

POSTER PRESENTATION ABSTRACTS

2024 ANIMAL BEHAVIOR CONFERENCE

Alphabetical by presenter's last name (**bold** if not first author). Numbers indicate poster numbers. Posters registered after program print are listed starting at #40 in order by first author last name.

1 **EFFECT OF ARTIFICIAL LIGHT AT NIGHT (ALAN) AND TRAFFIC NOISE ON ANURAN COMMUNICATION**

Bustos AA¹, Ospina AM¹, Bernal XE^{1,2}

¹*Department of Biological Sciences, Purdue University;* ²*Smithsonian Tropical Research Institute*

Urbanization has rapidly become an important threat to biodiversity as it results in habitat degradation and exposes species to novel sensory pollutants. Among those, artificial light at night (ALAN) and traffic noise are persistent threats to animals that rely on acoustic communication at night. These pollutants can modify the signaling and breeding behavior of animals as they have the potential to interfere with the detection and perception of sexual signals. While our understanding of the responses of animals to ALAN and traffic noise has increased in the last decades, there is limited information about the joint effects elicited by these sensory pollutants despite them often occurring together. Here, we investigated the independent and joint effects of ALAN and traffic noise in anurans, a group that relies on acoustic communication for reproduction. We assessed how these sensory pollutants affect the composition of mixed-species anuran choruses and individual male calling behavior. To do so, we performed experiments presenting ALAN, traffic noise, or both stimuli combined at anuran breeding sites. We found species-specific responses in the effects that these sensory pollutants have on the number of individuals calling when they are presented independently and together. Those changes in male calling activity, ultimately result in species richness reductions at choruses. When considering the latency to call again once the stimulus was retrieved, results also show species-specific responses to ALAN and traffic noise presented independently and combined. Our results suggest that while both pollutants affect calling behavior, ALAN may have a longer lasting impact on frog choruses. In general, our work reveals changes in breeding behavior and chorus structure elicited by ALAN and traffic noise may exacerbate the current anuran extinction crisis.

2 **THE EFFECTS OF TACTILE CUES ON CALIBRATING THE ORGANIZATION OF OPEN FIELD BEHAVIOR**

Campbell N, Sampson H, Schaeffer E, Lake R, Wallace D

Department of Psychology, Northern Illinois University

Stable environmental cues can be used to reset drift in error prone spatial representations. Previous research has shown that when an animal uses a tactile/visual cue as a home base, they will organize their movement based on the location of the home base. Previous research has demonstrated that tactile/visual cues will anchor home base establishment and movement will be organized around this location. The current study investigated the influence a tactile cue has on the movement organization of mice across multiple table

sizes (198cm and 80cm in diameter). Under complete dark conditions, mice were given 20 minutes to explore a table with a tactile cue (female, n=12; male, n=12) or without a tactile cue (female, n=12; male, n=12). The order of table sizes was counterbalanced across all mice. A motion tracking software (Ethovision Noldus) was used to track mouse movement in the open field. The resulting set of coordinates was to segment behavior into stops and progressions. Each 20-minute session was broken down into four 5-minute samples, allowing for the ability to measure stop clustering and progression characteristics. The results suggest that the presence of a tactile cue influenced the movement organization in different sized environments. These observations establish a foundation to investigate rodent models of neurodegenerative disorders influence spatial disorientation.

3 STUDYING HOST PREFERENCE AND ITS CONTRIBUTION TO THE CO-OCCURRENCE OF ENTOMOPATHOGENIC NEMATODES

Cortes Romero M², Enriquez Madrid J¹, Bashey-Visser F¹

¹Department of Biology, Indiana University; ²Department of Animal Science, Cornell University

Biodiversity plays a critical role in the maintenance of ecosystems by providing sustainable food chains and the general wellness of organisms. Biodiversity is enhanced when species can stably coexist, which can be promoted by niche partitioning. Entomopathogenic Nematodes (EPNs) are an interesting group of organisms as multiple species appear to co-occur in the same ecosystem while using the same resources. In addition, EPNs play a pivotal role in the maintenance of ecosystems. EPNs are known as obligate parasitic nematodes that will kill their insect host. Finding a worthy host to inhabit is a crucial milestone in an EPN's life cycle as they will reproduce inside the insect. They can be seen globally for agricultural purposes as they are used as environmentally friendly insecticides. A classic example that literature on these insect assassins highlights is their contribution to biological control, as EPNs have been proven to be successful biological insecticides that substitute chemical insecticides. In addition, EPNs could be using niche partitioning to decrease competition and increase the survival rate of their species. Understanding EPNs' behavior plays an important role in addressing inadequacies in existing research on biodiversity, host preference/animal behavior, and general environmental factors. We hypothesize that EPNs are co-occurring due to their preference to infect different host species in a manner that mitigates competition with one another. This research will follow an in-depth analysis of the abundance of nematodes in different sections of both chemotaxis assays. Three EPNs will be examined: *Steinernema affine*, *S. costaricense*, and *S. krausse*. All of them have been exposed to four different host species: *Acheta domestica*, *Galleria mellonella*, *Manduca sexta*, and *Tenebrio molitor*. They will be given 24 hours to express their attraction to a host.

4 PRENATAL ALCOHOL EXPOSURE INCREASES IMPULSIVITY IN ADOLESCENT MALE, BUT NOT FEMALE RATS

Perkins A, Norman T, Dart E, Kinney L

Department of Psychology, Purdue University Fort Wayne

Prenatal alcohol exposure can produce many adverse effects in humans, including an increased risk of impulsive behavior (Mattson et al., 2019). Deficits in self-control can

interfere with academic performance and can have a variety of detrimental, lifelong effects. In the present study, a rat model of prenatal alcohol exposure was used to measure self-control in adolescent and adult rats. Pregnant rats were assigned to one of three groups: Control rats received unlimited access to food and water. Diet only rats received a liquid diet and were matched to an alcohol-exposed rat such that they received the same amount of liquid diet, adjusted for body weight. Alcohol-exposed rats received a liquid diet with 6% alcohol (BAC ~80 mg/dL). Male and female offspring began testing in adolescence (starting on day 28) or adulthood (starting ~ day 90). Rats were first trained to bar-press, with reinforcement delivered on a VR-3 schedule. After rats were stably responding, they were switched to a DRL-15s schedule for 5 days of testing. In this paradigm, rats must withhold a response for 15s to receive reinforcement. Responding during the 15s interval results in a reset. The number of lever presses and resets, a measure of inability to withhold a response, were measured. Training and testing lasted 2-3 weeks. In males, the number of responses during testing was higher in alcohol-exposed rats, but this effect was only in adolescents. Adults did not show an effect of prenatal alcohol exposure. A similar pattern emerged for resets, where alcohol exposed males exhibited more resets than the controls, but no effects of condition were evident in females. Taken together, adolescent males were especially sensitive to alcohol-induced impairments in self-control. Future studies will evaluate aspects of the dopaminergic system in the prefrontal cortex and striatum, two brain regions implicated in self-control and impulsivity.

5 MULTIGENERATIONAL EFFECTS OF DREDGE-AMENDED CORN ON BEHAVIORAL DEVELOPMENT

Durkin BD, Czuba MI, Flanigan KAS, Willing J

Department of Psychology, Bowling Green State University

Environmental agencies have suggested using excess dredge material from Lake Erie as an agricultural amendment due to nutrient and organic carbon availability. This material likely contains contaminants of concern (COC) such as heavy metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs). Exposure to COCs may cause decreased body weight, cognitive deficiencies, memory loss, and abnormal neurodevelopment in mammals. Furthermore, multigenerational maternal transfer could pose an even greater risk to subsequent filial generations. Previous research demonstrated that perinatal exposure to corn grown with dredged sediment reduces hippocampal volume and alters anxiety and exploratory behavior into adulthood. In the present study, we used Long Evans rats (*Rattus norvegicus domestica*) to assess potential multigenerational effects of dredge-amended corn exposure on neonatal sensorimotor development and adult anxiety-like behavior, learning, and memory. Experimental subjects were the F2 generation of perinatal exposure. Dams were supplementally dosed with dredge-amended corn (or a non-dredge amended corn source) relative to their body weight every other day. Dosing occurred from pairing of adult subjects to weaning of pups at postnatal day (P)25. Females and males from each litter were tested on P5, 10, and 15 to assess sensorimotor development. The same subjects were tested again in adulthood using the elevated plus maze, open field, novel object placement, and spontaneous alternation tests. Results suggest that neonatal offspring of dams exposed to dredge-amended corn are less active compared to controls. Further, male offspring of these dams exhibit more anxiety-like

behavior in adulthood. These results support our hypothesis that exposure to corn grown on dredge-amended material alters both neonatal and adult behavior. Findings presented here contribute to the growing research of the effects of contaminants on brain development.

