

POSTER PRESENTATION ABSTRACTS

2023 ANIMAL BEHAVIOR CONFERENCE

Organized alphabetically by presenter's last name. Numbers indicate poster numbers.

1 ESTROGEN AND PROGESTERONE CONCENTRATIONS PREDICT GUT MICROBIOME COMPOSITION THROUGHOUT REPRODUCTIVE STATES IN FEMALE BABOONS

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The mammalian gut microbiome is a complex microbial community whose dynamics affect host health and fitness. In mammals, gut microbial composition shifts across phases of female reproduction (ovarian cycling, pregnancy, and postpartum amenorrhea), but the details of these changes (e.g. what species are involved and how much they change) vary considerably across species and populations. Changes in the steroid hormones estrogen and progesterone may contribute to these dynamics, but the connections between female reproduction, hormone levels, and gut microbiome composition are poorly understood. We will address these gaps using data from the Amboseli Baboon Research Project, a long-term field project based in the Amboseli ecosystem in Kenya. Our dataset consists of 5,087 fecal-based, 16S rRNA microbiome profiles collected from 173 adult female baboons *Papio cynocephalus* over a ten year span. We also have data on fecal estrogen and progesterone concentrations for each profile measured via radioimmunoassay. Using mixed effects models, we will test how Shannon diversity, species richness, and the principal components of a microbiome community composition vary with estrogen and progesterone concentrations, both across all phases of reproduction and within each phase. Our study will be the first to use longitudinal sampling to test the relationships between hormones, microbiome composition, across reproductive states in wild female mammals. Our results will help improve our understanding of the connections between the gut microbiome composition, hormone regulation, and female reproduction.

2 EFFECT OF MU-OPIOID RECEPTOR KNOCK-OUT ON FEAR CONDITIONING, EXTINCTION, AND MORPHINE-ANALGESIA

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Our understanding of the biological mechanisms underlying fear, trauma, and the development of related disorders like post-traumatic stress disorder (PTSD) are incomplete. Thus, the search for players in the game continues. Among the brain regions identified as

exhibiting maladaptive changes/activity in PTSD, the amygdala appears to serve an important role in the acquisition and expression of fear. Within the amygdala, the basolateral nucleus (BLA) integrates sensory information, with the central nucleus (CeA) helping to initiate/regulate a subsequent behavioral response. Between the BLA and CeA lie a subset of GABAergic neurons known as the intercalated interneurons (ITCs). They serve to modulate signaling, primarily from the BLA to the CeA. The result of this is inhibition of the CeA via ITC activation by the BLA. These ITC neurons also express the inhibitory mu-opioid receptor (MOR) very densely, and thus are sensitive to both the endorphins/enkephalins and exogenous opioids. Importantly, ITCs appear to play a significant part in fear extinction. In this experiment, we sought to determine the role of ITC MORs in fear extinction. To do this, we utilized a Cre expression (Cre- or Cre+) dependent knockout (KO) of *Oprm1* from FoxP2-expressing neurons (e.g., ITCs). Our results show no effect of ITC MOR KO on contextual fear acquisition or extinction, implying ITC MORs are not necessary for fear extinction. However, there appears to be a sex difference in fear extinction such that females extinguish slower than males. A control experiment assessing morphine analgesia on the hotplate confirmed the knockout of MORs in Cre+ mice. Cre- mice given morphine displayed increased latency of escape from the hotplate, whereas Cre+ animals showed no evidence of morphine analgesia.

3 THE IMPACT OF AEROSOLIZED IRON OXIDE NANOPARTICLE EXPOSURE ON BEHAVIOR OF THE HOUSE SPARROW *PASSER DOMESTICUS*

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Increased urbanization poses a threat to avian viability due to the introduction of air pollutants. Metallic nanoparticles, a component of particulate matter air pollution, can invade the bloodstream and brain and alter personality, or an animal's set of repeated behaviors. Previous research has found decreased antipredator behavior—scanning, freezing, and fleeing—and decreased movement time as an effect of nanoparticle exposure. Observationally, urban birds demonstrate increased exploratory and risk-taking behavior. However, it is unclear if this is due to environmental demand or personality changes from air pollution exposure. This project examines the effects of iron oxide nanoparticle (IONP) exposure, as they are abundant in polluted areas like cities, on the personality of house sparrows *Passer domesticus*. This species occupies environments across the urbanization gradient, so it may serve as a sentinel species of the environmental impact of air pollution. Previously, we examined antipredator behavior and puzzle-solving capability and found no behavioral differences between exposed and control birds, so future work will reexamine antipredator behavior, as primarily measured by flight latency following an auditory disturbance, such as a predator call or car horn. We are also introducing a novel-environment foraging test in order to measure risk-taking, as measured by initial latency to forage, and exploratory behavior, as measured by total movement time and sites visited. We predict shorter latencies to flee following a disturbance for IONP exposed birds, indicating lowered antipredator responses. We also predict shorter latencies to forage and decreased movement time in IONP exposed, indicating high risk-taking but less exploration overall. Results may identify behaviors that are connected to urbanization

and increased air pollution, and how we can observationally measure certain behaviors to assess the relative threat of air pollution to an ecosystem.

4 EFFECTS OF ACUTE EARLY LIFE STRESS AND CRH₂ RECEPTOR ANTAGONISM ON FEAR ACQUISITION AND ANXIETY IN ADULT RATS

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After undergoing an early life stress (ELS) event, susceptibility to fear and anxiety-related disorders becomes more common. Posttraumatic stress disorder (PTSD) and generalized anxiety disorder are often precipitated by ELS experience and can negatively impact one's life and ability to function. An established reciprocal neural circuit between serotonergic neurons of the dorsal raphe nucleus (DRN) and neurons of the bed nucleus of the stria terminalis that synthesize and release corticotropin-releasing hormone (CRH) may be critical for the long-term impacts of ELS on subsequent responding to environmental threats. This study aimed to examine the effects of the CRH₂ receptor antagonist (antisauvagine-30; ASV-30) in the DRN on the acquisition of adult fear learning and anxiety following exposure to acute ELS. Using a 2 X 2 factorial design, the impacts of ELS and DRN drug infusion were examined in contextual fear conditioning and subsequent anxiety-like behaviors. Intracranial surgeries were performed to place guide cannulae into the DRN for later infusion prior to fear conditioning. The next day, rats were tested for their fear to the context. Subsequently, rats were tested in the light-dark emergence (LDE) anxiety assay. The results showed no significant effects ASV-30 on freezing behavior during the context fear test nor on anxiety-like behaviors in the LDE test, although there appears to be a trend emerging in female rats. We currently have a small sample size in this experiment and are conducting additional replications.

