine base line testosterone. The qPCR did not run properly, and sperm telomere length could not be determined. We are working on troubleshooting our qPCR protocol. In the future we plan to look at the relationship between circulating testosterone and *Plasmodium Parasite level*.

SILVIA SDARY, Lebanon Valley College

The effects of 5-HTP on social behavior of isolated mice.

Mentors: Dr. Laura Hurley

The laboratory mouse is a new model for vocal signaling and reception that is context-dependent. In social situations, mice emit a lot of ultrasonic vocalizations. These vocalizations can be classified into syllable kinds that are produced consistently by different mouse subspecies and strains. Individual vocalizations vary by development and are influenced by social housing situations. Animal vocal communication is a common occurrence that sheds light on context-sensitive signaling and reception. Ultrasonic vocalizations (USVs) of adult laboratory mice have recently attracted a lot of attention as a model for both vocalization generation and auditory processing. USVs are created at a high rate during male-female encounters in adult social exchanges. Although both sexes produce USVs, males are thought to produce the majority of USVs produced during male-female interactions. Individuals produce distinctive vocalizations depending on features such as frequency, which change throughout time (Hanson & Hurley, 2012). Female mice emit audible vocalizations with a broadband harmonic structure ('broadband vocalizations,' or BBVs) during interactions with male mice, which are commonly referred to as 'squeaks' by human listeners (Finton et al. 2017). 5-Hydroxytryptophan (oxitriptan) is a chemical precursor, naturally occurring amino acid, and metabolic step in the manufacture of the neurotransmitter serotonin. The mouse was injected with saline and 5-HTP and the USVs were measured and analyzed via Raven! The findings suggest that injection of 5-HTP in isolated animals 5-HTP didn't seem to make a noticeable difference in suppression of USVs.