

POSTER PRESENTATION ABSTRACTS

2017 ANIMAL BEHAVIOR CONFERENCE

Organized alphabetically by first author last name. Numbers indicate poster numbers.

1 LOCAL AND SYSTEMIC CONTROL OF DEVELOPMENT OF A SOCIAL FEATHER ORNAMENT

Abolins-Abols M, Kassab HD, Ketterson ED

Department of Biology, Indiana University

Bird feathers are one of the most striking examples of diversity in nature. Variation in feather ornaments often signals the status or quality of an individual. To understand why and how particular ornaments are used as social signals, we must understand the factors that regulate their development. Here we used a combination of *in vitro* studies, protein and gene expression assays, and experimental manipulations to investigate the development of a melanin-based ornament used in attracting mates and signaling status – the white tail feathers of Dark-eyed junco – and test if it is regulated by testosterone, a hormone which has been shown to regulate sex differences in feather color. Our results show that melanocytes from white feathers produce pigment *in vitro*, and that the amount of white in developing feathers correlates positively with expression of melanocortin-1 receptor, and agouti signaling peptide. Developing feathers expressed androgen receptors, but experimental manipulation of testosterone signaling did not affect feather color. Our results show that color of this social ornament is regulated locally, but that its development is not sensitive to testosterone.

2 THE EFFECT OF *H. PROCUMBENS* NEUROPATHIC PAIN IN RATS

Bekemeier M, Ndam T, Miller D, Cui J, Gu Z, Folk W

Center for Translational Neuroscience, University of Missouri

Harpagophytum procumbens (Devil's Claw) is an African botanical that is an anti-inflammatory and is widely used in Africa and Europe for its analgesic effects. The overall goal of our research program is to evaluate *H. procumbens*' efficacy and mechanism of action. This study investigated *H. procumbens* in a new rodent model of SCI and the hypothesis was that the botanical would decrease SCI-induced neuropathic pain. A 2x2 design was used in which groups (n ≈ 10 rats/group) of male rats received 1) SCI surgery + *H. procumbens* (300mg/kg, p.o.), 2) SCI + water vehicle, 3) sham surgery + *H. procumbens*, and 4) sham + water. SCI was induced via a contusion model in which the spinous process at T10 was removed and a computer-controlled force was delivered to the spinal cord. Behavioral tests were performed before and after surgery and *H. procumbens* was administered for 21 days after surgery. SCI surgery induced a marked increase in sensitivity to the mechanical stimulus and an impaired locomotor function; however, it did not alter the response to the thermal stimulus. Importantly, *H. procumbens* attenuated the SCI-induced hypersensitivity to the mechanical stimulus, and the attenuation was most pronounced 5-11 days after surgery. However, *H. procumbens* did not alter the SCI-induced impairment of locomotor function. *H. procumbens* was effective to decrease the response to a mechanical stimulus in this rodent model of SCI-induced neuropathic pain, supporting clinical findings and folk use of the botanical. This study is currently being replicated and neuroinflammation and microglial proliferation are being investigated to elucidate *H. procumbens*' mechanism of action.

3 METABOLIC PHENOTYPES DURING EARLY DEVELOPMENT AFFECT ELEVATED PLUS MAZE BEHAVIOR IN ADULTHOOD IN BALB/C MICE

Blevins C, Harshaw C, Leffel J, Alberts JR

Department of Psychological and Brain Sciences, Indiana University

Thermoregulatory phenotypes appear to play a significant role in the development and expression of social-emotional behavior. For example, research by Robyn Hudson and colleagues has found that metabolic characteristics of infant rabbits and rats correlate with a variety of social-emotional behaviors in adulthood. Here, we investigated how individual differences in levels of heat production in BALB/c mouse pups relates to the expression of emotionality in adulthood. Litters were culled to 4 or 6 pups (half male, half female) on postnatal day 4 (P4) and all pups tattooed for identification. Rectal temperature (T_{rect}) was taken immediately after 5 min of maternal separation at 20°C on P7 and P9. Huddling tests were completed on P8 and P10: each litter was tested at 20°C for 50 min and T_{rect} taken immediately following the test. Weight and tail length were measured on P7-P10. To examine anxiety-like behavior in adulthood, we tested mice on an elevated plus maze (EPM) on ~P55-P60. We examined activity levels as well as entries, durations, and latency to enter the closed and open arms of the EPM. A MANOVA revealed that litter size and litter of origin impacted EPM behavior ($p < .01$ and $p < .07$). Given this, we constructed a mixed effects model for each outcome variable with litter and litter size as random effects. We found that T_{rect} relative to huddlemates and contacts (i.e., position in the huddle) interacted to affect adult activity levels, particularly for males. Weight relative to huddlemates, T_{rect} relative to huddlemates, and contacts also significantly influenced the ratio of entries into closed versus open arms. In females, interaction effects of weight, T_{rect} after maternal separation, huddling T_{rect} , and huddling contacts impacted the latency to enter closed arms ($p < 0.05$). These results indicate that variation in thermoregulation during early development likely plays a role in the emergence of emotional phenotypes in adult BALB/c mice.

4 AN INVESTIGATION INTO THE ALTERNATIVE REPRODUCTIVE TACTIC KNOWN AS "MALE-MALE CLASPING" IN *XENOPUS LAEVIS*

Bradley S, Rhodes H

Department of Biology, Denison University

Due to the multitude of reproductive pressures that exist, many species have adopted alternative reproductive tactics as a means of engaging in a low-cost mating strategy. These strategies are often context-dependent and mediated by both the internal physiological state of the animal and external environmental influences. Male *Xenopus laevis* frogs have been known to exhibit a behavior known as male-male claspings, in which a peripheral male will clasp another male, regardless of whether a female is present or not. The purpose of this behavior remains unclear; however, based on what is known about alternative reproductive tactics, it is possible that male *X. laevis* utilize this behavior to gain proximity to breeding events and engage in sperm competition. Therefore, we hypothesized that non-dominant males would exhibit male-male claspings in an attempt to engage in sperm competition, resulting in multiple paternity. To examine this hypothesis, we recorded the reproductive behavior of triads of frogs, consisting of an albino female, an albino male, and a pigmented male. We collected the fertilized eggs of each triad and let them develop until stage 39, so that the phenotype- and therefore paternity- of the frogs could be determined based on pigmentation. If we found offspring of both phenotypes and the male-male claspings behavior occurred during oviposition, then this would support our hypothesis. Out of the 16 total experiments run, this only occurred three times. However, in these instances, peripheral males engaging in male-male claspings were able to successfully fertilize a small portion of the eggs in the clutch, which suggests that this behavior may in fact be a tactic employed to engage in sperm competition. These findings are consistent with our hypothesis, but more data is still needed to determine the frequency of this behavior and the success of this strategy in producing offspring.

5 LOSE YOUR COOL! ELIMINATING THE COLD CHAIN IN FIELD COLLECTION OF SALIVARY SAMPLES DESTINED FOR ENZYME-IMMUNOASSAY OF STEROID CONCENTRATIONS

Chester EM^{1,3}, Madden JA², Vitzthum VJ^{1,3}

¹*Department of Anthropology*, ²*Human Biology Program*, and ³*Kinsey Institute, Indiana University*

Steroid hormones diffuse into saliva, thus salivary levels accurately reflect serum levels, but at a lower order of magnitude. The use of saliva for measuring hormone concentrations has several advantages over using blood: collection is non-invasive and thus can be collected without harming the subject, there is little to no stigma about saliva, and repeated sampling is fairly easy. Thus a more complete assessment of hormonal changes through time (e.g., during a menstrual or estrus cycle) can be achieved. Field collection of saliva samples requires preservation to inhibit microbial growth, either by keeping very cold (a cold chain) or by preserving with sodium azide, until permanent freezer storage is possible. A cold chain is difficult to achieve in many field conditions but sodium azide is incompatible with most commercially available EIA kits, which use horseradish peroxidase, an enzyme that is inactivated by sodium azide. We have developed extraction and EIA protocols for the measurement of salivary estradiol and progesterone based on commercially available enzyme immunoassay kits that use alkaline phosphatase in place of horseradish peroxidase (ADI-900-174, ADI-900-011, Enzo Life Sciences, Farmingdale, NY). Here we present the extraction method and validation results, and measurements of hormone profiles across the menstrual cycle of pubertal girls.