5 FEMALE VOCALIZATIONS IN RESPONSE TO MALE AND FEMALE URINE

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Intersexual and intrasexual communication shapes courtship behavior and social interactions in mice. Studies have shown that mice use vocalizations, both broadband and ultrasonic, to communicate with one another. Broadband vocalizations (BBVs), which are detectable by humans, are shown to be produced predominantly by female mice. Ultrasonic vocalizations (USVs) are shown to be produced by male mice, and recently shown to be produced by female mice as well. There is ample research that has been conducted concerning male vocalizations in response to female urine, but there has been little research on the corresponding vocalizations that are produced by females in response to male and female urine. Because mice are used in a variety of scientific studies and scenarios, understanding this communication model will be essential in gaining a complete picture of the dynamics of social interactions and communication among mice. This fills a large gap in the literature which has previously been limited to studying males. This study aims to examine the vocalizations, if any, that a female mouse might elicit in response to the urine of another female or male mouse, and if female estrus state has any impact on this communication. We measured the frequency and duration of vocalizations produced

when diestrus and estrus females were introduced to female urine, as well as urine from dominant and subordinate male mice. We hypothesized that male urine will elicit more BBVs from females, while female urine will elicit more USVs. We also hypothesize that females in estrus will vocalize less when paired with both males and females, compared to when they are in the diestrus stage. Results of this study will provide information on sex-specific communication between mice, and whether female mice produce vocalizations to communicate with other females.

6 ADRENAL STEROIDOGENESIS IN TERRITORIAL FEMALE TREE SWALLOWS

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Heightened territorial aggression has been correlated with increased circulating levels of glucocorticoid and/or sex-steroids in many species. However, the interplay of glucocorticoids and sex-steroid synthesis is understudied, especially in regard to female aggression. To address this gap, we studied adrenal gene expression in female tree swallows (*Tachycineta bicolor*) during the early spring period of territorial establishment, when they are highly aggressive. Included in our quantitative analysis of gene expression were ten study subjects who underwent a social challenge with a simulated territorial intrusion, and eight controls who were unchallenged. Using qPCR, we quantified adrenal gene expression of the following steroidogenic enzymes: p450scc, cyp17, 3bHSD, 17bHSD, AROM, and 11bHSD. We examined the relative expression of each gene in these females and did not find statistically significant differences between social challenge and control group. Among the social challenge group, aggressiveness was not related to gene expression, indicating that behavioral variation is independent of gene expression for these steroidogenic enzymes. However, correlations among genes shift between the social challenge and control groups. This finding suggests that a social challenge may elicit subtle changes in steroidogenesis in adrenal glands. Our study expands the understanding of adrenal steroidogenesis and proximate mechanisms of territorial aggression in females as they prepare to reproduce.

7 EFFECT OF TERRITORY PROXIMITY ON PERSONALITY AND DOMINANCE COST IN MALES OF THE CICHLID FISH *ASTATOTILAPIA BURTONI*

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Many species form dominance hierarchies centered around competition for resources and mates. High rank or social dominance has many benefits (such as mating rights), but the cost of social dominance is less understood. Here we altered the degree of territorial defense to test how social dominance influences behavior and measures of fitness in the cichlid *Astatotilapia burtoni*. Males in this species form dominance hierarchies in which males acquire territory where reproduction takes place. Dominant males exert aggressive behaviors towards conspecifics to maintain their territory. We manipulated the level of

territorial defense by placing defensible structures ('caves') either close together or far apart between neighboring males. We will examine how this influences behavior, personality, and markers of oxidative stress. Our results will provide insight into the cost of social dominance, which may help understand the evolution of variable life histories and pace of life.

8 STRANGER DANGER? THE SOCIAL ABILITIES OF PAINTED TURTLES

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Sociality in reptiles is wildly under-studied; we know very little about the social relationships between turtles within a population, despite them often living in high population densities. To determine if turtles have any level of social recognition, we ran behavioral assays to study whether the painted turtle, *Chrysemys picta*, chose to approach a familiar turtle or an unfamiliar turtle when given the option. We constructed a Y-maze which made one turtle choose between a familiar and an unfamiliar turtle. Turtles chose the familiar turtle first approximately 50% of the time, and they did not spend significantly more time with the familiar individual. Thus, turtles may not have a preference for familiar or unfamiliar individuals, but may still have a cryptic social structure that has been largely ignored in the literature. Studying these social structures is necessary to fully understand turtle behavior, to assess the impact of conservation decisions, and to study the potential impact of climate change.

9 STRIDES IN THE DARK: EFFECTS OF ARENA SIZE ON OPEN FIELD BEHAVIOR

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The scale of an environment has been argued to influence human and rodent spatial representations. Previous research has suggested that spatial cells have different firing characteristics depending on the size of the environment. However, only a few studies have examined the effects of varying environment sizes on the organization of open field behaviors in rodents. Therefore, the current study investigated the effects of varying environment sizes on movement organization and home base stability. Female (n=12) and male (n=12) C57BL/6 mice were exposed to circular tables that varied in diameter, from 80cm to 198cm. Both sessions were conducted under completely dark conditions with the order of arena size counterbalanced across mice. A black tab (20x5cm) was placed along the edge of the arena, serving as a tactile cue for the mice. A motion capture software was used to track and segment movements into stops and progressions to create measures sensitive to locomotion and spatial disorientation. The results show that changes in arena size influenced multiple characteristics of open field behavior organization. Understanding the representation that guides spatial movements may lead to interventions that will help humans encode environmental information, critical for improving spatial orientation. This work establishes a foundation to better understand spatial disorientation associated with many neurological disorders.

10 BEHAVIORAL RESPONSES TO CHRONIC AND ACUTE STRESSORS IN PRAIRIE VOLES

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Social isolation has several psychological and physiological consequences including anxiety and depressive-like behaviors, rapid heart rate, and elevated blood pressure. Social isolation also combines with acute environmental stress to influence emotions and behaviors. The present study evaluated behavioral responses to a combination of long-term social stress and acute stress in the prairie vole rodent model. Prairie voles engage in social behaviors similar to humans, including monogamous relationships, and provide a valuable model for investigating the interactions of social stress and acute environmental stress. In this study, a cohort of 4 male and 4 female prairie voles were isolated from a sibling for 4 weeks. Following the isolation period, each animal was individually placed in a small cage and set on a shaker table for 1 hour. Shaker stress as an acute stressor - as well as combined with other stressors - has been shown to influence hormonal and behavioral responses in previous research. Immediately following the shaker stressor, each animal underwent a 5-minute open field test to capture exploratory and anxiety-like behaviors. Preliminary results indicate that social isolation combined with shaker stress alters exploratory and anxiety-relevant behaviors compared to previous data from social isolation alone, an acute stressor alone, or unstressed control conditions, suggesting that the combination of a chronic and acute stressor increased anxiety responsiveness. Future research using this combination of chronic social stress and acute environmental stress will be important for understanding patterns of behavioral distinctions that may arise, potential sex differences, and treatment strategies for stress.