6 DO DIFFERENCES IN HOST PREFERENCE AND INFECTION STRATEGY FACILITATE PARASITE COEXISTENCE?

Enriquez Madrid J¹, Cortes Romero M³, Myung-won Kim L², Bashey-Visser F¹

¹Department of Biology and ²Program in Neuroscience, Indiana University Bloomington;

³Department of Animal Science, Cornell University

Simple behaviors can have rippling effects echoing across an ecosystem. Parasites are ubiquitous, but mostly hidden, members of every ecosystem. They have a plethora of behaviors used to infect hosts. Preference for different host species can result in parasites partitioning the host niche and result in parasite coexistence in a community. Community composition of parasites and fitness of host species can then be influenced by parasites showing a preference for infecting different host species. Entomopathogenic nematodes (EPNs) are obligate insect parasites with a soil dwelling, free-living juvenile stage. Juveniles exhibit various host-seeking behaviors. For a successful infection, multiple nematodes must enter a host, overpower the insect immune system, mate and reproduce in the insect carcass. Three species of EPNs (*Steinernema costaricense*, *S. affine*, and *S. krausseii*) are found co-occurring in forest soils in south-central, Indiana. Prior work showed that environmental niche partitioning could not explain the coexistence of these EPN species. My work tests if a preference for different host species is contributing to their coexistence. Chemotaxis assays were conducted to measure the attractiveness of different host species from three different insect orders to each nematode species. Here I present the results of assays conducted with nematodes collected from two different study sites. I also describe assays planned to assess how differences in chemotaxis relate to infection and reproductive success of each nematode species.

7 RISK ASSESSMENT GUIDES NEST DEFENSE BEHAVIORS IN FEMALE HOUSE WRENS (*TROGLODYTES AEDON AEDON*)

Fornara JH¹, Eggleston RC², and Reichard DG²

¹Department of Biology, Indiana University; ²Department of Biological Sciences, Ohio Wesleyan University

Predation is a critical threat to most animals, but altricial young that rely on their parents for protection are especially vulnerable. According to parental investment theory, parents that modulate their anti-predator responses based on the level of risk should have higher lifetime fitness than individuals that respond to all threats equally. House wrens (*Troglodytes aedon aedon*) are cavity-nesting songbirds that exhibit substantial variation in aggression towards nest predators. Here, we investigated the role of risk assessment in modulating defense behaviors by presenting nesting female house wrens with three predator decoys of varying risk levels and analyzed their anti-predator responses. Eastern chipmunk (*Tamias striatus*) and eastern ratsnake (*Pantherophis alleghaniensis*) decoys simulated nest predators that are “low-risk” to adult wrens. A Cooper’s hawk (*Accipiter cooperi*) decoy simulated a “high-risk” predator for both nestlings and adults. In line with

parental investment theory, female wrens defended their nests with equal aggression against the chipmunk and snake decoys but never dove at or attacked the hawk decoy. Despite high inter-individual variation in aggression, we saw population-level consistency in responses to the snake decoy over a two-year period, suggesting stability over time. Our results show that female house wrens exhibit plasticity in their responses to nest predators, indicating that risk assessment plays a role in determining nest defense behaviors in a potentially adaptive way despite risking the loss of current offspring.

8 HEAD-BOBBING: WHAT CAN WE LEARN FROM A SINGLE ELEPHANT?

Fowler AR¹, Burns-Cusato M², White B², Taylor S³

¹Biology Program and ²Department of Behavioral Neuroscience, Centre College; ³Louisville Zoo

Stereotypic behaviors in captive animals can stem from many sources, including central nervous system dysfunction, anticipation of reinforcement, or issues related to well-being. When the Louisville Zoo observed their Asian elephant (*Elephas maximus*), Punch, engaging in stereotypic head bobbing, we were recruited to identify the source of this behavior so that any possible welfare issues could be addressed through management practices. Punch's behaviors were coded from over 400 hours of video recordings made while she was in an outdoor space during the summers of 2021, 2022, and 2023. Frequency of head bobbing was highest when Punch was housed separately from the two other members of the herd, decreased significantly when housed together with the herd, and did not appear to be affected by the death of a herd member. There was no difference in rate of head bobbing between days with and without food-based enrichment activities (e.g., reinforce walking along the yard perimeter). We acknowledge that a single-subject study has limitations. Though conclusions must be made with caution, the data from this study suggest that physical contact with elephant herd members can be more beneficial in reducing stereotypic head-bobbing than food-based enrichment.

9 SHORT-TERM MELATONIN INJECTIONS INFLUENCES ON DEFENSIVE AGGRESSION IN FEMALE SIBERIAN HAMSTERS (*PHODOPUS SUNGORUS*)

Greenwell D², Han A¹, Demas G¹

¹Department of Biology, Indiana University; ²Department of Biology, Saint Francis University

Organisms have physiological adaptations to increase fitness due to seasonal environmental changes such as photoperiod, temperature, and availability of food. These adaptations are primarily influenced by the surrounding endocrine systems which can cause numerous changes such as metabolism, immune responses, and social behavior. Melatonin (MEL) is a hormone secreted by the pineal gland located inside the brain and plays a critical role as the endocrine signal in seasonal changes. Our lab's previous research shows that when Siberian Hamsters (*Phodopus sungorus*) are housed in short-day photoperiods, or given timed MEL injections mimicking short days, they display increased aggression common in the non-breeding season. This raises the question: will those same behavioral changes be exhibited in a shorter injection period? The design of the study consists of a short two-week period and also a longer ten-week period of timed injections amongst three groups of hamsters. Two of the three groups were housed in a long-day photoperiod and one group was housed in a short-day photoperiod. All three groups were given timed injections that

consisted of MEL or saline (SAL) for two weeks. We used a resident intruder paradigm (RIP) and a novel environment paradigm (NEP) to measure defensive aggression. We then collected and weighed the female reproductive tissues to assess gonadal regression. Experimental data shows that there were no significant differences in the reproductive weights between the three groups. There were no significant differences in the latency to first attack, attack duration, or chase duration among the three groups. However, a significant difference in scent-marking behavior, with NEP displaying it more often than the RIP, all other behaviors were insignificant between the two paradigms. Collectively, this data suggest that two weeks of short days or melatonin treatment is insufficient to induce behavioral or reproductive changes.

10 UNDERSTANDING THE EVOLUTIONARY PUZZLE OF VARIATION IN MATERNAL CARE IN NORTH AMERICAN RED SQUIRRELS

Griffin EA¹, Boutin S³, Lane JE⁴, McAdam AG⁵, Dantzer B^{1,2}

¹*Department of Psychology and* ²*Department of Ecology and Evolutionary Biology, University of Michigan;* ³*Department of Biological Sciences, University of Alberta;* ⁴*Department of Biology, University of Saskatchewan;* ⁵*Department of Ecology and Evolutionary Biology, University of Colorado*

Balancing selection has been suggested to maintain phenotypic variation within populations, but few studies have examined its role in maintaining variation in parental care. Even more uncommon are studies that have investigated the causes and consequences of variation in maternal behavior in natural settings, rather than laboratory settings. Here, we tested the hypothesis that the phenotypic variation of maternal care in North American red squirrels (*Tamiasciurus hudsonicus*) is maintained because its fitness benefits vary according to the environment, where selection on maternal care fluctuates due to ecological variation. We conducted standardized nest disturbances in nursing female red squirrels in the Yukon, Canada. Juvenile squirrels were temporarily removed from their natal nest during which we recorded two proxies of maternal care behavior: if the mother returned to the nest containing her offspring and how long it took the mother to return to the nest. We then examined how these proxies of maternal care behaviors correlated with annual and lifetime reproductive success, as well as whether the association between maternal care and annual reproductive success depended upon ecological variables, including the number of nest predators, competitors, and resource availability. We predicted that squirrels who exhibited strong maternal care behavior would have higher annual reproductive success. However, we also predicted that the benefits of this behavior depend on ecological variables, such as individuals displaying increased maternal care in high predator years will tend to have higher reproductive success. We will share our preliminary findings testing the hypothesis that fluctuating selection is maintaining maternal care variation through analyses of life-history, behavioral, and environmental data.