6 CYCLES IN ICELAND: A STUDY OF CIRCADIAN AND SEASONAL RHYTHMS IN MELATONIN

Chester EM^{1,3}, Wilhelm JN², Vitzthum VJ^{1,3}

¹*Department of Anthropology*, ²*Human Biology Program*, and ³*Kinsey Institute, Indiana University*

Melatonin regulates diverse physiological processes in its role as a biological “clock”. The hormone is produced by the pineal gland in the dark, and exposure to light signals production to cease. As such, the duration of the production of high levels of melatonin changes over the course of the year, as days lengthen and shorten. We are investigating the changes in women’s physiology, health, and wellbeing from midwinter to midsummer, and many of these differences may be mediated by melatonin. Currently it is known that melatonin has multiple actions in the body, from controlling the timing and release of reproductive hormones, affecting sleep cycles, as an antioxidant protecting tissues, and strengthening the immune system. We will present results of initial salivary melatonin enzyme immunoassays (EIAs) from a study in Reykjavik, Iceland (64.1265°N, 21.8174°W), and the research questions pertaining to the effects of melatonin and factors correlating with melatonin in the context of women’s health and seasonal differences.

7 VARIATION IN MOBBING BEHAVIOR OF MIXED FLOCK SONGBIRDS BETWEEN SITES

Christensen C¹, Mugal S¹, Roche D¹, Freeberg T^{2,3}, Sieving K⁴, Lucas J¹

¹*Department of Biological Sciences, Purdue University*; ²*Department of Ecology and Evolutionary Biology and* ³*Department of Psychology, University of Tennessee*; ⁴*Department of Wildlife Ecology and Conservation, University of Florida*

Mobbing is an anti-predator response that is observed in mixed species flocks of Carolina chickadees, Tufted titmice, White-breasted nuthatches and Downy woodpeckers. In this study, we examined variations in mobbing behavior of such flocks across three forest sites in Indiana. Calls of a known predator of these species (Eastern screech owl) were played near naturally occurring mixed flocks, and the response of the flocks was recorded. Preliminary data suggests that all three populations respond to a predation threat and there is no difference in latency of flock approach between sites. We found some differences across sites in latency and approach order at the species level. Nuthatches approach within ten meters from the speaker significantly faster at the first site. However, titmice are more likely to arrive within twenty meters first at the same site. At a second site, titmice are more likely to come within ten meters later. We are currently examining whether these observed patterns are seasonal.

8 REWRITABLE FIDELITY: EFFECTS OF REPEATED PAIR BOND DISRUPTION ON SUBSEQUENT PRAIRIE VOLE PAIR BOND FORMATION

Crose ND, Stanton CD, Perkeybile AM, Kenkel WM, Daughhetee A, Gray R, Reinhart J, Carter CS
Kinsey Institute, Indiana University

Previous research has demonstrated that prairie voles exhibit social monogamy. Repeated disruptions of pair bonds in prairie voles have the potential to hinder their ability to form new pair bonds. In the wild, high predation rates create pair bond disruption, but it is unclear if this repeated disruption affects the ability to form new bonds. To resolve this dilemma, a large sample of “rewritable fidelity” males underwent repeated pairings with new females, each lasting approximately 30 days. Following pairing, males underwent tests of partner preference formation, which were administered at the beginning of the first, fifth, and tenth pairings. Age-matched controls were also tested after their second pairing to account for the advanced age of males after multiple pairings. Additionally, males were tested for anxiety-like and depressive-like behaviors one week after pair bond disruption. We will present findings on the propensity of males with a history of multiple pairings to form new bonds. Thus far, the preliminary results of the study revealed that one week after pair bond disruption, males exhibited no enduring changes to their affective state. This is the first study on the plasticity of the pair bonding system in the face of repeated disruption.

9 DEVELOPMENT AND IMPLEMENTATION OF ELECTROOLFACTOGRAM APPARATUS FOR STUDYING *XENOPUS LAEVIS*

Darrah K
Department of Biology, Denison University

The goal of this project was to develop instrumentation and protocol to test the response of medial cavity (MC) epithelium in adult *Xenopus laevis* to water-born odorants via electroolfactogram (EOG) recording. Although the detection of water-born odorants is likely a significant part of intraspecific communication, there has been limited research into the olfactory epithelia response to odorants in this species, and no protocol for EOG recordings in adults. Because it is secondarily aquatic, *Xenopus laevis* has been studied for the changes in olfactory epithelia that occur during metamorphosis. Fish-like olfactory receptors are found in the medial cavity of *Xenopus laevis* and have been shown to respond to both volatile and aqueous odorants using patch-clamp recording. The project discussed here intended to develop working machinery and protocol to test EOG responses in the medial cavity of this species. Male *Xenopus laevis* were anesthetized with MS222 and pithed before dissection of the nasal cavity. Odorants including methionine, dissolved food, and tank water were introduced to an aqueous saline flow and recordings were analyzed for EOG responses. Several dissections and recording locations were explored to find the region producing the strongest response to these odorants. Overall protocol and apparatus setup were determined to be successful based on results to be presented. Experiments using this protocol can now explore male EOG responses to female whole-body odorants in searching for evidence of chemical communication during mating in *Xenopus laevis*.

10 TIME BUDGET ANALYSIS OF CAPTIVE BUDGERIGARS *MELOPSITTACUS UNDULATES*: A STUDY OF HOUSING AND ENRICHMENT'S EFFECT ON ACTIVITY LEVELS BY SEX

Davie (Voorhees) C

Department of Biology and Mathematics, D'Youville College

Captive budgerigars (*Melopsittacus undulates*) are prone to obesity. Obesity is commonly observed in female budgerigars. Females are at higher risk to obesity due to behaviors such as courtship feeding. Flying and climbing are energy expending behaviors in budgerigars. In this study, a group of 6 adult budgerigars were observed for one-hour, 3-4 times a week for 3 months to create an ethogram and time budget analysis of activity levels by sex. Overall, the flock spent the majority of their time, 64%, perching and there was no difference between sexes in duration of perching. Both males and females spent the majority of their time engaged in either eating or perching. Males spent significantly more time engaged in physically demanding activities, such as flying and climbing, than females ($\chi^2 = 28.005$, $p < .00001$). Females spent more time manipulating toys (enrichment) in the exhibit than males ($\chi^2 = 1115.4$, $p < 0.0001$). Recommended that aviaries are constructed with perches, food and water at varying levels to encourage flight and movement to reduce the risk of obesity in captive budgerigars.

11 EFFECTS OF *SMOKE ALARM* GENE DYSFUNCTION IN NOCICEPTIVE NEURONS

Fisher KH^{1,2}, Mauthner SE¹, Tracey WD¹

¹*Gill Center for Biomolecular Sciences, ¹Department of Biology, and ²Department of Psychological and Brain Sciences, Indiana University*

Because of the abundance of genetic tools available, *Drosophila melanogaster* make an exceptional model to study nociception. Through a genetic screen we identified a gene, *smoke alarm*, which is enriched in nociceptive class IV neurons. Knockdown of *smoke alarm* resulted in a hypersensitive behavioral response to a nociceptive thermal stimulus and analysis of class IV neurons revealed a significant increase in dendrite length. We used recombinant technology to introduce an artificial GAL4 exon into the *smoke alarm* locus to drive the expression of GFP where *smoke alarm* is present. We saw expression in class IV neurons as expected, as well as in many other sensory neurons. Now, using various mutant alleles and confocal microscopy, our research aims to understand the role of *smoke alarm* in the morphology of nociceptive and other sensory neurons.