11 THE EFFECTS OF INFLAMMATION AND SOCIAL STRESS ON EMOTION IN AN ANIMAL MODEL

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The present study investigated the protective effects of social bonds, including whether social isolation increases mental health issues and excessive inflammation in the body. Specifically, this study investigated correlations between inappropriately high inflammation with depression- and anxiety-related behaviors in the context of loneliness and social isolation. We utilized a prairie vole model for the present experiments because these unique rodents respond similarly to humans following social isolation and disruptions to their social bonds, therefore allowing us to apply the results to humans. In Experiment 1, we explored male-female bonds in a prairie vole model to determine whether levels of anxiety and inflammation increase with social isolation, and whether reducing excessive inflammation reduces anxiety. In Experiment 2, we studied the protective effects of family bonds, and whether excessive inflammation is associated with depression during social isolation. The results of Experiment 1 indicate that decreasing excessive inflammation with an anti-inflammatory drug decreased anxious behaviors in socially isolated prairie voles. The results of Experiment 2 indicate that increasing inflammation with a bacteria increased depression behaviors in socially isolated prairie voles. These results suggest that excessive inflammation can pose mental health risks, including behaviors related to both depression and anxiety. Additionally, the data suggest that reducing excessive inflammation may be a

useful strategy to protect against depression, anxiety, and stress associated with loneliness and social isolation. The present study can contribute to awareness of the harmful effects of social isolation and inflammation on physical and mental health, and the benefits of reducing inappropriately high inflammation to improve mental well-being in humans.

12 HOW DO FEMALES OF A MOUTHBROODING CICHLID FISH REGULATE THE METABOLIC COST OF REPRODUCTION?

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The metabolic demands of reproduction may increase reactive oxygen species (ROS) which, if not kept in check, may cause oxidative damage. Consequently, it has been suggested that oxidative stress mediates the trade-off between reproduction and future reproductive success or longevity. However, there is limited support for this hypothesis because organisms can buffer themselves against the negative consequences of oxidative damage through specific mechanisms, such as elevating antioxidants or changes in behavior. Here we examined how oxidative status and metabolic function are linked to egg production in the mouthbrooding cichlid fish *Astatotilapia burtoni*. We found that egg production was linked to increased oxidative damage and associated with antioxidant defense. Since mitochondria produce cellular energy and ROS, we will also explore adjustments in mitochondrial performance during reproduction. Our findings contribute to our understanding of how animals cope with the metabolic challenges of reproduction.

13 SENSITIVITY TO SEX STEROIDS IN THE VISUAL SYSTEM IN RESPONSE TO SOCIAL COMPETITION

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The visual system plays an important role in informing an animal about its physical and social environment. Past work in birds has focused on how motivational circuits in the brain respond to social competition, yet it is unknown how hormonal interactions in sensory tissues may be impacted. Here, we focused on the visual system, including the retina in the eye and the optic tectum in the brain. Using wild tree swallows *Tachycineta bicolor*, we measured how social instability affects sensitivity to sex steroid hormones (i.e., androgens and estrogens) using quantitative PCR. Both sensory tissues showed a positive correlation between mRNA for androgen receptor and estrogen receptor within tissues. Further, gene expression in the retina was not related to experimental changes in the social environment, but we found some evidence of social sensitivity in the optic tectum, particularly with androgen receptor. This suggests that androgens may play a role in mobilizing the visual system to respond to social instability. Altogether, our work highlights the need to look at sensory systems as potentially important factors in social behavior.

14 THE ROLE OF THE PARAVENTRICULAR NUCLEUS OF THE THALAMUS IN THE EXPRESSION OF SAFETY LEARNING

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An estimated 70% of the population experiences a traumatic event at some point in their life, and up to 20% of these individuals go on to develop posttraumatic stress disorder (PTSD). PTSD is a debilitating condition that significantly reduces the quality of life and alters an individual's ability to regulate fear and safety cues. Rodent models and laboratory fear conditioning are effective in simulating PTSD conditions and allow for analysis of how exposure to trauma changes the brain and its ability to process and respond to future threats. The paraventricular nucleus of the thalamus (PVT) is a midline brain structure that integrates threat- and arousal-related signals from cortical and subcortical inputs and relays this information to limbic circuits that mediate defensive responses. The present study investigated a role for the PVT in mediating the expression of safety learning. We presented an auditory safety cue that predicted the absence of footshock within a context that strongly predicts footshock. We infused half of the rats with the GABA-A receptor agonist, muscimol, directly into the PVT prior to the test of safety learning. Data are currently being analyzed. If the PVT is necessary for the expression of learned safety, inhibition of this structure will reduce safety (i.e., eliminate the decrease in freezing observed in the presence of the auditory safety cue) compared to rats that receive a control infusion. If there is a trending sex effect, future studies will be conducted to address the possible sex differences in PVT and the expression of safety learning. Results from our study will provide a greater understanding of the PVT's role and contribute to our understanding of a novel neurobiological mechanism in safety learning.

15 BODY MASS AND BROOD SIZE INTERACT WITH THERMOREGULATORY MECHANISMS IN WILD NESTLING SONGBIRDS

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With longer, hotter heat waves, animals are enduring prolonged heat stress. Animals can combat heat behaviorally by evaporative cooling (e.g., panting), or physiologically by upregulating heat shock proteins (HSPs) to repair cellular damage. However, excessive panting can cause water loss, and prolonged HSP upregulation may itself cause cellular damage. Considering larger bodies and broods may retain more heat, rising heat waves could select for reduced body and brood sizes by virtue of size-dependent thermoregulatory mechanisms. We investigated how mass interacts with HSP mRNA abundance and panting in 12-day-old tree swallows (*Tachycineta bicolor*). Using air-activated warmers, we experimentally heated nests to 4°C above controls for 4 hours in the afternoon. We video-recorded and quantified panting during the 2nd hour of heating. Later, using qPCR and one chick per nest, we quantified hippocampal HSP90AA1 gene expression because the hippocampus mediates exploration and migration, both vital behaviors for juvenile migratory birds. We found that HSP90AA1 abundance and panting were positively correlated across treatments, suggesting thermoregulatory responses are

linked. In heated nests, larger chicks had more HSP90AA1 mRNA. In control nests, bigger broods panted more and had higher HSP90AA1 mRNA. Thus, larger chicks and broods may be more affected by heat. These responses may be beneficial in the short-term, but intensifying heat waves may eventually cause selective pressures against large body and brood sizes.