11 CONSTRUCTING SOCIAL NICHE IN GOULDIAN FINCH (*CHLOEBIA GOULDIAE*) FLOCKS IS PREDOMINANTLY INFLUENCED BY FEMALES

Haag A, Kohn G

Department of Psychology, University of North Florida

The arrangement of animal collectives arises from and influences the dynamics of interactions among individuals. Studying animal social structure aims to grasp how creatures develop resilient social frameworks, or consistent interaction patterns that persist across time and group alterations. In this study, we examined social frameworks within mixed-age and mixed-sex flocks of Gouldian finches amidst shifting social dynamics. We observed social approaches, displays, and dominance behaviors, pinpointing interaction patterns. Group organization was characterized by sub-flocks formed through age and sex-based assortative mixing. Notably, female interaction preferences played a pivotal role in shaping social structure. Adult females predominantly engaged with other adult females, creating stable female sub-flocks, while juveniles tended to interact with siblings, forming juvenile sub-flocks. Despite fluctuations in group size and composition, flocks maintained stable interaction networks, suggesting individuals preserved their specific interaction patterns. These findings underscore Gouldian finches' capacity to construct resilient social structures in captivity, with females significantly influencing higher levels of organization through their selective interaction choices.

12 LONG-TERM MELATONIN ADMINISTRATION INDUCES A SEASONAL SWITCH IN DEFENSIVE AGGRESSION IN SIBERIAN HAMSTERS (*PHODOPUS SUNGORUS*)

Han Y, Demas GE

Department of Biology, Indiana University

Many animals display seasonal changes in physiology and behavior. Research from our lab suggests that the pineal hormone melatonin (MEL), the key cue encoding photoperiod, acts through steroid hormones to regulate seasonal aggression in Siberian hamsters (*Phodopus sungorus*). Our lab has identified the role of the adrenal hormone dehydroepiandrosterone (DHEA) in regulating territorial aggression in both sexes and proposed the Seasonal Switch hypothesis to describe the potential neuroendocrine mechanisms underlying a shift from gonadal to adrenal regulation of agonistic behaviors. Here, we test the hypothesis that MEL influences seasonal aggression and explore the associated neuroendocrine mechanisms underlying the seasonal switch. To test our hypothesis, we housed adult females and males in long- (LD) or short-day (SD) photoperiods, administering daily timed MEL or saline two hours before dark for either two or ten weeks. We used resident intruder and neutral cage tests to assess defensive and offensive aggression. We hypothesized that long-term MEL and SD hamsters would experience physiological and behavioral changes. Blood samples were collected pre- and post-behavioral tests. Fixed brains were collected and are currently being examined for immediate early gene expression to assess changes in neural activation in response to aggression. We found that SD and long-term MEL inhibited reproduction and increased defensive aggression in both sexes. However, the seasonal switch in aggression was not consistent with offensive aggression, suggesting that the neuroendocrine mechanisms regulating aggression appear specific to territoriality. Besides, we found support for the 'challenge hypothesis' as DHEA levels were increased after agonistic behavior in long-term treated animals. Our findings demonstrate the importance of MEL in

the seasonal switch in defensive aggression and highlight neural mechanisms underlying seasonal aggression in both sexes.

**13 INVESTIGATING RECEPTIVE AND PRODUCTIVE SYMBOL USE IN RHESUS MACAQUES
(*MACACA MULATTA*)**

Jackson BN, Sanchez A, Church BA, Smith JD

Department of Psychology and Language Research Center, Georgia State University

Relational conceptualization is an important cognitive ability that has been of interest to cognitive, developmental, and comparative psychologists (e.g., Smith & Church, 2021). Relational tasks require abstraction beyond the perceptual cues of the stimuli and are thought to require higher-order cognition. Decades of research has shown that human adults are very good at relational tasks and apes (at least symbol-trained apes) have clear relational conceptualization. However, research has shown that monkeys' abilities are less developed (for review, see Smith et al., 2021). The role of symbols in the observed cognitive differences among various human age groups and between human and non-human primates remains unclear. Across two studies, we aim to bridge this gap. In one experiment, we are examining whether rhesus macaques (*Macaca mulatta*) can use symbols to declare the type of dimensional match, color, or shape, that is present (productive use). In a second experiment, we are investigating whether rhesus macaques can transfer their performance to take instruction from a symbol to choose a match (receptive use). Currently, two macaques have finished both experiments and show bidirectional usage of the symbols.

**14 DOING WHAT YOUR NEIGHBOURS DO: FINDING EVIDENCE OF SOCIAL INTERACTION
WITHIN AN EGG CLUTCH USING NETWORK-BASED DIFFUSION MODELS.**

Johnson J¹, Hasenjager M², Ward J¹

¹Department of Biology, Ball State University; ²National Institute of Mathematical and Biological Synthesis, University of Tennessee Knoxville

Social interactions are omnipresent in group-living animals, and they serve various roles in animal communication. Although conspecific social interactions have mostly been studied in the juvenile and adult phases of animals, growing evidence suggests that individuals may also communicate with others during the embryo or the egg stage. Studies in birds, insects, reptiles, fish, and crustaceans have shown that embryos interact with sibling embryos and/or parents for diverse functions, including synchronized hatching, hatching assistance, and alerting to the presence of a predator. However, although evidence of embryonic communication is commonly observed, the sensory mechanisms that facilitate the transfer of information and understanding how that information flows across a clutch are often unknown. In this study, we are using simulated predator attacks on clutches of fathead minnow (*Pimephales promelas*) embryos and network-based diffusion modeling to investigate whether disturbance to one embryo influences behaviour patterns in adjacent embryos, and the extent to which that information is socially propagated through the egg clutch. Our pilot data suggest that a localized disturbance to a single focal egg (e.g., a predatory attack) may be transmitted through at least three eggs in physical contact with the focal embryo, and suggests a role for mechanosensory mechanisms of information transfer. This study also illustrates the various adaptive mechanisms favoured by embryos, given that the embryo stage is one of the most vulnerable stages of an animal's life.

15 A COMPARISON OF REPRODUCTIVE METRICS IN CAPTIVE AND WILD DARK-EYED JUNCOS

Kelson AS, Wanamaker SM, Ketterson ED

Department of Biology, Indiana University

Biodiversity is declining and the loss of birds is well documented. Three billion fewer birds are found in North America than 50 years ago owing to declines in productivity. Captive rearing is a conservation tool that might be used to combat losses, but it is notoriously difficult to breed songbirds in captivity due to the complexity of recreating natural reproductive cues in captive settings. However, few studies have directly compared breeding metrics between captive and wild passerines. We compared clutch size, hatch rate, and fledging success between captive and wild dark-eyed juncos (*Junco hyemalis*). Data was collected from captive dark-eyed juncos housed at Kent Farm aviary (Bloomington, IN) and from their wild counterparts at Mountain Lake (Pembroke, VA). Captive birds had significantly smaller clutches than wild birds, and the hatch rate of eggs laid in captivity was significantly lower than the hatch rate of eggs in wild nests. In captivity, nests that reached fledgling stage also fledged a smaller proportion of nestlings. Captive birds fared worse at each stage of the nesting process. We suggest that high population density in captivity may trigger increased territorial aggression and nest interference. Real or perceived dietary insufficiencies in captivity may also contribute to poor egg quality and low hatch rates, and could lead to partial or full brood loss due to brood reduction and starvation.