12 LARGE BRAIN EVOLUTION GENERATES ENERGETIC AND BEHAVIORAL CONSTRAINTS ACROSS AND WITHIN HIGHLY ENCEPHALIZED SPECIES OF WEAKLY ELECTRIC MORMYRID FISHES

Freiler M^{1,2}, Sukhum K², Carlson B²

¹*Department of Biology, Indiana University; ²Department of Biology, Washington University in Saint Louis*

Mormyrids, weakly electric African fishes, have complex brains for processing electrocommunication signals. Interestingly, certain species evolved an especially large brain relative to body mass. Energetic expenses for costly brain tissue could be met through trade-offs in other organ sizes or increased metabolic rate. It is unclear whether diversifying selection within species drove variation seen across lineages, or if large brain size and its associated costs evolved after divergence. By comparing patterns of inter- and intraspecific variation in oxygen consumption rate and hypoxia tolerance in species of mormyrids with varying brain sizes, I determine how selection within species impacts brain size across species. Given mormyrid brain size is uncorrelated with other organ sizes, large brain evolution likely necessitates increased metabolism. As predicted, large-brained species have increased oxygen consumption rates and reduced hypoxia tolerance. Intraspecifically, if increased brain size generates energetic costs before divergence, relatively large-brained individuals should exhibit greater metabolic requirements. Within large-brained species, relative brain size appears to be positively correlated with metabolic rate and negatively correlated with hypoxia tolerance, while the trend is less well-defined within smaller-brained species. Species-specific differences suggest the metabolic and behavioral costs of large brain evolution constrain extreme encephalization in mormyrids, but may not create strong selective pressures within smaller-brained lineages.

13 EARLY LIFE ACTIVE SLEEP AS A MECHANISM FOR NORMAL BEHAVIORAL DEVELOPMENT IN MICE

Gompa S, Rodda C, Alberts J

Department of Psychological and Brain Sciences, Indiana University

Infant mammals spend a large portion of their overall time budget sleeping; of sleep time, active sleep (AS) is the dominate sleep state. Infant mice spend over 80% of overall sleep time engaged in AS. The high amount of AS which characterize infant sleep is theorized to promote brain maturation. Investigations into the importance of infant AS are typically conducted using pharmacological means to accomplish total AS deprivation and/or older animals (8 days or older). In order to disrupt the AS of mouse pups starting on postnatal day (PND) 2 and ending on PND 12 we implemented a technique called 'gentle handling'. The AS of pups was disrupted for three 30 minute sessions a day over the course of 11 days. We then tested mice for social/emotional development in the pre-weaning period (PND 17-19), the post-weaning period (PND 25-30), and as adults (PND 55-60). Post-weaning and adult mice were tested for deficits in learning/memory, depression-like and anxiety-like behaviors, and social behavior, as measured by elevated plus-maze discriminative avoidance task, a two choice bottle test for anhedonia (sucrose vs. water), open-field behavior, and a social interaction test with an unfamiliar animal of the same age, sex, and weight. Our results demonstrate long term deficits in social/emotional behavior that persist into adulthood, suggesting the homeostatic mechanisms of sleep pressure and rebound do not completely mitigate the effects of early post-natal AS disruptions. Currently, we are exploring play behavior as a measure of social/emotional development following AS disruptions in pre-weaning mice.

14 SEX DIFFERENCES IN THE EFFECTS OF CHRONIC STRESS ON DENDRITIC REMODELING IN ORBITOFRONTAL CORTEX

Gutierrez AM¹, Wellman CL^{1,2,3}

¹Department of Psychological and Brain Sciences, ²Program in Neuroscience, and ³Center for the Integrative Study of Animal Behavior, Indiana University

Stress is linked to the development of psychological disorders such as depression and posttraumatic stress disorder (Kendler et al., 1999). This effect is thought to be related to sex, with twice as many women suffering from stress-related disorders than men (Solomon & Herman, 2009). Dysfunction of medial prefrontal cortex (mPFC) and orbitofrontal cortex (OFC) has been implicated in these stress-sensitive disorders. We have previously shown dendritic remodeling in mPFC after chronic stress is sex-specific. Whereas male rats exhibit dendritic retraction after chronic stress, females show dendritic growth (Garrett & Wellman, 2009). In OFC, male rats show dendritic growth following chronic stress (Liston et al., 2006). However, how stress influences dendritic morphology in OFC of female rats is unknown. In this study, we examined dendritic remodeling of pyramidal neurons in OFC of male and female rats after exposure to chronic stress. Rats underwent chronic restraint stress (3h/d for 10d). Rats were then euthanized and neurons were visualized using Golgi-Cox histology. Pyramidal neurons in OFC were reconstructed in three dimensions and morphology of apical and basilar dendrites was quantified using a Sholl analysis. Our preliminary results show a basal sex difference in unstressed animals for both apical and basilar dendrites, with female rats having longer branches compared to males. This finding is opposite that found in mPFC, where unstressed males have longer apical dendrites (Garrett & Wellman, 2009). Consistent with previous studies (Liston et al., 2006), following chronic stress, dendrites in OFC of male rats showed dendritic proliferation. In contrast, little dendritic change was observed in female rats. These results expand upon previous data, and further suggest that stress produces different dendritic remodeling in the prefrontal cortex of males and females, and that the pattern of changes can differ by subregion.

15 SEX DIFFERENCES IN THE EXPRESSION OF ER α IN HIPPOCAMPUS DURING ALTERED ENERGY STATES

Haifei S, Krolick K, Marshall S, Bhardwaj M, Gulla E

Department of Biology, Miami University

Obesity and metabolic disturbances continue to be a top health concern. Estrogens, long associated with their role in regulating the female reproductive system, are now recognized for their neuroprotective and anorexigenic effects in males and females. Estrogens work through estrogen receptor alpha (ER α), which is differently expressed between the sexes. In both male and female rats, estrogens are shown to decrease body weight, decrease food intake, and increase energy expenditure; although both sexes respond differently to diet-induced obesity conditions. Traditionally, studies involving estrogenic actions on energy regulation have taken place in regions such as the hypothalamus and brainstem. More recently, studies are beginning to focus on more limbic areas of the brain that have connections to the hypothalamus, and have uncovered a role of extra-hypothalamic regulation of food intake in regions such as the amygdala and hippocampus. A better understanding of how ER α is regulated in these limbic regions during different energy statuses and across the sexes is still lacking. Using immunohistochemistry, we quantify the expression of ER α in the hippocampus during different energy statuses. We propose that ER α is expressed differently depending on (1) energy status of the animal and (2) sex of the animal.

16 SPLEEN SENSITIVITY TO ACUTE STRESS IN HIGH- AND LOW-DISTURBANCE ENVIRONMENTS

Hanauer RE¹, Gonzalez AD², Abolins-Abols M¹, Rosvall KA¹, Ketterson ED¹

¹*Department of Biology, Indiana University;* ²*University of Puerto Rico at Cayey*

Stress has strong immunomodulatory effects, which vary with the duration of the stressor. For wild animals, human disturbance is potentially quite stressful, but we have a poor understanding of how this might affect the immune system or whether animals in high-disturbance environments respond differently to stressors than animals in low-disturbance environments. The spleen is an important coordinator of immune responses, and we asked whether a high-disturbance environment affects cytokine production and sensitivity to hormones of the spleen. We also asked whether a high-disturbance environment affects spleen responses to acute stress. The dark-eyed junco (*Junco hyemalis*) is a North American sparrow that usually breeds in low-disturbance, non-urban environments but recently has colonized several high-disturbance urban environments. We captured non-urban male juncos in Indiana and exposed them to 30-minute disturbances 4x/day for 3 weeks. We compared these frequently-disturbed birds (n=18) to a control group (n=18) which was disturbed the minimum necessary for animal care and sampling. We measured plasma corticosterone throughout the experiment. After 3 weeks of treatment, we euthanized half the birds in each group immediately after capture to measure baseline gene expression, and the other half 90 minutes after capture to measure stress-induced gene expression. We evaluated spleen cytokine signaling and sensitivity to steroids by measuring gene expression of interleukin-6 (IL-6), interleukin-10 (IL-10), androgen receptor (AR), and mineralocorticoid receptor (MR). We found that expression of AR and MR were significantly positively correlated regardless of treatment group. MR expression was negatively correlated to plasma levels of corticosterone. Results of this study improve our understanding of songbird responses to high-disturbance environments.