16 LONG-TERM MELATONIN ADMINISTRATION INDUCES SEASONAL PHYSIOLOGICAL AND BEHAVIORAL SWITCHES IN FEMALE SIBERIAN HAMSTERS (*PHODOPUS SUNGORUS*)

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Seasonal adaptation is an essential survival strategy for animals living in non-tropical areas that experience a tradeoff between reproduction and survival. In most vertebrates, changes in photoperiod trigger alterations in both physiology and behavior. The pineal hormone melatonin, secreted during darkness, is a core hormone for signaling changes in photoperiod. Previous studies have shown that exogenous melatonin can induce seasonal switches in behavior independent of changes in day length. Here we aim to examine if melatonin administration influences aggression in female Siberian hamsters (*Phodopus sungorus*). To test whether the timing of melatonin administration affects seasonal behavior, we singly housed adult female hamsters in long days and administered exogenous melatonin either 2 hours (timed; T) or 8 hours (mis-timed; MT) before lights-off. A subset of animals in each group experienced short-term (ST; 2 weeks) treatment, whereas others received long-term (LT; 10 weeks) treatment. Control animals received daily saline injections. To measure physiological changes, we weighed reproductive tissues and collected blood samples to measure steroid concentrations. To evaluate aggressiveness, we used a five-minute intrasexual resident/intruder paradigm. We hypothesized that hamsters would decrease their reproductive mass in the LT-T melatonin group and increase circulating DHEA levels. We also predicted hamsters in the LT-T melatonin group would increase aggressiveness (i.e., attack duration). We found that female hamsters with long-term timed melatonin administration displayed significant body mass declines, gonadal regression, and increased aggressive behaviors toward same-sex intruders. Similar patterns were shown in male hamsters in previous studies in our lab, suggesting little sexual dimorphism in seasonal behavioral phenotypes in Siberian hamsters. Future studies will explore the neural mechanisms underlying seasonal aggression in both male and female hamsters.

17 THE EFFECT OF SOCIAL STATUS ON TRANSCRIPTIONAL REGULATION AND OF OXIDATIVE STRESS IN THE BRAIN

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Due to its high metabolic rate, the brain is particularly vulnerable to oxidative stress, the imbalance between antioxidants and reactive oxygen species. Consequently, increased oxidative damage has been linked with nervous system disorders. Social status within

dominance hierarchies is associated with distinct social stressors, but we know little about the effects on brain oxidative stress. In the cichlid fish *Astatotilapia burtoni*, males compete vigorously for social dominance. Dominant males are territorial and reproductively competent; subordinate males are submissive and reproductively suppressed. Past studies in *A. burtoni* have indicated that social status specific patterns of oxidative stress vary across brain divisions, but we know little about the regulation of oxidative balance. In the current study, we obtained dominant and subordinate males from mixed-sex groups. For each male, we combined the forebrain and hypothalamus and used them for transcriptome profiling through RNA-sequencing. Of 17,936 genes that were sequenced, 249 genes indicated differences between dominant and subordinate males. Several gene modules, including those that regulate oxidative balance, were found to be significantly related to social status and the activation of the reproductive system. Social status is thus linked to transcriptional regulation of genes used for maintaining redox homeostasis. In the current study, we combined two brain divisions, and hence our analysis may have missed regional differences in gene expression. Future studies will assess how social status and competition alter transcriptional activity in more specific brain regions relevant to the regulation of social challenges.

18 EMBRYONIC LEARNING IN LAKE STURGEON (*ACIPENSER FULVESCENS*) UNDER WARMING CONDITIONS

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Lake sturgeon (*Acipenser fulvescens*) are a culturally, economically, and ecologically important fish to the Great Lakes region. Sturgeon populations face threats from a variety of pressures over the last century, including habitat destruction, invasive species, and climate change, but little is known about how these stressors influence the behavior of sturgeon at early life stages. In this study, we evaluated the potential for warming waters to influence embryonic learning and acquired predator recognition in sturgeon embryos. Studies in multiple species have shown that oviparous aquatic embryos can learn to identify local predators based on a variety of sensory cues, thereby increasing survival and fitness after hatching. Because the duration of embryogenesis is dependent on temperature, warming waters due to climate change can limit such opportunities for embryonic learning. We conditioned sturgeon embryos to recognize and respond to an invasive predator, the rusty crayfish (*Orconectes rusticus*) via paired olfactory presentations of conspecific alarm cue and predator cue at three different temperatures (14°C, 18°C, and varied from 12°-22°C). We then evaluated embryonic behavioral responses to the predator cue alone 24 h before hatching (i.e., same stage of development). Our results indicated that sturgeon embryos demonstrate embryonic acquired predator recognition, similar to other species. Embryos in warmer treatments hatched earlier, but similar evidence for embryonic learning was observed in all temperature treatments. This study adds to a growing body of literature on the mechanisms underlying embryonic learning in fish, suggesting that learning may more strongly be influenced by developmental stage than embryonic duration. In addition, these data provide insight into the behavioral responses of vulnerable aquatic species to respond to emerging environmental pressures.

19 DOES THE HOUSE SPARROW (*PASSER DOMESTICUS*) PREFER LOCATIONAL OR COLOR-BASED CUES WHEN EXHIBITING FORAGING BEHAVIOR?

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Foraging impacts an animal's fitness as it is an essential dimension to an animal's ability to survive and reproduce. Animals use different memory tactics to successfully select their food source, including color and location-based cues that have proven successful in past foraging events. In particular, some birds have been found to have preferences in utilizing color-based cues while foraging, such as the hummingbird feeding from bright, attractive flowers, while other birds utilize location-based methods, such as the albatross navigating with precision. However, less is known about which cue is preferred during foraging behavior when observing the house sparrow (*Passer domesticus*). House sparrows are an optimal model of study due to their high learning capacity and their expansive population density. This study aims to determine the preferred memory cue used by house sparrows while foraging. To test this, a two-by-two design was performed in which we varied feeder color and location. After acclimating house sparrows to original conditions, we switched the locations or colors of the feeders to observe which memory-based cue the sparrows preferred while foraging. The preferred cue was determined by totaling up the amount of birds that went to each feeder first. We hypothesize that house sparrows will prioritize location-based cues due to the spatial memory often exhibited by bird families as they return to specific previously successful feeding sites. Therefore, we predict that even when the feeders change location or color, the house sparrow will still return to the location that they were acclimated to during the training period. This study's finding will increase understanding in how these birds are able to access the food resources essential to survival.

20 THE INFLUENCE OF SOCIAL ISOLATION ON THE REGULATION OF VOCAL PERCEPTION BY SEROTONIN

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Animals reliant on vocal communication are affected by social isolation due to its impact on the serotonergic system. This system plays a role in mental illnesses like depression and anxiety, influencing auditory attention and vocal communication. Studies in mice have revealed how serotonin levels in the inferior colliculus, a critical point of the auditory pathway where most acoustic information is processed, rise when mice interact. With an interest in studying the impact of social isolation on patient populations, this project aims to learn more about the neurological effects of isolation on human behavior. In the current study, the impact of systemically injected 5-hydroxytryptophan (5-HTP), a serotonin precursor, was measured to investigate how isolated males respond to female rejection calls. A total of 24 male mice at 7 weeks of age (young adults) were used for this experiment. After a week of social isolation, 12 mice were injected with saline while 12 were injected with 5-HTP, increasing serotonin levels in the auditory system. A split cage with a female on one side and a male on the other separated by a plastic slip barrier with a small hole to allow for investigative behavior between the mice was used to encourage the

production of courtship ultrasonic vocalizations (USVs) by males. Five minutes of female rejection squeaks (BBVs) were played to the males (playback), preceded and followed by 5-minute periods of silence (baseline and recovery). Results revealed that there was an effect of 5-HTP treatment on investigative behaviors such as digging, rearing, grooming, and investigating the hole. For the behaviors of grooming and rearing, there was also an effect of time bin; grooming increased over time while rearing decreased over time. With these preliminary results, we aim to determine the effects of serotonin on individuals in different environmental settings and investigate how this may impact communication.