16 EXAMINING THE NEUROBIOLOGICAL AND BEHAVIORAL EFFECTS OF NEURONAL DDIT4 OVEREXPRESSION IN THE MEDIAL PREFRONTAL CORTEX OF MICE

Kuhn AM¹, Bosis KE², Jerow L², Larke Vollmer L¹, Bollinger JL¹, Wohleb ES¹

¹Department of Pharmacology & Systems Physiology and ²Neuroscience Graduate Program, University of Cincinnati

Chronic stress exposure leads to molecular changes that induce structural remodeling and synapse loss on pyramidal neurons in the prefrontal cortex (PFC), and this contributes to behavioral deficits and working memory impairments. One of the primary mediators of these molecular and cellular adaptations is glucocorticoid receptor signaling, which regulates expression of specific genes including DNA Damage-Inducible Transcript 4 (Ddit4, aka Redd1). Prior studies demonstrate that chronic stress increases Ddit4 levels in the PFC. Our recent work indicates that microglia contribute to neuronal remodeling and synapse loss in chronic stress. In this context, we aimed to test the hypothesis that Ddit4 expression in neurons engages neuroimmune interactions and this leads to behavioral consequences. For these studies we bilaterally infused AAV5-hSyn1-Ddit4-tdTomato or a control vector into the medial PFC of male C57BL/6 mice and examined several molecular, cellular, and behavioral endpoints. Initial RT-PCR confirmed that the adeno-associated virus (AAV) caused robust expression of Ddit4 (Ddit4-OV) transcript in the PFC. Mice were then assessed for behavioral changes using the forced swim test (FST) and temporal object recognition (TOR) test to assess passive stress-coping and working memory. Mice with Ddit4-OV did not show any change in FST immobility, but there was a decrease in the discrimination index during TOR. Further RNA-seq analyses revealed that Ddit4-OV caused differential expression of 378 genes in the PFC. Immunohistology in Thy1-GFP(M) mice showed an increase in microglial density and nearest neighbor distance (NND) within Ddit4-

OV mice compared with controls. Interestingly, initial analysis of dendritic spine density suggests a decrease in Ddit4-OV mice compared with controls. Altogether, these results indicate that neuronal Ddit4 over-expression recapitulates some of the cellular and behavioral deficits observed following chronic stress.

17 EFFECTS OF BROODING STATUS ON LIPID PEROXIDATION AND MITOCHONDRIAL FUNCTION IN A MOUTHBROODING AFRICAN CICHLID FISH

Mitchell H¹, Dolben E², Buzinski O¹, Dijkstra PD¹

¹*Department of Biology, Central Michigan University;* ²*School of Biological Sciences, University of Manchester*

Reproduction is well-known as one of the most physiologically demanding life-history events. The existing 'oxidative cost of reproduction hypothesis' asserts that the physiological cost of reproduction leads to the production of excess reactive oxygen species (ROS), leading to oxidative damage to the individual and a resulting decline in longevity or future reproductive capacity. However, it has been suggested that perhaps different mechanisms are more important to physiological well-being and future fitness levels, necessitating a shift away from examining the oxidative cost of reproduction in isolation to a more complete examination of the physiological costs of this important life-history event. Mitochondria are a key component of ATP production and ROS formation, and measuring mitochondrial performance along with oxidative damage could result in a more complete picture of the physiological costs of reproduction. The African cichlid fish *Astatotilapia burtoni* is a commonly used model organism that exhibits complex, well-defined social behavior including extensive parental care. For instance, females carry developing embryos in their mouths for up to 4 weeks after spawning, and are subsequently unable to forage for food. Female *A. burtoni* also develop eggs while not engaging in this mouthbrooding behavior. Our experiment found evidence for variability in mitochondrial respiratory capacity in female mouthbrooding *A. burtoni*. We also found that mitochondrial efficiency was linked to oxidative damage (specifically lipid peroxidation), and that this effect depended upon brooding status. Our results show that oxidative stress levels alone do not give a complete picture of the physiological consequences of reproduction, and offer plausible evidence that mitochondrial function is also a key driver in the physiological processes related to reproductive function.

18 MICROGLIAL NR3C1 DEPLETION ALTERS STRESS EFFECTS ON SYNAPTIC DENSITY AND BEHAVIOR IN A SEX-DEPENDENT MANNER

Mueller E¹, Vollmer LL¹, Bollinger JL¹, Salazar Gonzalez RM², Robinson JE², Wohleb ES¹

¹*Department of Pharmacology & Systems Physiology, University of Cincinnati*

²*Division of Experimental Hematology & Cancer Biology, Cincinnati Children's Hospital Medical Center*

Several studies show that chronic stress influences neuron-microglia interactions in the prefrontal cortex (PFC) in a sex-specific manner, leading to divergent effects on synaptic plasticity and behavior. In particular, male, but not female, mice display cognitive impairment and a reduction of synapses in the PFC after 14 days of chronic unpredictable stress (CUS). Prior studies using pharmacological and broad genetic manipulations demonstrate that glucocorticoid receptor (GR; Nr3c1) signaling is necessary for stress-

induced synapse loss in the PFC and associated behavioral consequences. Despite this, the cell type-specific role of GR signaling in the neurobiology of stress and how this pathway contributes to sex differences in stress responses have not been explored. In this study, male and female mice with inducible microglia-specific depletion of GR ($Cx3cr1^{CreER/+};Nr3c1^{fl/fl}$) and their genotype controls ($Cx3cr1^{CreER/+};Nr3c1^{+/+}$) were used to determine the role of microglial GR signaling in stress-induced synapse loss in the PFC and the associated behavioral consequences. As expected, male mice showed microglia-mediated neuronal remodeling and impaired working memory following CUS exposure, but these endpoints were not affected by microglial *Nr3c1* depletion. In contrast, microglial *Nr3c1* depletion in female mice led to increased microglial phagocytosis of neuronal elements in the PFC and reduced discrimination in the temporal object recognition following CUS exposure. In conclusion, these findings suggest that microglial GR signaling plays a vital role in regulating the response to chronic stress, with female mice being more susceptible to stress when this regulation is disrupted. Further studies are necessary to determine the exact mechanisms underlying these effects and their potential relevance to human stress responses and microglial regulation.

19 INNOVATION AND DIVERSIFICATION OF AND THROUGH SEXUAL DIMORPHISM: INSIGHTS FROM HORNED BEETLES

Nadolski EM, Moczek AP

Department of Biology, Indiana University

Sexual dimorphism represents one of the most significant dimensions of intraspecific variation, with the potential to constrain or facilitate the diversification of novel traits and functions. Yet, rather than exhibiting equal sexual dimorphism across all traits, organisms are mosaics of tissues that vary in the degree to which they exhibit dimorphism. While the fitness relevance of sex-dependent development is often well characterized, the genetic and developmental mechanisms underlying sexual dimorphism and its evolution are not. Closely related horned beetle species in the tribe *Onthophagini* possess an array of dimorphic traits that are ecologically relevant and employed in suites of sex-specific behavior. My work assesses the regulatory mechanisms that instruct sex-biased development along two critical axes of diversification: divergence across different body regions and macro-evolutionary divergences across species, with the ultimate goal of identifying genomic mechanisms by which sexual dimorphisms originate and diversify. Among others, I aim to test the hypotheses that (i) evolutionary elaboration of sexual dimorphism is made possible through the rapid acquisition of novel cis-regulatory elements and/or the elaboration of sex- and trait-specific transcriptomes, and (ii) that the evolution of novel secondary sexual traits is facilitated by the evolution of novel regulatory interactions, rather than the re-use of preexisting regulatory machinery. I discuss my results in light of fundamental questions regarding gene regulatory network evolution: are the networks that instruct the formation of a trait the same as those that facilitate its diversification, or is context-responsiveness decoupled from trait formation in development and evolution?