17 DETECTING BIOLOGICAL SAMPLES USING OLFACTORY SENSORS

Hiler L, Nippert-Eng C, Shih PC

Department of Informatics, Indiana University

We present an olfactory sensor prototype that consists of an array of alcohol, propane, dioxide, methane, and ammonia sensors. We provide an analysis of sensor readings of a variety of samples including cat fecal samples, onion and garlic cheese, sharp cheddar cheese, and uncooked bacon. Ongoing work involves collecting fecal samples and hormone assays from lab mice to detect for correlation patterns. The olfactory sensor prototype could potentially be used to detect other biological samples in animal behavior studies.

18 METABOLIC PHENOTYPES DURING EARLY DEVELOPMENT INFLUENCE OPEN FIELD BEHAVIOR DURING ADOLESCENCE IN BALB/C MICE

Hong S, Harshaw C, Leffel JK, Alberts JR

Department of Psychological and Brain Sciences, Indiana University

Recent studies suggest a connection between individual variation in thermoregulatory phenotypes and the development of social-emotional behavior. Hudson and colleagues have shown that metabolic and huddling-related phenotypes during infancy correlate with social-emotional behaviors in adulthood in infant rabbits and rats. Here, we explored this question in litters of BALB/c mice, culled to 4 or 6 pups (half male, half female) and tattooed for individual identification on postnatal day 4 (P4). Rectal temperature (T_{rect}) was taken after 5 min of maternal separation at 20°C on P7 and P9. Tests of huddling were performed on P8 and P10. Each litter was tested at 20°C for 50 min and T_{rect} taken immediately following the test. Weight and tail length were also measured on P7-P10. During adolescence (~P30) each pup was given two tests of emotional reactivity on successive days in a miniature (25 x 25 x 35 cm) 'open field' (OF). Scores for the two tests were averaged. A MANOVA revealed significant main effects of sex ($p < .01$) and litter size ($p < .02$) on OF behavior. We thus employed separate mixed effects models (MEMs) for males and females, with litter size and litter controlled as random effects. For males, the only variable that significantly predicted time spent in the center of the OF and center: edge ratio was the interaction between contacts while huddling (i.e., huddle position) and the weight of pups relative to huddlemates in infancy ($p < .03$). For females, the largest effects were of adolescent weight, tail length, and age of testing (all $p < .002$), with additional interaction between T_{rect} following maternal separation and weight relative to littermates ($p < .05$). Overall, there were significant sex differences in which variables influenced adolescent open field behavior. These results indicate that individual variation in sex differences during early development likely plays a particular role in the appearance of emotional phenotypes in adolescence BALB/c mice.

19 MALE MICE RESPOND TO DISMISSIVE FEMALE REPERTOIRES

Hood K¹, Ramis F², Hurley L¹

¹*Department of Biology, Indiana University;* ²*Stetson University*

House mice (*Mus musculus*) are a growing model for the study of context-dependent vocal communication. During courtship interactions, successful mating attempts are associated with a high level of production of ultrasonic vocalizations (USVs) by males, and an increased proportion of specific classes of USVs. USVs have been well-studied, but there is very little information on the role of female broadband vocalizations (BBVs). BBVs are produced with female rejection behaviors, and are associated with decreases in the likelihood of male mounting. We examined the potential role of BBVs in courtship interactions by measuring the vocal and nonvocal behaviors of male mice exposed to a novel female with or without a BBV playback. In order to measure these responses without the impact of female rejection behaviors, males and females were placed on opposite sides of a plexiglass barrier with a single contact point that was large enough for olfactory investigation but not large enough for direct contact. In interactions with a barrier, males produced the same number of USVs as in natural interactions, including USV types associated with mounting attempts or close investigation. Playbacks of BBVs decreased male output while USV playbacks and white noise bursts increased or did not change USV production. No significant difference in duration of non-vocal male behaviors including, time at the contact point, digging, and self-grooming, was found between interactions with or without playbacks. These results suggest that BBVs alone are sufficient to modify male vocal behavior.

20 A CLOSER LOOK AT THE AGE WHEN RHESUS MACAQUE FEMALES DEVELOP A RED FACE PREFERENCE

Jaiswal S¹, Coyne S², Maestripieri D²

¹*Department of Social Sciences, University of Chicago;* ²*Department of Comparative Human Development, University of Chicago*

Red skin coloration has been important in primate sexual selection since they evolved trichromacy. In rhesus macaques (*Macaca mulatta*), researchers have found that adult females prefer dark red faced males as opposed to pale pink faced males as mates. Surprisingly, red pigmentation of the face is not correlated with dominance rank in males. This preference makes females more likely to solicit dark red faced males, irrespective of rank. However, juvenile individuals (18 month olds) did not display the same bias, so the present study investigated when the bias develops to determine the role of the red face/red face preference in sexual selection. We conducted a looking-time experiment in which individuals of both sexes (male, female) and different ages (2, 3, 4 years) were simultaneously presented with two male faces (one dark red and one pale pink). Analyses show no significant looking time preference for either face in any age of sex class. The results of this study may indicate that the bias seen in previous studies is driven by older females, perhaps those who have had several mating seasons' experience, or pregnancy.

21 AAV9-GLT1 TREATMENT AND NEST BUILDING BEHAVIOR IN THE Q175 MOUSE MODEL OF HUNTINGTON'S DISEASE

Karim AN, Barton SJ, Rebec GV

Department of Psychological and Brain Sciences, Indiana University

Huntington's disease (HD), an autosomal dominant neurodegenerative disorder, is characterized by cognitive and motor deficits in adults. HD is a trinucleotide repeat disorder in which an abnormal number of CAG repeats are expressed in the gene encoding the huntingtin protein. Glutamate transporter 1 (GLT1), the protein responsible for 90% of glutamate reuptake in brain interstitial fluid, is down-regulated in HD patients and mouse models, resulting in compromised striatal glutamate transmission. The Q175 knock-in mouse model of HD expresses 175 CAG repeats and many symptoms that describe HD, including aberrant motor functioning and inadequate expression of GLT1. Nest building behavior in mice, often an indicator of cognitive and motor function, is impaired in HD mouse models and worsens with age. Wildtype (WT), heterozygous (HET), and homozygous (HOM) Q175 mice were administered adeno-associated virus serotype 9 carrying the gene for GLT1 (AAV9-GLT1) by way of tail vein injection of approximately 10^{12} vg/injection. The viral vector delivers the GLT1 gene to striatal glial cells. Without treatment, WT mice build better quality nests and use more nesting material compared to HET and HOM. Regardless of treatment, quality of nest built and amount of material used deteriorates with increasing age for HET and HOM, but not WT, animals. While AAV9-GLT1 treatment did not have an effect on percent of nesting material used in adult WT, HET, or HOM Q175 mice, AAV9-GLT1 treated HET mice showed improvement in quality of nest built, expressing a WT phenotype. This result suggests that enhanced glutamate transmission may play a therapeutic role in alleviating HD symptomatology.