21 NMDA ANTAGONIST REVERSES BEHAVIORAL DEFICITS INDUCED BY MUSCARINIC ANTAGONIST

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Cognitive deficits in Alzheimer's disease (AD) are closely linked to deficient cholinergic transmission, partly due to abnormal muscarinic receptors (mAChR), particularly muscarinic M1 mAChR activated during learning and memory. Behavioral deficits induced by mAChR antagonist can be potentiated by N-methyl-D-aspartate receptors (NMDAR) antagonist. However, recent reports suggest that excessive stimulation of glutamatergic receptors leads to cell death in AD, and NMDA antagonists may prevent further excitation of neurons. This study examined the effects of mAChR antagonist on simple learning and reversibility by NMDA antagonist. We hypothesized that MK801, the NMDAR antagonist, would reverse behavioral deficits induced by scopolamine, the M1 mAChR antagonist. Wistar rats were trained to make 20 lever-presses for a food-pellet, a fixed ratio 20. Upon reaching a behavioral criterion, drugs were injected in a counter-balanced manner: saline+saline, saline+scopolamine, saline+MK801 and scopolamine+MK801. Scopolamine (0.5mg/kg) and MK801 (0.05mg/kg) were dissolved in saline. All injections were given intraperitoneally, <2 mins before testing. Response latency and runtime were compared across treatment conditions. Scopolamine reliably impaired behavior by increasing the response latency and runtime. Co-administration of MK801 and scopolamine partially reversed scopolamine-induced deficits, whereas MK801 alone did not affect behavior. Our data provide additional evidence for the beneficial use of NMDA antagonists in AD. Further study is warranted.

22 REPLAY OF INCIDENTALLY ENCODED EPISODIC MEMORIES IN THE RAT

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In daily life, although events are not always known to be important when they occur, people can still remember details about such events using episodic memory. The replay of episodic memory is defined as the ability to sequentially recall the flow of past events. Evidence has shown that rats can replay episodic memories after extensive training. In addition, it has been documented that rats can use incidentally encoded information about a single event to answer an unexpected question. However, it is not known if rats can replay incidentally encoded episodic memories to answer an unexpected question using multiple events. To address this problem, we provided rats with opportunities to learn two

tasks. In one task, rats were presented with a list of trial-unique odors in an encoding context; then, following a 15-minute retention interval, were asked to report the third to last item from the recently presented list. In the second task, rats foraged in a standard 8-arm radial maze task which included a 15-minute retention interval. On a critical test, rats foraged in the radial maze, but scented lids covered the food. Next, following a 15-minute retention interval, memory of the third to last odor was assessed. All participating rats correctly answered the unexpected question. These results provide evidence that rats can encode multiple pieces of seemingly unimportant information, and later can replay a stream of episodic memories when that information is needed to answer an unexpected test. Evidence that rats replay incidentally encoded episodic memories of documents a crucial aspect of human episodic memory in a nonhuman animal.

23 A COMPARISON OF ANTIPREDATORY RESPONSES TO VISUAL AND OLFATORY STIMULI IN HOUSE SPARROWS

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As of 2019, the house sparrow population has declined 84 percent in North America since 1966. Antipredatory behavior in birds has long been observed, but little is known about the relative roles of visual, auditory, and olfactory cues in triggering antipredator responses. This research focuses on the visual and olfactory influences on the antipredatory response of the house sparrow (*Passer domesticus*). House sparrows are an ideal model because they are gregarious, innovative birds on which previous research has focused concerning visual and olfactory stimuli. There is conflicting evidence as to the extent that birds respond to olfactory cues, and further research is necessary to determine the relative importance that birds attribute to olfactory information. Our research seeks to answer this question by asking how house sparrows respond differently to visual feline stimuli, olfactory feline stimuli, and a combination of both. We chose the domestic cat (*Felis catus*) as our model predator because they are the most common threat to house sparrows, especially in urban environments. House sparrows collected from Holland, Michigan will be placed individually in an enclosure and their antipredator behavior will be recorded in the presence of visual (i.e., model cat), olfactory (i.e., urine), and combined stimuli. We predict that house sparrows will have a stronger antipredatory response when exposed to combined stimuli, becoming vigilant and flushing to cover more often than when exposed to isolated stimuli. We also expect a stronger response to visual than olfactory stimuli because birds have been shown to rely primarily on visual stimuli. Results of this study will provide information on how house sparrows use olfaction relative to vision, which may illuminate their predator detection and evasion strategies and provide important insights into their population decline.

24 RED-WINGED BLACKBIRDS NESTING NEARER TO YELLOW WARBLER AND CONSPECIFIC NESTS EXPERIENCE LESS BROOD PARASITISM

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In referential communication systems, the signaler's message intended for a conspecific receiver may be intercepted and used by a heterospecific eavesdropper for its own benefit. For example, yellow warblers (*Setophaga petechia*) produce seet calls to warn conspecifics of nearby brood parasitic brown-headed cowbirds (*Molothrus ater*), and red-winged blackbirds (*Agelaius phoeniceus*) eavesdrop on and recruit to seet calls to mob the brood parasites. Prior work found that warblers nesting closer to blackbirds were less likely to be parasitized, suggesting that blackbirds may even be the target of warbler's seet calls to assist with antiparasitic defense. Here we discovered for the reverse to apply, too: blackbirds nesting closer to yellow warblers also experienced lower probability of brood parasitism. Concurrently, we also found that blackbirds nesting closer to other blackbirds also experience lower parasitism rates. Although these are strictly correlational results, they nonetheless suggest that blackbirds are better able to defend their nest against cowbirds when also listening to nearby warblers' referential alarm calls.