20 POTENTIAL CHEMICAL REPRODUCTIVE COMMUNICATION IN BABOONS

Neufell T¹, Nonnamaker L¹, Lightcap I², Archie B¹

¹*Department of Biological Sciences and* ²*Center for Sustainable Energy, University of Notre Dame*

Reproductive communication is essential to nearly every animal's fitness. Within primates, studies on reproductive signaling typically focus on visual (e.g. sex skin swellings) or vocal (e.g. copulation calls) cues and signals. However, in yellow baboons (*Papio cynocephalus*), when visual cues are unreliable, males continue to identify fertile females, suggesting that females use other modes of communication to signal fertility. Given that catarrhine primates were previously considered to have a poor sense of smell, olfactory reproductive communication is severely understudied within primatology. In this study, we investigate olfactory reproductive communication through scent compounds from olive baboon (*Papio anubis*) vaginal secretion. We used a thermal desorption approach followed by gas chromatography-mass spectrometry (GC-MS) to measure and compare the chemical compositions of fertile and non-fertile vaginal secretions. While we expected to find a difference in the abundance of compounds between fertile and non-fertile samples, no significant differences were detected but scent profiles were found to vary with each individual. To test if scent profiles among fertile and non-fertile females were biologically relevant, we conducted behavioral bioassay experiments on captive male olive baboons. We found no significant difference in male interaction time between boxes with fertile scents, non-fertile scents, and control blank scents. Instead, males spent significantly more time investigating the scents of specific females, suggesting olfactory communication could be used to strengthen a male's ability to routinely identify females and form long-lasting social bonds. To our knowledge, this is one of the first studies investigating the entire vaginal scent profile across the ovarian cycle using a thermal desorption approach. Understanding whether baboons use olfactory communication will provide us greater insight into primate reproductive communication.

21 COMPARATIVE PHYLOGENETIC ANALYSIS OF DUETTING AND OTHER LIFE HISTORY TRAITS IN THE AVIAN ORDER STRIGIFORMES

Nieves DR¹, Goldberg D¹, Araya-Salas M², Odom K³

¹*Department of Biology, Albion College;* ²*School of Biology, University of Costa Rica;*

³*Department of Biological Sciences, University of the Pacific*

This study is meant to analyze the relationship between vocal duetting behaviors and other aspects of life history across the avian order Strigiformes (the owls). Although anecdotal reports have described many species of owls that call in unison as mated pairs, behavioral correlations have never been attempted across owls to uncover the evolutionary associations of duetting. Owls are an ideal group for studying duets, as we hypothesized that these communal signals in owls are associated with a nocturnal lifestyle, densely vegetated habitats, long-term territoriality and social bonds, and a lack of white plumage patches (a visual signal for distant communication at night). We compiled a spreadsheet of species-specific information from Claus König and Friedhelm Weick's comprehensive 2008 book, *Owls of the World*, and from various academic journal articles across the published literature, which provided data on 63 well-studied owl species. We next ran a comparative phylogenetic analysis of duetting across this sample using R statistical software and

Bayesian multilevel models. Our expectation is that duetting owl species show similar life history traits to duetting songbirds: owls should duet to maintain pair bonds and defend territories year-round, and duetting should also be common in nonmigratory species that inhabit tropical latitudes and maintain home ranges over many years. A relationship between duetting and nocturnality, inversely correlated with conspicuous white plumage patches for visual signaling, would be a novel discovery among birds as well.

22 FREQUENCY OF AFFILIATIVE BEHAVIOR AMONG NON-ORPHANED AND ORPHANED AFRICAN SAVANNA ELEPHANTS *LOXODONTA AFRICANA*

Resonno Jr S¹, Chusyd DE²

¹Department of Zoology, Southern Illinois University; ²Department of Environmental and Occupational Health, Indiana University

African savanna elephants *Loxodonta africana* live in families composed of related adult females and their offspring. Older elephants provide guidance for the younger elephants allowing them to receive proper socialization. Due to poaching, culls, and human-elephant conflict, many young elephants are orphaned and thus do not receive the social guidance from the species' traditional herd composition (i.e., grandmother, mother, older cousins, and siblings). Therefore, this study aimed to investigate whether orphaned elephants, compared to non-orphaned elephants, display a similar frequency of affiliative behaviors. Videos of orphaned and non-orphaned elephants were watched, and the behavior of the focal elephant was documented every five seconds. Affiliative behavior was defined as when the focal elephant rubbed their body against, rested their head on, intertwined their trunk with, or put their trunk to another elephant's mouth or body. The age class and sex of the focal elephant were documented and efforts were made to match the sex and age class of non-orphaned to orphaned elephants. Age classes were defined as infants (0-4 years), juveniles (5-8 years), and subadults (9-15 years). The amount of times the focal elephant displayed affiliative behavior would be divided by the time they were observed out of an hour leaving you with the rate of affiliative behavior. A total of 54 elephants were used, 35 of which were non-orphaned elephants and 19 as orphaned elephants. Non-orphaned elephants showed greater frequency of affiliative behavior per hour compared to orphaned elephants in this population ($P=0.006$). These results support the importance of living in a traditional herd to foster social behaviors.

23 DIFFERENTIAL ANTIPREDATOR RESPONSES OF TWO-LINE SALAMANDER LARVAE TO TWO SPECIES OF PREDATORY CRAYFISH

Ronk S, Winn CM, Betzner J, Gall BG

Department of Biology, Hanover College

Two-lined salamander (*Eurycea cirrigera*) larvae are an important prey species for several species of stream-dwelling crayfish. Rusty crayfish (*Faxonius rusticus*) and Cavespring crayfish (*Cambarus tenebrosus*) have both been observed consuming larvae, with Cavespring crayfish serving as a more aggressive predator. We conducted a study to test the flight initiation distance of two-lined salamander larvae in response to the physical approach of Rusty crayfish and Cavespring crayfish. Larvae were placed inside a linear raceway and a live crayfish was slowly coaxed toward the larvae. The number of flights and the distance of each flight were recorded, as well as the distance from the crayfish when

the larvae first initiated flight. A larvae's flight initiation distance (distance between predator and prey when they fled) was not different in response to the two species of crayfish. However, the length of the initial flight and the average distance of all flights were significantly longer when exposed to the Cavespring crayfish relative to Rusty crayfish. Neither crayfish or larvae size appeared to influence flight initiation distance, flight distance, or number of flights. These results indicate that two-lined salamander larvae are capable of distinguishing between these predators and respond with more intense antipredator behaviors when exposed to the more prominent threat.

24 POTENTIAL INFLUENCES OF ANTI-AGING SUPPLEMENTS ON NEONATAL BEHAVIORS IN *RATTUS NORVEGICUS*

Ruby H, Willing J

Department of Psychology, Bowling Green State University

Disorders due to cognitive aging are of continuous concern, resulting in the development of multiple "anti-aging" supplements. Two examples of these "anti-aging" supplements are nicotinamide mononucleotide (NMN) and resveratrol. Previous studies observed that, in animal models, both NMN and resveratrol slowed the cognitive aging process through a reduction in apoptotic cell death. However, these supplements are continuously marketed as beneficial for general brain health, which creates a diverse population of consumers. This population may include pregnant mothers, which raises concerns as apoptosis during early embryonic and postnatal development is critical in optimizing neural circuits. In the present study, we exposed Long Evans dams to NMN alone, resveratrol alone, or a combination of NMN and resveratrol. Exposure continued throughout gestation until P10. Pups underwent neonatal behavioral testing on P5, P7, and P10, which included observations of rooting, righting, cliff-aversive, and crawling behaviors. These tests reflect sensory motor development as the cerebral cortex gains control over brain stem reflexes. Following behavioral testing, neonatal brain tissue was collected from two subjects per litter on P12. Additional behavioral testing occurred at P80 to assess any long-lasting effects on anxiety and cognitive abilities. Maternal behavior, body weight, and reproductive success were also observed throughout our study. Although data collection is still ongoing, preliminary analyses suggest that maternal exposure to NMN and Resveratrol may affect P7 crawling behaviors in offspring. Information gathered from our results may provide a better understanding of how these "anti-aging" supplements affect the mechanisms of neurodegenerative disorders and may influence future research models investigating neurodevelopmental disorders.