22 ANALYSIS OF CFOS BANDS IN THE AUDITORY MIDBRAIN OF MALE MICE IN SOCIAL VERSUS ASOCIAL CONDITIONS

Klein TLW, Petersen CL, Hurley LM

Department of Biology, Indiana University

In social interactions, acoustically communicating animals are faced with the need to listen not only to themselves, but to their conspecific partners as well. Vocal cues may carry information regarding the valence or the context of a social interaction; therefore, how the brain processes these cues is critical to appropriate behavioral responses. Male mice *Mus musculus* represent a tractable system to address questions regarding social-acoustic processing as female vocal cues signal rejection, and may be a salient cue for males. We compared vocal behavior and the number of cFos immunoreactive(-ir) neurons in male mice placed with females and lone males placed with a novel object. We measured two types of male-specific ultrasonic vocalizations (USVs): those with harmonic features which are typically associated with mounting behavior, and non-harmonic USVs which may be general social signals. Additionally, we quantified the number of female “squeaks”, which are associated with rejection behaviors. As expected, in all categories we found that there were significantly more vocalizations produced during social encounters than in isolated conditions. cFos-ir neurons in the midbrain inferior colliculus (IC) occurred in striking banding patterns corresponding to isofrequency laminae, which has not been previously reported during social interactions. Interestingly, there were fewer cFos-ir neurons in the IC of social males, though this difference was not statistically significant. Our results lend insight into how IC processes salient acoustic cues during social interactions.

23 OBSERVING ANIMAL BEHAVIOR IN POLAND - WSU AMBASSADOR PROGRAM

Kraszpulski M^{1,2}

¹Department of Psychology and ²Department of Neuroscience, Cell Biology & Physiology, Wright State University

For 3 weeks this past August, 10 students and 2 faculty members traveled to Poland to observe and work with animals in 2 remote field stations and a zoo. During their travels American students collaborated with Polish students and faculty conducting behavioral observations under the supervision of English-speaking Polish faculty and zoo personnel. Through their involvement, students experienced international cooperation first hand, while at the same time learning a new language and culture, enhancing critical thinking and problem solving skills, and deepening their knowledge and respect for science. Between assignments at the field stations, students stayed in the historic city of Gdansk, toured the medieval Malbork Castle – considered the largest gothic castle in the world, walked and shopped in the Old Town of Gdansk, strolled along the beach on the Baltic Sea, and visited neighboring cities and other important sites. They also enjoyed traditional Polish cuisine and the Polish nightlife. Developed with the aim of creating a significant educational and life changing experience, Dr. Kraszpulski designed this study-abroad experience to help his students be better prepared for careers in the global village. This program was offered for first time in August of 2016 and will be offered again in August of 2017 and is a component of the Psychology/Biology Animal Behavior course (PSY 4941/BIO 4010).

24 EFFECTS OF TRAFFIC NOISE ON ADVERTISEMENT CALL PLASTICITY IN JAPANESE KAJIKA FROG

Madden RP, Legett HD, Bernal XE

Department of Biological Sciences, Purdue University

Anthropogenic noise, such as noise generated by automobile traffic, has become a widespread concern as human populations continue to expand into previously undeveloped areas. For species that rely on acoustic communication to reproduce, human-produced noise can reduce the ability of females to detect mating signals and localize mates. To avoid this masking effect, males in some species alter the rate, duration, or frequency of their signal. This behavioral plasticity has been extensively investigated in birds. The effects of noise pollution on anurans, however, have been less explored. Here we examined the effects of traffic noise on the calling behavior of the Japanese Kajika frog, *Buergeria japonica*, using playback experiments. As predicted, we found changes in calling strategies as an effort to compensate for increased background noise. We also evaluated the effect of traffic speed on call plasticity and discuss the implementation of conservation strategies that would reduce noise exposure. In the context of previous studies, our results highlight the species specific nature of plasticity of anuran advertisement calls in response to background noise.

25 THE ONTOGENY OF GAITS IN AFRICAN ELEPHANT *LOXODONTA AFRICANA* CALVES

Moellering MA¹, Machado JM², Patton CN², Dale RHI²

¹Department of Biological Sciences and ²Department of Psychology, Butler University

There are virtually no data concerning the ontogeny of gaits in elephants. In fact, there is almost no data at all on the gaits of elephant calves. We investigated the development of gaits in six African elephant calves at the Indianapolis Zoo. We video-recorded the calves as they moved freely about the large exhibit at the zoo collecting 307 two-stride samples of gaits in calves under six years of age. We separated the ages of the calves into 3 categories: Birth-38 days, 43-405 days and 419-2145 days (just under 6 years of age), with 102, 105 and 100 observations in each of these categories, respectively. According to the Hildebrand (1985) gait categories, the calves relied on four different gaits at each stage of life: Lateral sequence-lateral couplet (LSLC), lateral sequence-singlefoot (LSS), lateral sequence-diagonal couplet (LSDC), and trot (T). The LSLC gait (50%) was the most common, with the other gaits less frequent: LSS gait (29%), T (13%), LSDC (8%). The duty factors were typically 0.55-0.60 (moderate walk) for the LSLC and LSS gaits and about 0.70 (slow walk) for the LSDC and T. All four gaits became less variable as the calves aged.

26 SEX DIFFERENCE IN INFERIOR COLLICULUS SEROTONIN FIBERS IN RESPONSE TO VARYING SOCIAL HOUSING CONDITIONS

Morningstar M¹, Hurley LM^{1,2,3}

¹Department of Biology, ²Program in Neuroscience, and ³Center for the Integrative Study of Animal Behavior, Indiana University

Responding appropriately to sensory stimuli is crucial for an organism's survival. A mouse is receiving a constant array of sensory stimuli that it must correspondingly process and respond to. Important to our present study are auditory signals. The inferior colliculus is a mammalian subcortical brain region that receives input primarily from auditory regions. The neuromodulator serotonin is also heavily present in the inferior colliculus and has been shown in previous work via *in vivo* voltammetry to elevate in social situations. This suggests a role for serotonin in responding to contextual social stimuli. The present study investigates serotonergic fiber density in the inferior colliculus in female mice that have been socially housed for four weeks versus female mice that have been individually housed for four weeks after weaning. An estimate of fiber density is accomplished by using immunohistochemistry to select for and fluorescently mark the serotonin transporter in brain tissue sections. Photomicrographs are taken of these sections and a line-scan analysis protocol mathematically estimates the fiber density of the corresponding sections. Previous work has shown through this analysis that male mice show no difference in serotonin fiber density across housing treatment, however, current work in female mice suggests that there may be a sex difference in the density of serotonergic fibers in response to the varied housing condition.

27 UPREGULATION OF POLYAMINE BIOSYNTHESIS AND γ -AMINOBUTYRIC ACID (GABA) PRODUCTION ARE INDICATIVE OF OSMOTIC PLASTICITY IN KILLIFISH (*FUNDULUS SP.*)

Munley KM¹, Whitehead A², Liu D³, Galvez F⁴

¹Department of Biology, Indiana University; ²Department of Environmental Toxicology, University of California Davis; ³Agricultural Center Biotechnology Laboratory and ⁴Department of Biological Sciences, Louisiana State University

Killifish (*Fundulus sp.*) inhabit marshes along the U.S. Atlantic coast and Gulf of Mexico, where they must rapidly adjust to large fluctuations in environmental salinity. While some killifish have evolved euryhalinity and can tolerate a wide range of salinities, other species exhibit marine physiologies and have little to no ability to tolerate osmotic challenges. We have recently shown that euryhaline species of killifish stimulate polyamine biosynthesis and accumulate putrescine (PUT) in the gill during acute freshwater exposure. Interestingly, PUT can be converted to γ -aminobutyric acid (GABA), the major inhibitory neurotransmitter in the central nervous system (CNS) of all vertebrates. While it is clear that polyamines play a role in osmoregulation, the consequences of the upregulation of polyamine biosynthesis on other downstream metabolic pathways, such as GABA production, have yet to be explored. To address this question, we utilized molecular and physiological techniques to compare the importance of PUT in GABA production in the gill of a marine (*F. majalis*) and euryhaline killifish species (*F. heteroclitus*) during acute hypoosmotic challenge. Here, we show that *F. heteroclitus* upregulates polyamine biosynthesis in the gill in response to acute freshwater exposure, as exhibited by increases in the relative mRNA expression of genes associated with polyamine biosynthesis and the accumulation of GABA, PUT, and the polyamine spermidine. In contrast, these changes in mRNA expression were attenuated in the gill of *F. majalis*, and decreases in concentrations of PUT, GABA, and the polyamine spermine were observed. Collectively, our study provides insight into the physiological and genomic mechanisms that contribute to the remarkable osmoregulatory abilities of killifish in response to shifts in environmental salinity. More broadly, our data suggest a novel role for GABA in the regulation of homeostatic mechanisms during environmental stress.