25 ZEBRA FINCH LEARNING IN VARIABLE TEMPERATURE CONDITIONS

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Current climate change is leading to increasingly unpredictable ambient conditions. In order to cope with highly variable environments, animals rely on effective cognition. However, environmental fluctuations may limit cognitive development because of a trade-off in the allocation of resources. These two options could be reconciled if parental effects can prepare offspring to face harsh conditions. Thus, we investigated the impact of ambient temperature variability during development on zebra finches' cognitive abilities, including song learning, associative learning, and social learning. We expected that parental effects would attenuate the consequences of variable temperature conditions during development; a mismatch between the pre- and post-hatching conditions should decrease the learning performance. We designed a 2x2 factorial study with two temperature conditions (stable and variable with the same mean temperature), with half of the juveniles cross-fostered at hatching. We tested the associative learning performance of 209 juveniles during their development and after independence, and we tested their social learning abilities and the song learning performance of males at adulthood. We found an impact of the temperature conditions only on song learning, males from variable pre-hatching condition learned more accurately the song of their father than birds from stable pre-hatching condition. We also observed a higher participation in associative learning test and song recordings when the birds developed in variable condition. Thus, variable temperature conditions may not act as a stressor as we supposed, but may be perceived as an environmental enrichment enhancing activeness in captivity.

26 IMPACTS OF PRE-GESTATIONAL SOCIAL ISOLATION ON MATERNAL FERTILITY AND OFFSPRING COGNITIVE FUNCTION

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Social distancing during the COVID-19 pandemic led to increased social isolation around the world. While social distancing is effective at reducing disease transmission, isolated individuals are at increased risk of anxiety, depression, and cognitive dysfunction. Although it is clear that reduced social interaction has negative impacts on isolated individuals, whether there are transgenerational effects of social isolation is underexplored. Thus, we conducted a study to investigate the effects of social isolation prior to gestation on maternal fertility and cognitive function of offspring. To do this, we placed female mice into four housing treatments (n = 3 per category): short-term individual (IND-ST), long-term individual (IND-LT), short-term group (GR-ST), and long-term group (GR-LT). Female mice were then bred with male mice. Here, we found that IND-ST and IND-LT females had larger litters than group-housed females. Following this, we tested the hypothesis that pre-conception social isolation impairs offspring cognitive function, as assessed by the novel object recognition test. Offspring were from the following mothers: GR-LT (n = 4), IND-ST (n = 7), and IND-LT (n = 9). We ran the test in stages: habituation, familiarization, and test. Subsequently, we quantified investigation of a new versus familiar object during the test stage. GR-LT offspring spent more time investigating the new object, and IND-ST offspring had a slight preference for the new object. Interestingly, IND-LT offspring did not display a consistent preference for the new object. These findings suggest that maternal social isolation may impact memory in offspring, depending on the duration of isolation. Taken together, our preliminary results suggest that reduced social interaction before conception has implications for fertility and offspring cognition and add to the growing literature suggesting that experiences prior to gestation have significant reproductive consequences.

27 DIETARY DEFICIENCY IN POLYUNSATURATED FATTY ACIDS (PUFAS) RESULTS IN GENERAL MOTILITY DEFECTS IN *DROSOPHILA MELANOGASTER* LARVAE BUT NOT ADULTS

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Essential polyunsaturated fatty acids (PUFAs) include n-3 (omega-3) and n-6 (omega-6) fatty acids which can only be obtained from the diet. These fatty acids are a significant component of neural membranes and are important in the function and development of the brain in both humans and nonhuman animals such as insects. Previous work has shown that PUFA-deficient diets cause defects in phototaxis behaviors in *Drosophila melanogaster* adults. Furthermore, these defects were found not to be due to a reduction in general motility. We sought to assess the effect of PUFA deficient diets on *Drosophila* larval behaviors. As a first step in this direction, we needed to understand the effect of the low PUFA diet on general larval motility. Larvae were raised on either a standard (high PUFA) diet or a low PUFA diet that lacks cornmeal and then larval crawling speed was assessed. Larvae raised on low PUFA diets demonstrated significantly reduced crawling speeds compared to those raised on standard, high PUFA diets. This defect does not appear to be

the result of a developmental delay as L3 larval weight and pupal eclosion rates were similar between the two groups. The differential impact of low PUFA diets at the larval versus the adult *Drosophila* stages warrants further investigation into the role of PUFA in larval motility.

28 TISSUE-SPECIFIC EXPRESSION OF DOPAMINE RECEPTORS DURING BREEDING IN BIPARENTAL BURYING BEETLES, *NICROPHORUS ORBICOLLIS*

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Burying beetles, *Nicrophorus orbicollis*, have extended biparental care of young. To breed, a male-female pair of beetles bury and prepare a small vertebrate carcass as food for their young. Upon hatching, altricial larvae are fed by both parents, and parental behavior is coordinated at appropriate times to provide effective care for offspring. The neurophysiology of this remarkable caregiving behavior is however poorly understood. This research seeks to understand the role of monoamines, particularly dopamine, in regulating the complex changes in behavior that burying beetles must undergo during a reproductive cycle. Our recent work indicates that brain levels of dopamine rise significantly after 24 hours of care when parental care rates peak, consistent with a role in the transition from nonparental to parental state and with coordinating caregiving behavior. To further test the effects of dopamine signaling, we investigated gene expression profiles of dopamine receptors in the female brain and ovary during breeding. We predicted that changes in dopamine receptors transcript levels will reflect the rise in dopamine and that differential gene expression will be consistent with both ovarian development state and behavioral changes associated with parental care stages. While dopamine receptor (Nodr) 1 was not detected in the female ovary, Nodr2 and Nodr2r receptors were expressed in both ovary and brain tissues. Moreover, Nodr2 and Nodr2r receptors were upregulated in the female ovary in highly parental females compared to nonbreeding controls, further implicating dopamine in regulating reproductive behavior in burying beetles.

29 SERGEANT MAJOR (*ABUDEFDUF SAXATILIS*) SPAWNING AND NESTING BEHAVIOR IN THE 1724 GUADALUPE UNDERWATER ARCHAEOLOGICAL PRESERVE (GUAP)

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Indiana University Center for Underwater Science established the 1724 Guadalupe Underwater Archaeological Preserve (GUAP) as a replica shipwreck underwater park and Living Museum in the Sea. Since its establishment in 2004, Indiana University students have conducted annual archaeological and biological monitoring. One of the significant biological components is the phenology of sergeant major (*Abudefduf saxatilis*) breeding patterns. Sergeant majors require vertical surfaces to lay their eggs, which makes the GUAP a unique site to monitor this activity as it has a variety of complex features. During the breeding season, sergeant major males become territorial, change their body color, and become aggressive towards intruders. This study analyzes the aggressive behaviors and color changes that are associated with the breeding season as well as the increasing number of nests from 2006 to 2022. Results aim to understand the relationship between coloration,

aggression, and nest size. Overall, the increase of nests demonstrates the importance of *in situ* conservation for sergeant major spawning and nesting behavior.