25 EFFECTS OF LARVAL DIET AND DENSITY ON BRAIN MORPHOLOGY AND GENE EXPRESSION PLASTICITY IN *SPEA BOMBIFRONS*

Sequeira A¹, Ledón-Rettig C², Lagon S³, Nesta D²

¹Department of Psychology, Tufts University; ²Department of Biology, Indiana University Bloomington; ³CDC National Center of Environmental Health

Brain morphology is well known to be influenced by environmental stimuli, through a phenomenon known as plasticity. However, little is known about how various diet types and social environments interact to impact larval brain morphology. In order to study this, a two-way factorial experiment was performed with *Spea bombifrons*, in which tadpoles were

given either a live prey diet or a detritus diet, and either a high or low social density. Tadpoles were raised for 12 days, after which brains were dissected, imaged, and measured to obtain volumes of the following regions: telencephalon, diencephalon, optic tecta, cerebellum, and hypothalamus. A gene expression assay was performed on whole brains, using BDNF (brain-derived neurotrophic factor) primers and qPCR to assess whether larval environments impact neurological gene expression. We found that diet significantly impacted whole brain volume and individual brain regions, but tradeoffs between brain regions were not found. Social density did not affect brain volumes, except for marginally within the optic tecta. qPCR found no significant differences in gene expression across groups, indicating that BDNF levels are not largely impacted by diet and social environment. We postulate this has to do with the role of BDNF in neuronal upkeep—it is favorable for the protein to function in a wide range of environments to maintain the function and survival of the larvae. Morphometric results indicate that diet significantly impacts brain size as a whole rather than individual brain regions, whereas social density may selectively impact optic tecta size.

26 REPLAY OF INCIDENTALLY ENCODED NOVEL ODORS IN THE RAT

Sheridan C¹, Bonner L^{1,2}, Crystal JD¹

¹*Department of Psychological and Brain Sciences, Indiana University;* ²*Department of Cognitive, Linguistic, and Psychological Sciences, Brown University*

Although events are not always known to be important when they occur, people can remember details about such incidentally encoded information using episodic memory. Previously, Sheridan et al. (2024, *Current Biology*) argued that rats replayed episodic memories of incidentally encoded information in an unexpected assessment of memory. In one task, rats reported the third-last item in an explicitly encoded list of trial-unique odors. In a second task, rats foraged in a radial maze in the absence of odors. On a critical test, rats foraged in the radial maze, but scented lids covered the food. Next, memory of the third-last odor was assessed. All rats correctly answered the unexpected question after 0- and 15-minute delays. Because the odors used in the critical test were the same as those used during training, it is possible that the rats automatically encoded odors for the purpose taking an upcoming test of memory (stimulus generalization) instead of replaying incidentally encoded episodic memories. Here, we provided an opportunity for incidental encoding of novel odors to eliminate the possibility that familiarity with previously trained odors could contribute to successfully answering the unexpected question. Previously trained rats foraged in the radial maze with entirely novel odors covering the food. Next, memory of the third-last odor was assessed. All participating rats correctly answered the unexpected question. High accuracy when confronted with novel odors provides evidence that the rats did not automatically encoding odors for the purpose of taking an upcoming test, ruling out stimulus generalization. The observation that rats replay episodic memories of completely novel incidentally encoded odors in an unexpected assessment of memory suggests that rats encode multiple pieces of putatively unimportant information, and later replayed a stream of episodic memories when that information was needed to solve an unexpected problem.

27 COMPARING NATURAL AND DRUG REWARD SENSITIVITY IN NON-FOOD RESTRICTED RAT MODEL

Shultz E, Thompson K, Cromwell HC

Department of Psychology, Bowling Green State University

Shared reward pathways in the brain unveil the potential for the development of dependence on a variety of substances, including commonly recognized drugs of abuse and, more insidiously, sugar. Sugar overconsumption has been associated with compulsivity and impulsivity repetitive behaviors which are predictors of later substance abuse. Furthermore, previous research has shown that rats can develop symptoms mirroring addiction such as binging, craving, tolerance, and withdrawal in response to sugar alone. Motivation research has indicated that impaired reward relativity is a key component of vulnerability to addiction. The ability of an animal to discriminate between differing levels of rewards for the amount of work exerted to receive that reward may predict later addictive behavior to a variety of substances. This project examines the appetitive and consummatory behavior of female Wistar rats in self-administration tasks of sucrose and ethanol solutions. The rats have ad-libitum access to food and water. Relative reward effects are evaluated by using trials that differ in time of access to the reward (20sec vs. 10sec vs. 5sec). Volume of solution consumed, nosepoke latencies, and lick rate have been evaluated. Future data will be analyzed to examine relative reward effects and to determine if previous behavior in response to sucrose has predictive potential of later response to alcohol. The incentive contrast paradigm being used in this project will allow a closer examination of the motivational processes shared by alcohol and sugar that could result in addiction. Using natural reward sensitivity to predict future addiction could aid significantly in preventing and treating substance use disorders.

28 EFFECT OF HEAT STRESS ON ZEBRA FINCH COMMUNICATION

Smith T, Empson T, Derryberry E

Department of Ecology and Evolutionary Biology, University of Tennessee Knoxville

As global temperatures continue to rise due to climate change, it is imperative to understand how these rising temperatures will impact songbird reproductive behavior, such as in zebra finches (*Taeniopygia castanotis*). Previous research indicates that in hotter temperatures, male zebra finches sing less. However, at which temperature this change occurs is yet to be determined. Here, we aim to understand how heat stress behaviors correlate with changes in number of songs and song duration. Using a within-subjects design, we measured song production at various temperatures. We predicted that male performance would vary in temperature yet tend to decline at around 40°C. Overall, this study will provide insight into how increasing global temperatures could alter zebra finch communication and mating success.

29 FEAR FACTOR: HOW EMBRYONIC EXPOSURE TO CONSPECIFIC ALARM CUES IMPACTS BEHAVIOR AND DEVELOPMENT IN *PIMEPHALES PROMELAS*

Steinberg K, Ward J

Department of Biology, Ball State University

Chemical alarm cues secreted by aquatic organisms alert conspecifics to the presence of a nearby predatory attack. Most research to date has focused on how animals learn and

respond to these olfactory stimuli at the adult and larval stages. However, limited research suggests that embryos can also perceive and respond to these cues. Furthermore, embryos may be able to distinguish between cues indicative of different levels of predation risk, such as those that signal an attack on eggs vs an attack on an adult conspecific. To gain a better understanding of the ability of aquatic embryos to perceive, discriminate, and respond to olfactory cues from conspecifics at different life stages, we exposed fathead minnow (*Pimephales promelas*) embryos on days 3, 4, and 5 post-fertilization to alarm cues generated from either adult or embryonic conspecifics, and observed embryonic spontaneous locomotor activity inside the egg. Our goals were to determine (i) whether embryos differentiate between an adult vs an embryonic alarm cue; and (ii) the stage of development at which embryos first respond to the cues. Preliminary data suggest that embryonic activity levels generally decrease over development, and that embryos perceive and respond differently to alarm cues from conspecifics at different ontogenetic stages as early as 3 days post-fertilization. Furthermore, embryos appear to be able to distinguish between adult and embryonic olfactory cues. The ability to differentiate and respond to chemical cues would suggest that embryos are more cognitively sophisticated than previously thought.

30 MATERNAL DEFENSE STRATEGIES: INVESTIGATING FEMALE AGGRESSION IN DYEING POISON FROG, *DENDROBATES TINCTORIUS*

Strohmeier IR, Westrick SE, Fischer EK

School of Integrative Biology, University of Illinois Urbana-Champaign

Despite common bias toward thinking of mothers as gentle caregivers, they often display increased aggressive behavior as an important part of parental care. Yet the mechanisms underlying aggression are much less studied and understood in females than males. This is partially due to a historical bias of considering testosterone, a common driver of aggression, to be a 'male' hormone. In dyeing poison frogs *Dendrobates tinctorius*, the male is typically the sole caregiver to the eggs and young tadpoles, while the female is the more aggressive sex and defends her territory from competing females. To understand the role of social and breeding context on female aggression, we conducted intrusion experiments in home tanks of breeding pairs using within-individual comparisons in a two-by-two design (male partner present or absent, eggs present or absent). We measured testosterone levels before and after intrusion trials to investigate whether female testosterone correlated with aggression. We found that females were most aggressive to intruders when eggs were present and their male breeding partner was absent. We also found that females with eggs had higher testosterone levels than females without eggs, and the relationship between aggression and testosterone varied with context. Using *D. tinctorius* as a model system, we can further understand the physiological and behavioral mediators of maternal aggression.