28 HORN DIMORPHISM AND REPRODUCTIVE REPERTOIRES: A POSSIBLE ROLE FOR SEROTONIN IN THE PHENOTYPIC INTEGRATION OF HORNED BEETLES

Newsom KD, Schwab DB, Moczek AP

Department of Biology, Indiana University

Despite sharing the same genotype, individuals of the same population may express substantially different phenotypes as a function of their environment. These divergent phenotypes are frequently comprised of complex mosaics of morphological, physiological, and behavioral traits that are highly integrated and function interdependently. However, the physiological mechanisms that enable the integration of behavioral with physiological and morphological phenotypes across environments remain poorly understood. In the horn polyphenic beetle *Onthophagus taurus*, larval feeding conditions cue the development of males into either hornless minor or horned major morphs, which adopt either opportunistic sneaking or highly aggressive fighting tactics, respectively, in order to gain access to females. Recent work demonstrated that decreasing serotonin signaling lowers the body size threshold needed for induction of the horned morph, which is intriguing, as serotonin has been shown in diverse prior studies to regulate the expression of aggressive behaviors across invertebrate taxa. Here, we test whether serotonin signaling may serve as an integrator of morphological and behavioral development using a pharmacological approach to manipulate systemic levels of serotonin in adult males (aim 1) and developing larvae (aim 2). In our first aim, we investigate the degree to which serotonin modulates aggressive behaviors in both adult morphs during male-male interactions. Results to date suggest that increased levels of serotonin signaling increase frequency, intensity, and duration of fights in both morphs. In our second aim, we manipulated serotonin signaling to induce horn expression in small-bodied males and are currently investigating whether these males adopt the behavioral repertoire of control hornless or horned morphs. We discuss our most recent findings and explore their evolutionary implications for developmental plasticity and phenotypic integration.

29 EXPLORING UNDERLYING MECHANISMS OF SEASON VARIATION IN BEHAVIORAL TYPES OF *TRACHEMYS SCRIPTA*

Nichols H, Wilson Carter A, Bowden R

Department of Biology, Illinois State University

Correlated patterns of behavior, termed behavioral types, can affect the fitness of individuals. The most advantageous behavioral type may differ across predictable environments (e.g. seasonally), and maternally mediated effects may be important for matching hatchling behavior to their environment. In 2014-2016 we measured righting response, an indicator of behavioral type, of juvenile turtles (*Trachemys scripta*) emerging from early and late season clutches to understand if the production of bold-shy behavioral types differs across the nesting season. We found a significant effect of season, with early season hatchlings being bolder than late season hatchlings. The seasonal variation in righting time combined with significant clutch effects suggests a maternal influence on this behavior, and we therefore explored two potential underlying mechanisms. First, maternal yolk allocation can vary with season, and this differential allocation of energy stores could affect how hatchlings behaviorally modulate energy consumption. Residual yolks were removed from the hatchlings and wet and dry masses taken. Though there was high variation in residual yolk there was not a significant correlation between residual yolk mass and hatchling behavioral type. Secondly, concentrations of maternal estrogens in the yolk also vary with season, and are known to affect other aspects of hatchling phenotype. We dosed early season eggs with an estrogen mixture in a concentration that resembles late season eggs (20 ng estradiol + 77.5 ng estrone sulfate/5 μ l 70% ethanol or a sham control) and assayed righting responses. There was no effect of the estrogen dose on hatchling righting. We demonstrate that the production of behavioral types systematically varies across the nesting season; however, future research is needed to identify the ecological contexts favoring each behavioral type and the underlying mechanisms.

30 THE FIELD CRICKET *GRYLLUS RUBENS* (ORTHOPTERA: GRYLLINAE) EXHIBITS DEVELOPMENTAL PLASTICITY IN ITS MATING CALLS

Norman N, Pease J, Murphey K, Beckers O

Department of Biological Sciences, Murray State University

The development of behavioral phenotypes is frequently responsive to variable environmental conditions, leading to alternative phenotypes. This developmental or phenotypic plasticity can have important evolutionary consequences if it affects fitness via behavioral phenotypes that are tightly linked to reproduction. The ramifications of changes in reproductive behavior that are the result of temperature are especially relevant in the context of global warming. The field cricket, *Gryllus rubens*, uses acoustic communication in the context of pair formation: males call and silent females use these calls to identify and localize conspecific males for mating. In Kentucky, *G. rubens* has two breeding seasons: one in the spring and one in the fall. Offspring of each generation develop under different environmental conditions. First, we tested whether male mating calls differ in each season. We found that fall males produced significant faster pulse rates than spring males, which was explained by a shortening of the sound pulses that comprise their calls. Second, we conducted a series of rearing experiments to determine (i) when during development male cricket behavior is responsive to the environment, and (ii) which environmental cue is responsible for the alternative mating calls. Our results suggest that rearing temperature had a permanent and significant effect on male calls similar to that observed between field generations. Moreover, rearing temperature only affected the development of calls when experienced as juveniles and not as adults. Photoperiod, however, did not affect male calls. Our results indicate that seasonal temperature experienced during juvenile development explains the behavioral differences observed between spring and fall males. The effect of seasonal environment on female preferences is not known, but will be the focus of future studies.

31 REPLAY OF EPISODIC MEMORIES IN THE RAT

Panoz-Brown DE¹, Brotheridge S¹, Sluka CM¹, Almeida B², Hex S³, Gentry M¹, Corbin HE¹, Somekh I¹, Kestenman J¹, Cox K¹, Crystal JD¹

¹*Department of Psychological & Brain Sciences and Program in Neuroscience, Indiana University;* ²*Department of Neurosciences and Cognition, Federal University of ABC;* ³*Department of Psychology, Cornell University*

Episodic memory in people has been characterized as the replay of events in sequential order. We recently showed that rats remember multiple unique events and the contexts in which they occurred using episodic memory (Panoz-Brown et al., 2016. *Current Biology*). However, it is not known if rats remember a stream of events in sequential order using episodic memory. Here we show that rats remember multiple events in sequential order. Rats were presented with a variable length list of trial-unique odors, followed by memory assessments that required judgments about the order of events. Three lines of evidence suggest that rats remember the sequential order of events. First, rats correctly selected items when both sequence and familiarity cues of the odors were put in conflict. Second, sequence memory was resistant to a retention-interval challenge. Third, item sequence memory was resistant to interference from memory of other odors. We conclude that rats remember a stream of events using episodic replay.

32 PACLITAXEL SELECTIVELY IMPAIRS REVERSAL LEARNING WHILE SPARING EPISODIC MEMORY, PRIOR LEARNING, AND NEW LEARNING

Panoz-Brown D, Gentry M, Carey LM, Smith AE, Sluka CM, Corbin HE, Wu J, Hohmann AG, Crystal JD
Department of Psychology and Program in Neuroscience, Indiana University

Chemotherapy is widely used to treat patients with systemic cancer. The efficacy of cancer therapies is frequently undermined by adverse side effects that have a negative impact on the quality of life of cancer survivors. Cancer patients who receive chemotherapy often experience chemotherapy induced cognitive impairment across a variety of domains including memory, learning, and attention. In the current study, rats received treatment with paclitaxel, a taxane derived chemotherapeutic agent. Following treatment, episodic memory, prior learning, new learning, and reversal learning were evaluated. Neurogenesis was quantified post-treatment in the dentate gyrus of the rats using Bromodeoxyuridine (BrdU) and Ki67 immunostaining. Paclitaxel treatment selectively impaired reversal learning while sparing episodic memory, prior learning, and new learning. Further, paclitaxel treated rats showed decreased hippocampal cell proliferation. This work highlights the importance of using multiple measures of learning and memory to identify the pattern of impaired and spared aspects of chemotherapy induced cognitive impairment.