30 IMPACTS OF BACKGROUND COLOR ON PHYSIOLOGICAL STRESS AND FITNESS IN AN AFRICAN CICHLID FISH

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It is well known that throughout the animal kingdom, many different organisms change color to match their surroundings in order to evade predation. Animals such as the arctic hare change coat color on a seasonal basis, while others such as the cephalopod *Octopus cyanea* have the ability to rapidly change color. Although the benefits of color plasticity in heterogeneous environments is clear, phenotypic plasticity can also be costly when plastic changes are correlated with other changes that are not necessarily beneficial. Identifying these costs may give us key insights into the adaptive significance of color plasticity. Males of the African cichlid fish *Astatotilapia burtoni* display two main color morphs of predominantly blue or yellow coloring, and have been shown to change between colors depending on light or dark conditions in nature. To test if there is a fitness cost to background color matching, we raised groups of juvenile fish to adulthood in either yellow or blue tanks. We confirmed that *A. burtoni* matched the color of their background. Fish raised in blue tanks were found to have a lower growth rate, but also a lower mortality rate than those raised in yellow tanks. After 8 weeks, half of the fish were moved to a tank with the opposite color treatment, and half remained in the same color tank. We did not find a difference between these two treatment groups in relation to growth or mortality rates. Interestingly, however, fish that we originally raised in the blue tank tended to show higher levels of oxidative stress and the regulation of oxidative stress was linked to tank color treatment. Our study shows that background color adaptations can influence fitness related traits, which may ultimately influence the evolution of phenotypic plasticity.

31 SEX DIFFERENCES IN STRING PULLING WITH AN ACUTE STRESS RESPONSE DRUG: FEMALE RATS SHOW SENSITIVITY TO YOHIMBINE

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Motivation is described as energizing behavior in pursuit of a goal (Simpson and Balsam, 2016), such as a rat bar pressing (energizing behavior) to access water (the goal) when thirsty. Previous research has shown that motivated behaviors are affected by stress. For example, chronic social stress increases immobility time in the forced swim test, indicative of behavioral despair associated with decreased motivation (Rygula et al., 2005). Yohimbine, an adrenergic receptor antagonist causes acute physiological stress response in rodents. Whether yohimbine acting as an acute stressor also alters motivated behavior has not been well established. We are interested in assessing the impact of yohimbine on the naturalistic motivated behavior of string pulling, which has been studied previously in rodents (Blackwell & Wallace, 2020). The current study tested whether the adrenergic receptor antagonist yohimbine affects behavior in a string-pulling choice task. Male and female Sprague-Dawley rats were trained to pull strings of varying lengths (1, 3, and 6

meters) into a string-pulling apparatus to receive a honey nut Cheerio (high reward). Alternatively, rats could consume traditional rat chow (low reward) available in the apparatus with no effort. After 4 days of string-pulling training, rats were injected with yohimbine (2mg/kg) or saline and tested with an “infinite” string for 10 minutes. Female rats pulled significantly more string than males during training and following a saline injection. Moreover, female rats showed significantly less pulled string following a yohimbine injection compared to following saline injections, but males did not. These data suggest that female rats are more sensitive to the effects of stress in the string pulling, but this may be due to the low levels of string pulling by males. Further research is needed to understand the effects of stress on naturalistic motivated behavior in male rats.

32 ACCEPT OR REJECT: DO MALE MICE ALTER SEXUAL BEHAVIOR IN RESPONSE TO FEMALE VOCALIZATIONS?

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During courtship males and females must consider dynamic communication signals to increase chances of successful courtship. Both male and female signals play essential roles during courtship interactions. In mice, the role of female signals and their role in courtship is not well understood. A possible role may be portraying receptiveness which may allow males to further increase their mating attempts. Mice present an interesting system to study this idea due to female production of vocal signals of different valence and structure in the same behavioral context. In response to male interest during courtship, female mice may send two types of signals to the males, broadband vocalizations (BBVs), which are low frequency signals and ultrasonic vocalizations (USV), which are high frequency signals. BBVs occur during physical rejection of males and female USVs occur during positive courtship encounters. Male mice presented with female BBVs have previously shown decreased male vocal behavior. We set out to identify the role that female vocalizations of different types may have on male courtship behavior. This was done using a 10-minute direct interaction in which male mice were exposed to 5-minute playbacks of female USVs and BBVs then 5 minutes of silence. The mounting behavior of males was measured during the interaction. Total mounts across groups were compared and mounting behavior was also binned into the first 5 minutes during playback and the 2nd five minutes for comparison. Males did not alter their mounting behavior in response to playbacks, and a Friedman's two-way ANOVA showed no significant differences across treatments ($p=0.088$, $N=14$). This trend may reveal a subtle role of female USVs in male mounting behavior. Male vocalizations in response to female vocalizations playbacks may show more information about their effects on male behavior, as well as examining other male social behaviors.

33 SINGING IN THE HEAT: HOW MALE ZEBRA FINCH SONGS VARY WITH TEMPERATURE

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The frequency and intensity of heat waves are increasing across the globe. Many animals, including songbirds, must cope with these extreme events by altering their behavior and physiology. Though emerging research shows that male songbirds produce fewer songs

during natural and simulated high temperature events, it is less clear whether and how heat affects song traits. For instance, some studies suggest song temporal traits in zebra finches (*Taeniopygia castanotis*) shorten under high temperatures, whereas others find that their song temporal traits lengthen. We hypothesized that male songs would vary with air temperature. We predicted that songs would be shorter in duration and less consistent under acute heat, as behavioral performance generally declines under heat stress. To test our hypothesis, we recorded domesticated male zebra finches singing in a thermally neutral treatment ($T_a = 30^\circ\text{C}$) and a heat challenge treatment ($T_a = 44^\circ\text{C}$). We evaluated the air temperature threshold at which song traits change, as this may explain differences in findings among previous studies. Altogether, understanding the extent to which heat-wave like conditions alter song performance will provide insight into how natural heat waves could impact communication in wild songbirds.

34 “TAP DANCING” IN *DENDROBATES TINCTORIUS*: AN INVESTIGATION INTO POSTERIOR TOE TAPPING AND FEEDING BEHAVIOR

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Animals adapt in many fascinating ways to hunt in the most efficient and effective manner in the wild. One mysterious behavior suspected to be related to hunting is the posterior toe tapping behavior of dyeing poison frogs (*Dendrobates tinctorius*). In this study, we explored this tapping in a series of experiments designed to test our hypothesis that tapping is important to hunting behavior. We predicted that tapping would be more frequent when individuals were feeding versus not feeding. We also explored what possible benefits this tapping behavior might have towards hunting. In our first experiment, we found that tapping rate was significantly higher when feeding. In our second and third experiments, we investigated tapping behavior on different surfaces. We found that tapping was higher when the prey was on the same surface as the frog and on more responsive surfaces. Lastly, we tested if higher tapping rate correlated with more success in catching prey but found little correlation between the two. Taken together, our experiments show that tapping is associated with feeding and related to substrate characteristics. We suspect mechanostimulation of prey to induce movement could be behind tapping behavior, which is what future studies will focus on.