31 ARTIFICIAL LIGHT AT NIGHT AND PARASITE LOADS IN THE DARK-EYED JUNCO (*JUNCO HYEMALIS*)

Tysver AM, Diedrich SS, Wanamaker SM, Talbott KM, Ketterson ED

Department of Biology, Indiana University Bloomington

As the human population continues to grow and urbanization increases, exposure to artificial light at night (ALAN) will continue to increase for many wildlife species. This poses

a large challenge for many species, including songbirds, that mediate various physiological processes and behaviors based on the light cycle. Disruption of these body processes can have consequences for the health, behavior, and fitness of an organism. Research has established that exposure to ALAN decreases melatonin production in songbirds, which has broader implications for immune function and regulation, and may also alter the gut microbiome of these birds. Given these significant effects, it is likely that prolonged ALAN exposure may also alter other aspects, such as the gastrointestinal parasite community in these birds. We exposed a subset of our birds to constant dim ALAN for 7 weeks, while others experienced a natural photoperiod, and quantified the amount of coccidia, a common gastrointestinal parasite found in these birds, throughout the experiment to test whether exposure to ALAN alters the population of these parasites within their host. Results will point toward the relationship between coccidia load in the gastrointestinal tract and exposure to ALAN, with potential implications for the health of songbirds with increasing urbanization.

32 UNRAVELING THE NET: EXPLORING THE IMPACT OF SOCIAL REGROUPING ON BEHAVIOR AND PERINEURONAL NET DEVELOPMENT, A MARKER OF NEUROPLASTICITY

Varman S, Coutellier L

Department of Psychology, The Ohio State University

Social isolation during early development can lead to abnormal behavior in adult mice, encompassing deficits in exploratory behavior, social interaction, and cognitive performance. On the cellular level, recent findings show that social isolation negatively affects the maturation of perineuronal nets (PNNs), a condensed form of the brain's extracellular matrix. PNNs are theorized to be markers for neuroplasticity, and their irregular formation is associated with behavioral deficits reminiscent of those observed after social isolation.

Previous studies notably demonstrate that social regrouping following early social isolation can improve the aforementioned behavioral deficits, but the underlying mechanisms are unknown. This study aims to establish PNNs as a cellular component positively impacted by social regrouping in the prefrontal cortex (PFC). We hypothesize that socially regrouping mice during adolescence following early childhood social isolation will lead to behavioral rescue, associated with the restoration of PNNs in the PFC.

Our experimental approach started with pseudo-randomly separating mice into 3 experimental groups after weaning on PD21. These groups include: (1) group-housed from PD21 to completion of data collection at PD67; (2) single-housed from PD21 to PD67; and (3) single-housed from PD21 to PD44, and socially regrouped from PD44 to PD67. The emergence of behavioral deficits among groups was measured with four behavioral tests, including Open field (OF), Novel Object Recognition (NOR), Y-maze, and social interaction. Following behaviors, brains were collected to count PNNs in the PFC. Initial analysis of the NOR and Y-maze tests reveals no significant differences between experimental groups. Ongoing analyses focus on social interactions and counting PNN numbers and densities. Finding social regrouping to positively affect PNN development in the PFC will support PNNs as a potential therapeutic target for mitigating behavioral deficits.

33 THE EFFECT OF ANTHROPOGENIC ACTIVITY & VARIATION IN BODY CONDITION ON MATERNAL BEHAVIOR IN *MACACA FASCICULARIS*

Velarde Chong AS¹, Coggeshall E²

¹*Department of Wildlife, Cal Poly Humboldt*; ²*Department of Anthropology, Indiana University Bloomington*

Human driven environmental change has increased encounters with free roaming animals, which has resulted in anthropogenic presence and activity inadvertently affecting surrounding life. Long-tailed macaques (*Macaca fascicularis*), the focus of this study, are one of the most widely distributed primate species across the globe and consequentially experience high exposure to anthropogenic presence. This study aims to investigate the effect of anthropogenic activity and variation in body condition on maternal behavior in the long-tailed macaques. Data was collected in 2019 via video footage in the northeastern Amnat Charoen Province of Thailand within a Buddhist monastery forest which is home to ~1000 free-ranging macaques. Behavioral data was collected from 10-minute focal follows of mother-infant dyads. Body condition scores were determined using a novel body condition scale that was created based on this population and is scored from 1 to 5. We found that individuals who were scored as group 3 with optimum body condition, as well as individuals that were exposed to a medium range of anthropogenic activity had significantly higher time engaging in cling carriage, infant on nipple, proximity to infant, restraining infant, touching infant, and infant on ventrum behaviors. Our results lead us to believe that primates living in anthropogenic landscapes are highly susceptible to body condition changes, which can disrupt individual growth, diet, and behavior— subsequently impacting their offspring's behavior and physiology. This population and investigation offers insight into how individuals adapt in human centered environments and highlights the positive and negative behavioral and physiological tradeoffs that are made to survive. It is crucial to study the ways in which human populations are interacting with and affecting the biosphere in order to maintain stable populations and environments.

34 THE EFFECT OF SEX AND MATING STATUS ON METABOLIC ACTIVITY AND RESOURCE ALLOCATION IN *G. VOCALIS* CRICKETS

Von Deylen MF¹, Muñoz-Garcia A², Gershman SN³

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

²*Department of Evolution, Ecology, and Organismal Biology, The Ohio State University at Mansfield*; ³*Department of Evolution, Ecology, and Organismal Biology, The Ohio State University at Marion*

All living organisms must allocate resources between individual growth, maintenance, and reproduction. Males and females differ, however, in their strategies to increase fitness. Since sex, success in attracting mates, and reproductive output can influence the life history of a particular individual, there should be a relationship between these traits, metabolic rate, and mass. I will be presenting the preliminary results of a study in which we examine the effect of mating status and sex on resource allocation to morphological traits (body mass, gonadal mass, gut mass) and metabolic rate. We hypothesize that resource allocation patterns will be different based on sex and success in mating. We predict that mated females will increase metabolic rate, invest more in reproductive organs, and invest less in non-reproductive organs, as compared to unmated females. Conversely, we predict a lesser

effect of mating status on male reproductive organ mass, metabolic rate, or total body mass when compared to females. This study will help us discern the physiological limits to the evolution of traits that drive fitness in crickets.

35 THE EFFECTS OF MICROBIAL SYMBIOTES ON ENTOMOPATHOGENIC NEMATODES

Weston S¹, Familo M², Bashey-Visser F²

¹Department of Biology, Truman State University; ²Department of Biology, Indiana University

Multiple species coexist and compete for resources with bacteria and their hosts in nature. The health and behavior of animals can be influenced by their symbiotic bacteria, which can be harmful or mutualistic. Depending on the genetics of the host and microbes, these relationships can change very quickly. One such organism is entomopathogenic nematodes, which have a co-evolved mutualistic relationship with the bacteria that live inside of them. These bacteria aid the nematodes in all aspects of life - competitively, nutritionally, behaviorally, and reproductively. The competition between other nematodes and bacteria strains occurs inside of their insect host. Our experiment looked at how much the bacteria, *Xenorhabdus*, affected the nutrition and behaviors of the nematodes, *Steinernema*, by placing different strains of nematodes and bacteria in the same environment (plate) together. As past literature suggests, the nutritional specificity between these nematode-bacteria pairs could allow them to exploit their host environment without aiding competing nematode-bacteria pairs. This was analyzed on a series of Lipid Agar plates acting as a nutrient-deficient environment for the nematodes.

We observed how entomopathogenic nematodes developed and behaved when encountering the bacteria of competing nematodes over the course of 10 days. Each day the plates were scored for developmental stage and any notable behavioral or physical changes. In total, 10 nematode stocks consisting of three species (*S. costaricense*, *S. kraussej*, and *S. affine*) were experimentally paired with 10 different strains of bacteria. We hypothesize that nematodes will do better on bacteria associated with their own species than of a different nematode species.