33 SOCIAL STATUS AND SIZE INFLUENCE TRANSMISSION OF SOCIAL INFORMATION IN A SOCIAL CICHLID FISH (*NEOLAMPROLOGUS PULCHER*)

Pope AJ¹, Hoskins EA¹, Hamilton IM^{1,2}

¹*Department of Evolution, Ecology, and Organismal Biology and* ²*Department of Mathematics, The Ohio State University*

Social learning occurs when information is obtained by interaction with another individual, and can bestow benefits to an observer by reducing the costs of acquiring information. Determining who to pay attention to is often a challenge observers face. Because many species live in hierarchal social groups where individuals differ in social status and queue for dominance, differences in status may influence who observers pay attention to. Dominants have been successful at surviving and advancing in status, thus information gained from them may be useful. Additionally, dominant demonstrators are more noticeable and opportunities for transmission of information to observers may already be high. We hypothesized that individuals are likely to use information from dominant (high status) individuals. We tested this hypothesis in the social cichlid fish *Neolamprologus pulcher*, by presenting observers with opportunities to gain information about food location from demonstrators. We predicted that observers would feed more where a demonstrator fed when the demonstrator was of higher social status. We created groups with a dominant male, dominant female, and subordinates. We trained observers to associate a location with food and allowed them to observe a demonstrator acquiring food in a different location. We measured the time observers spent searching where the demonstrator had fed. We found that only fish that had observed dominant female demonstrators differed in foraging location from controls and that the direction of the effect depended on the female's size relative to the observer. Our results show that the salience of social information is influenced by attributes of both the demonstrator and observer. It is possible that size-based social learning may also generalize to other types of information, such as assessing environmental risk or choosing a mate.

34 ANXIETY DURING THE POSTPARTUM PERIOD: EXAMINING THE ROLE OF GABA IN THE MEDIAL PREFRONTAL CORTEX

Post C¹, Sabihi, S², Maurer S¹, Leuner B^{1,2}

¹*Department of Neuroscience and* ²*Department of Psychology, The Ohio State University*

The postpartum period is commonly accompanied by emotional changes, which for many new mothers includes a reduction in anxiety. Previous research on the postpartum reduction in anxiety in rodents has shown that it is dependent on offspring contact and further has implicated enhanced GABAergic neurotransmission as an underlying mechanism. However, the specific brain regions where GABA acts to regulate the offspring-induced reduction in postpartum anxiety requires further investigation. Of particular interest is the medial prefrontal cortex (mPFC), which has been shown to play a role in the modulation of anxiety-related behavior. Here, we test the hypothesis that offspring interactions reduce anxiety-like behavior in postpartum females via GABA signaling in the mPFC in three experiments. In experiment one, we confirmed that postpartum females display reduced anxiety compared to virgin females when tested on the elevated plus maze (EPM) and following an infusion of the GABA_A receptor antagonist bicuculline in the mPFC this effect was abolished. In experiment two, we found that dams that had been separated from their pups for 4h displayed increased anxiety as compared to dams that were not separated. Furthermore, activation of GABA_A receptors in the PL mPFC by the agonist muscimol restored the reduced levels of anxiety-like behavior. In a final experiment, we found that mothers that were separated from their pups not only show increased levels of anxiety but also had a lower number and percentage of activated GABAergic neurons within the mPFC. Together, these results suggest that mother-pup interactions reduce anxiety in postpartum females via GABA_A neurotransmission in the mPFC and provide insight into mechanisms that may become dysfunctional in high postpartum anxiety.

35 THE INFLUENCE OF SOCIAL CUES ON OVIPOSITION DECISIONS IN THE MOSQUITO *Aedes aegypti*

Ramesh A^{1,2,3}, Sharma M², Isvaran K²

¹Indian Institute of Science, Education, and Research – Pune; ²Centre for Ecological Sciences, Indian Institute of Science; ³Department of Biology, Indiana University

Animals use a variety of social and non-social cues in evaluating the habitat quality of a patch. Assessing social information and incorporating it into future decisions can translate into important fitness consequences for an individual. Local adult-density, among other social cues, can heavily influence individual adult decisions. In particular, adult-density can play a crucial role in affecting maternal decisions like oviposition site-selection that can potentially set-off a cascade of responses in both the parent and the offspring. Using *Aedes aegypti* as a model-system we investigated the influence of adult-density on oviposition responses. Specifically, we measured oviposition responses of individual adult females to patches differing in quality when present singly (solitary), or in the presence of non-breeding adult individuals (social setting). In a series of binary choice experiments, patch quality was represented by pools differing in larval predation risk in one set of experiments and by pools differing in larval competition risk in another. Overall, the study indicates that individual adult females are able to assess the presence of other individuals and in response modify their behavior during oviposition events. Adult females seem to respond to the presence of other females by adopting a bet-hedging strategy, sometimes withholding eggs perhaps to distribute eggs further across multiple pools while exhibiting preference for riskier patches. We suggest that adult female density may favor a shift in preference of individual females towards seemingly riskier patches and discuss potential evolutionary explanations for this shift.

36 VARIATION IN THE EFFECTS OF SUB-LETHAL ROUNDUP EXPOSURE ON ANTI-PREDATOR BEHAVIOR IN *HYLA VERSICOLOR* LARVAE FROM PRISTINE AND AGRICULTURAL POPULATIONS

Ross J

Environmental Science Program, Wittenberg University

We sought to examine the effects of long-term Roundup exposure in a population of grey tree frogs (*Hyla versicolor*) breeding at an agricultural pond surrounded by roundup ready corn and a population breeding in a pristine pond located at a county nature preserve. Grey tree frog tadpoles collected from each site were randomly assigned to either a control or Roundup treatment. We observed overall activity levels of tadpoles as well as their activity levels after exposure to a caged predator. Gray tree frogs from the agricultural site showed no change in behavioral response to a predator when exposed to Roundup. However, tadpoles from a pristine environment increased their activity levels when a predator was present, showing an inappropriate response to the risk of predation.

37 EXAMINING THE HORMONAL PLEIOTROPY HYPOTHESIS: MELANIZATION CORRELATES IN LIZARDS

Seddon RJ, Hews DK

Department of Biology, Indiana State University

A growing area of behavioral ecology examines how mechanisms underlying production of pigments can affect traits other than body coloration. Regulation of melanin, which involves the melanocortin system, can directly and indirectly affect other phenotypic traits, such as aggression or physiology. Selection on one trait within a hormone-mediated suite of traits may lead to changes in the hormone signal, causing either beneficial or detrimental changes in correlated traits. These associations have been studied mainly in birds and mammals, but less so in reptiles. We studied correlation of melanization with these other traits, comparing between-population differences of adult male western fence lizards, *Sceloporus occidentalis*. We compared five high- and four low-elevation population in California where individuals are increasingly darker at higher elevations, working during comparable periods of the breeding season at each site. We measured and confirmed that the higher elevation populations that we sampled were significantly darker than our lower elevation populations. We measured baseline peptide (α -melanocyte-stimulating hormone) and steroid (corticosterone, testosterone) hormones to compare hormone and melanization relationship both across and within populations. While we did not find any significant differences in baseline levels of α -MSH, we found a positive relationship with baseline plasma testosterone and a negative correlation with baseline corticosterone. We also counted ectoparasite loads for all males as an immunological measurement. We describe potential differences in selective regimes that could produce these different patterns across vertebrates. These data suggest that hormonal pleiotropy does not constrain phenotypic variation.

38 A NOVEL BATTERY OF BEHAVIORAL TESTS TO ASSESS THE MATURATION OF EXECUTIVE FUNCTIONS DURING THE TRANSITION FROM ADOLESCENCE TO ADULTHOOD IN MICE

Shepard R¹, Beckett E¹, Coutellier L^{1,2}

¹Department of Psychology and ²Department of Neuroscience, The Ohio State University

Adolescence marks a period of significant brain and cognitive development during which complex cognitive control mechanisms that allow for goal-oriented behavior become increasingly in demand. These highly interrelated “executive functions” arise from molecular changes in brain regions like the prefrontal cortex, striatum, and hippocampus and are necessary for normal behavior in adulthood. Understanding how executive functions develop normally from adolescence to adulthood may provide better insights into how developmental brain disorders lead to deficits in these cognitive processes. However, there is a lack of research that defines accepted methods for measuring the maturation of executive functions during transitional periods of brain development in rodents. The present study aims to establish a novel battery of behavioral tests to assess the maturation of executive functions during the transition from adolescence to adulthood in mice. Male and female adolescent (postnatal day [PND] 25-39) and adult (PND 60-75) C57BL/6J mice were tested in one of three behavioral tests, including an Attentional Set Shifting Task (ASST), a Puzzle Box Task, and a Delayed Alternation T-maze Task, to measure attention, cognitive flexibility, problem-solving, and spatial working memory. We demonstrated that male adolescents have poorer performances in the ASST than adults as measured by trials to reach criterion and total number and percent of incorrect choices, while no age effect was seen in females. Both male and female adolescents took longer than adults to complete the problem-solving task in the puzzle box, while short- and long-term memory remained intact. Finally, female adolescents required significantly more days to reach criterion in the delayed alternation phase of the T-maze. Together, these findings offer discrete behavioral tests for measuring sex-specific developmental differences in executive functioning during the transition from adolescence to adulthood.

39 LEARNING FROM FEMALES PAYS OFF FOR MALE WOLF SPIDERS

Sullivan-Beckers L¹, Hebets EA²

¹*Department of Biological Sciences, Murray State University;* ²*Department of Biological Sciences, University of Nebraska-Lincoln*

As animals communicate their signals travel through the environment and are degraded, distorted, and masked by noise. Additionally, signaling environments are altered with changes in humidity, precipitation, and with noise produced by other signaling animals. A few of the ways in which animals deal with the problem of being heard in a variable and noisy environment include communicating at particular times of the day or night; in particular locations; communicating with unique structures; and/or incorporating multiple components into a signal. For some of these solutions, the ability to learn may explain how animals solved the problem of being heard, suggesting that learning could be highly adaptive in an uncertain or changing environment. We propose that male wolf spiders can optimize their signals by paying attention to feedback from potential mates. We test this hypothesis with males of the wolf spider, *Schizocosa rovernii*, which court females using vibrational signals transmitted through substrates on the forest floor. In response, receptive females perform a display, producing visual and vibrational cues. We mimic female receptivity using puppets and ask whether males alter their use of signaling substrates that differ in transmission effectiveness. Furthermore, we test whether variation in the male ability to learn from this feedback, benefits males in terms of mating success and attack avoidance. We found that (i) males do vary in the ability to learn from female feedback, (ii) that learning requires vibrational, but not visual feedback, and that (iii) the males showing the greatest (positive) change in courtship behavior were more likely to mate and less likely to be attacked. These findings demonstrate that males that are able to learn from female feedback and optimize their courtship signaling are likely to have greater evolutionary fitness.

40 INFLUENCE OF SEX AND AMBIENT TEMPERATURE ON ASIAN ELEPHANT (*ELEPHAS MAXIMUS*) DUSTING

Summers K, Hankison S

Department of Zoology, Ohio Wesleyan University

Previous studies indicate that elephant dusting behavior can be promoted by several factors including environmental temperature and social interaction. We hypothesized that (1) if dusting serves as a voluntary thermoregulatory function, then increased ambient temperature would result in increased dusting performance, and (2) if dusting is influenced by social interactions, then male and female elephants will exhibit dusting at similar rates in a group setting. Preliminary data indicated no significant relationship between temperature and the number of dustings performed by an individual. Contrary to our predictions, females exhibited a greater rate of dusting than males in a social environment. The current study reexamines the relationship between ambient temperature, elephant sex, and dusting performance. Understanding behavioral adaptations and striving to maintain natural instincts are key to facilitating a healthy captive environment. If we understand environmental factors that influence elephant behavior, perhaps we can identify aspects of their natural environment that need to be preserved in order to protect the species. The researchers would like to extend their thanks to the Columbus Zoo and Aquarium for permitting behavioral observations.

41 A FIRE IN THE BELLY: SEX-SPECIFIC MODULATION OF THE GUT MICROBIOME AND AGGRESSION

Sylvia KE¹, Jewell CP¹, Rendon NM¹, St. John EA¹, Demas GE¹

Department of Biology, Indiana University

The gut microbiome is a diverse, host-specific, and symbiotic bacterial environment that is critical for mammalian survival and exerts a surprising yet powerful influence on brain and behavior. The effects of repeated antibiotic treatment in adulthood and its consequences on social behavior in a non-model species (e.g., Siberian hamsters) however, have yet to be explored. To investigate how changes in microbial diversity affect behavior, this study sought to determine the influence of antibiotic treatment on social behavior. Specifically, we tested the effects of short-term vs. repeated antibiotic treatment on aggressive and investigative behaviors. To address this, male and female hamsters were either administered sterilized water or an antibiotic (0.3 µl of Baytril 10% oral solution per gram of body mass) orally via sterile pipette for seven days during two treatment periods (D1-7 and again on D15-21). Each treatment period was followed by a 7-day recovery period (D8-14 and D22-28). On the last day of each treatment and recovery period (D7, D14, D21, and D28), social behavioral trials were conducted. To assess behavior, we used a resident-intruder model by which a non-aggressive intruder was introduced into the home cage of an experimental animal for five minutes. At the end of the experiment, all animals were euthanized and organs were weighed. We found that two, but not one, treatments caused marked decreases in aggressive behavior, but not other social behaviors, in males; aggression returned to normal levels following recovery. Antibiotic-treated females, in contrast, showed decreased aggression after a single treatment, with all other social behaviors unaffected. Unlike males, female aggression did not return to normal during either recovery period. Here, we show that treatment with a broad-spectrum antibiotic, which has dysbiotic effects, also has robust, sex-specific effects on aggression.

42 EXAMINING VIGILANCE AND SENTINEL BEHAVIOR OF MONK PARAKEETS AND POSSIBLE CONNECTIONS TO VIGILANCE OF OTHER URBAN ADAPTED BIRDS IN THE CHICAGOLAND AREA

Thomas RA¹, Wilcoxon TE², Appelt CW³

¹*Department of Biological Sciences, Saint Xavier University;* ²*Department of Biology, Millikin University;*

³*Department of Biological Sciences, Saint Xavier University*

Vigilance can increase survival by increasing the probability of detecting potential threats. A sentinel system, in which one or more individuals are consistently alert, allows other individuals of a group to participate in non-vigilant behaviors. Monk parakeets (*Myiopsitta monachus*) are gregarious, have successfully colonized areas throughout the world, and have been in the Chicago area for more than 40 years. Part of their success could be due to a sentinel system, which has been attributed to this species but has never been demonstrated. Furthermore, if monk parakeets are more vigilant than other resident species, those species might exhibit reduced vigilance in their presence. Therefore, we had three hypotheses about avian vigilance in the Chicago area: 1) monk parakeets use a sentinel system; 2) individual monk parakeet vigilance and that of sympatric bird species are related to flock size dynamics; 3) monk parakeets exhibit greater vigilance than other urban adapted bird species. To test the first hypothesis, we collected focal vigilance data on three individuals in monk parakeet flocks based on physical position: highest, second highest, and lowest. To test the second and third hypotheses, we collected corporate vigilance data for single and mixed species flocks. Preliminary analyses have not supported the use of a sentinel system or greater vigilance by monk parakeets than other avian species in the Chicago area; however, vigilance does seem to relate to changes in flock size. These data provide new information about how monk parakeets might interact with the ecosystems they colonize.