36 THE EFFECTS OF ECOLOGICALLY RELEVANT AND IRRELEVANT SOUNDS ON EARTHWORM BEHAVIOR IN AN OPEN FIELD ENVIRONMENT

Worthen B, Herb L, Arzola E, Burton A, Claflin D

Department of Psychology, Wright State University

The simplistic nervous system and behavioral repertoire of earthworms enable us to study basic stimulus-response relationships that serve as the foundation of higher-order learning. Catania et al. (2008) observed the effectiveness of two different subterranean sound stimuli in getting earthworms to emerge to the soil's surface. One sound was that of a natural predator, the mole, and the other was an "artificial" sound used to quickly bring large numbers of earthworms to the soil surface—a technique known as "worm grunting." We conducted a test similar to Catania's in order to study the difference in the behavior of earthworms in an open-field environment using the same sounds, presented for 14 s each. Each worm experienced both sound, half heard the grunting first and half heard the mole first. We monitored 9 possible behaviors but focus on the worms' freezing behavior here, this being a typical fear response in most animals. Results indicate that 100% of worms

presented with sound produced an observable response compared to only 42% of the control group which heard no sounds. The "worm grunting" sound elicited a response of freezing three times more often (75%) than did the mole sounds (25%), but freezing duration (when it occurred) did not appear to differ, averaging around 11 s. Beyond Catania's study, we are interested in further exploring whether earthworms exhibit differential behavioral responses to ecologically relevant stimuli, such as predator vs non-predator bird sounds, and whether there are certain specific features or frequencies of sounds that influence these responses.

37 LOST IN THE K-HOLE: USING THE PAVLOVIAN CONDITIONED APPROACH TO PREDICT PERFORMANCE IN A PROGRESSIVE RATIO SCHEDULE OF REINFORCEMENT UNDER SUBANESTHETIC KETAMINE IN SPRAGUE-DAWLEY RATS

Wright C, Muscott S, Akinbo-Jacobs O, Matuszewich L

Department of Psychology, Northern Illinois University

The Pavlovian Conditioned Approach (PCA) procedure is a valuable tool for characterizing addiction vulnerability. The PCA procedure draws out different patterns of conditioned responses through the repeated presentation of a conditioned stimulus (a lever), predictably followed by a response-independent unconditioned stimulus (a sucrose pellet). Throughout the course of PCA training, three behavioral phenotypes emerge: goal-trackers (GT) whose conditioned responses are primarily directed by unconditioned stimuli, intermediate responders (IR) for whom both cues have relatively equal salience, and sign-trackers (ST) whose conditioned responses are chiefly directed by conditioned stimuli. For ST, the cue alone becomes a powerfully salient motivator of behavior; the ST phenotype is associated with increased cue-induced reinstatement of drug seeking behavior. While these behavioral characterizations are useful for understanding how the incentive-motivational value of reward-related cues drives addiction-related behaviors, they do not directly measure drug-reinforcing efficacy. To better understand the reinforcing properties of subanesthetic ketamine, the present study evaluated the predictive power of PCA-identified phenotypes on performance in a progressive ratio schedule of reinforcement (PR). Forty-eight Sprague-Dawley rats, across four cohorts, first underwent five consecutive days of PCA training and were classified as STs, GTs, and IRs. Following PCA training, rats completed a PR schedule. In this schedule, the rat is required to press a lever a progressively increasing number of times to receive a reward; the highest ratio achieved is known as the breakpoint. Here, it was predicted that subanesthetic ketamine will result in lower breakpoints, suggesting a decrease in the incentive-motivational value of reward-related cues and further supporting ketamine's potential value in treating addiction. Full analyses will be presented in the conference poster.

38 EMBRYONIC ASSOCIATIVE LEARNING IN FATHEAD MINNOWS (*PIMEPHALES PROMELAS*)

Sodo L, Yake A, Ward J

Department of Biology, Ball State University

The ability of developing embryos to detect and learn to recognize external environmental cues is adaptive because it can improve survival after hatching. Previous research has shown that embryonic fish can learn to identify a potential predator via association with alarm cues from conspecific adults and show enhanced antipredator behaviors after

hatching. However, it is not known whether embryos can similarly learn to identify a predator based on association with cues indicative of attacks on eggs. In this study, we examined the responses of embryonic and larval fathead minnows, *Pimephales promelas*, exposed to various predation cues during the egg phase. Embryos were exposed to predator cue, egg alarm cue, a combination of predator and alarm cue (PAC), or control water for 5 days post fertilization (dpf). Activity levels of 5 dpf embryos were then tested in response to predator cue alone. After hatching, larvae were reared to 21 dpf and tested in two types of behavioral assays, open field and refugium trials, to assess perception of risk. We hypothesized that embryos reared in a more high-risk environments (Alarm and PAC treatments) would show higher activity levels at 21 dpf, suggestive of stress, and will be less likely to perform “risky” behaviors. Preliminary data suggests that PAC embryos show lower activity levels at 5 dpf in response to predator cue alone, suggesting that embryos can learn to recognize a predator based on egg clues alone.

39 A NEW BIO-LOGGING SYSTEM UNVEILS BEHAVIOR OF PRAIRIE VOLES IN SEMI-NATURAL FIELD ENCLOSURES

Zhang M^{1,2}, Gaidica M^{2,4}, Burkett J⁵, Dantzer B^{2,3}

¹School for Environment and Sustainability, ²Department of Psychology, and ³Department of Ecology & Evolutionary Biology, University of Michigan; ⁴Department of Neuroscience, Washington University; ⁵Department of Neurosciences, University of Toledo

Individual behavior variation is an intricate interplay between genetic and environmental factors, impacting individual fitness, population dynamics, and community interactions. The *shank3* gene, recognized as a monogenetic cause of a form of autism spectrum disorder in humans, has been primarily studied using a single inbred mouse species in laboratory settings. Prairie voles (*Microtus ochrogaster*), known for exhibiting social monogamy, offer an intriguing model for exploring the mechanistic causes of complex social behavior. While naturalistic environments help reveal complex behavior and lead to higher translational value, we leverage advancements in bio-logging to present a novel approach for studying the effects of *shank3* mutations on prairie vole social behavior in semi-natural settings. We placed wild-type and *shank3* mutant voles into four field enclosures, equipped them with self-developed proximity loggers (Juxta) and live-trapped them regularly. Based upon previous research, we expected that voles with the *shank3* mutation would exhibit reduced levels of social behavior. Preliminary findings indicate smaller home ranges for mutant voles compared to wild-type voles within the same sex category, with males having larger home ranges than females for both groups. Mutant voles weighed less than wild-type voles of the same sex. Additionally, mutant females tended to have a shorter lifespan than wild-type females while in the field enclosures. The use of proximity loggers, despite device loss and limited battery life, significantly increased the amount of interaction data collected, offering the potential of constructing social networks in secretive free-ranging small animals. Overcoming trade-offs in battery life, data resolution and device weight, along with improved deployment methods on animals and rigorous quantification of intra-logger bias and inter-logger variability, is crucial for achieving less biased and more comprehensive social networks.

40 AN EXAMINATION OF POSSIBLE SEX DIFFERENCES IN REWARD-PROBABILITY, FEATURE-BASED ASSOCIATIVE LEARNING IN HOMING PIGEONS (*COLUMBA LIVIA*)

Mullen A

Department of Social Science, Indiana University Southeast

The ability to predict and associate specific reinforcement outcomes with goals has been well-documented in homing pigeons (Zentall, 2017). Research has demonstrated that homing pigeons can form feature-based associations to acquire food resources in open-field environments (Colombo & Broadbent, 2000; Herold et al., 2015; Sizemore & Bingman, 2016; Sizemore et al, 2022; Coppola et al, 2014). In the current study, we investigated how pigeons associated color cues with specific probability-based reward sites. Specifically, we wanted to examine possible sex differences in learning the feature-based task. We hypothesized that males would be better at learning the task in comparison to females.