35 EFFECTS OF MICROPLASTICS AND ITS POTENTIAL AS A VECTOR OF 17 α -ETHINYLESTRADIOL (EE2) ON EARLY LIFE STAGE BEHAVIORS IN JUVENILE *PIMEPHALES PROMELAS*

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Microplastics are ubiquitous contaminants in freshwater systems and understanding the effects on aquatic biota are of increasing importance. Unique properties of MPs allow them to act as vectors for common environmental contaminants such as endocrine-disrupting chemicals (EDCs). One common aquatic EDC in urban systems, 17 α -ethinyl estradiol (EE2), is known to affect the hypopituitary axis responsible for behavior in vertebrate organisms. Microplastics have the potential to serve as an additional route of exposure for EDCs, compounding their effects on physiology and behavior. However, few studies have

considered the synergistic effects of microplastics and contaminants on the early life-stage behaviors in freshwater aquatic vertebrates. We exposed juvenile *Pimephales promelas* to microplastics alone and associated with a low (MP^{EE2 5}) or high (MP^{EE2 25}) concentration of EE2 for 14 or 21 days, and then assessed larval swimming performance and space use using open-field swimming trials. Swimming performance was statistically similar in larvae from all treatment groups at both 14 and 21 days post-hatch with the exception that larvae in the MP^{EE2 5} treatment had significantly faster angular velocity at 14 days. However, there were several non-significant trends seen across the data. Exposed larvae showed trends towards increased time spent in the middle of the arena across treatments for day 14 and a decrease in time for day 21, as well as an increase of latency of time it took to first entrance in the middle for both days. There was also a trend towards increased time spent moving, velocity, and total distance moved during the trial for day 21 across treatments. These results suggest that early developmental exposure to microplastics, alone or in combination with other contaminants can impact larval behavior and performance in important fitness contexts. Such individual-level differences may translate into higher-order effects for populations and communities.

36 SSRI-ASSOCIATED SEXUAL AND ROMANTIC SIDE EFFECTS IN AMERICAN ADULTS: DIFFERENT PATTERNS AMONG DIFFERENT SEXES

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The treatment of sexual difficulties has recently garnered greater attention in human health. Some human sexuality scholars have cautioned that trends in biomedicine toward the use of pharmaceuticals to treat sexual problems may have resulted in unnecessary medicalization of sexual difficulties. Further, medicalization of other health problems can lead to iatrogenic sexual side effects. Our study explores issues of antidepressant use and associated sexual side effects, focusing on ways that women and men are impacted differently. Existing research shows that SSRIs affect sexual functioning in ways that are unrelated to depressive symptomology. We address the lack of consensus in biomedicine around SSRI mechanisms of action, and, based on the role of neurotransmitters in sexual and romantic interest, we investigate the impacts of SSRIs on sexual and romantic outcomes for women compared to men. We conducted a secondary analysis using two waves of annual survey data, including over 5,000 single (unmarried, unpartnered) US adults in both waves, plus over 1,000 married US adults in one wave. Respondents answered questions about their romantic and sexual behavior and SSRI use. Compared to men, women were more than twice as likely to be taking SSRIs. Fifty-one percent of men and 38% of women reported experiencing a sexual/romantic side effect, with a significant difference between single and married women (53% of married women reporting sexual/romantic side effects compared to 36% of single women). Single women and men reported differing patterns of iatrogenic impacts; for example, SSRI use was significantly associated with more interest in sexual exploration for men but not women. These data raise questions about how women and men taking SSRIs may experience relationships

differently. Our findings highlight a need for further attention to sexual and romantic side effects associated with SSRIs and a more nuanced approach to these issues in research and clinical settings.

37 DO PAIR-BONDING POISON FROGS PREFER THE CALLS OF THEIR MATES OVER THOSE OF STRANGERS?

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Mate choice can have a profound effect on evolutionary processes, thus it is important to understand the factors that influence partner preference across a diversity of mating systems. In pair-bonding species, familiarity may influence preference because proven partners confer surer contributions to an individual's own fitness, for example through coordination of parental care. Pair-bonding is taxonomically widespread; however, studies investigating the mechanisms that facilitate these preferential associations are limited. In this study, I enlisted a monogamous frog species (*Ranitomeya imitator*) to explore whether females use male acoustic stimuli to guide preferences. I first assayed the behavior of virgin females in a no-choice phonotaxis test to inform whether inexperienced females show behavioral attraction to calls across multiple male *R. imitator*. I found that there was a preference for the presence of calls over no calls, but found no preference for specific males. Based on this, I next explored whether bonded adult females preferred the calls of their own mates. I performed a two-choice phonotaxis test in which females were presented with both the call of a stranger and their mate. Females showed no consistent behavioral preference for calls based on familiarity. In hormone analyses, corticosterone concentrations also did not differ significantly between bonded females exposed to calls of mates vs. strangers, suggesting that preference is not manifest at a physiological level when paired with acoustic cues alone. While these findings support the importance of acoustic signals in attraction, they also suggest that communication required in maintaining pair bonds is likely multimodal.

38 MIGRATORY STRATEGY PREDICTS REPRODUCTIVE READINESS IN A WILD SONGBIRD: IMPLICATIONS FOR RESPONSES TO CLIMATE CHANGE

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Climate change generates timing mismatch events, which occur with unequal shifts in seasonal timing (i.e., phenology) of interacting species, such as consumers and their resource. These mismatches are particularly notable in avian organisms. Research investigates avian mechanisms of timekeeping to better understand the flexibility in scheduling energy-intensive annual cycle events, such as migration, molt, and reproduction, to better match a changing environment. Until recently, implications of migratory strategy on annual cycle timing did not receive much attention, particularly in wild populations, conspecifics, and females. This study explores the effects of migration strategy on early breeding season reproductive readiness in males and females of two wild populations of a common songbird, the American robin (*Turdus migratorius*), that differ in migratory

strategy—one breeding in Alaska (i.e., the AK population) and the other in Indiana (i.e., the IN population). I hypothesized that migratory strategy predicts differences between populations in sex steroid levels and variance, helping shape the timing of reproduction. I predicted that the longer migrators (i.e., the AK population) will have higher sex steroid hormone levels and lower within-population variation than shorter migrators (i.e., the IN population), since a shorter breeding season creates greater selective pressure to: (1) respond more rapidly to timekeeping cues, and (2) time reproduction more precisely and accurately. Results indicate that the AK population had higher sex steroid levels with higher variation in males and equal variation in females. This research improves our understanding of how species tune their phenology to match their environment, which is crucial for predicting population dynamics as species are faced with challenges of rapid environmental change.

39 FORAGING JUVENILE WOLF SPIDER RESPONSE TO PREDATORY BIRD CALLS

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Adult male spiders amidst courtship displays respond to predatory avian cues in one of two ways, they either attempt to escape or freeze. While juvenile spiders are not capable of courtship displays, they may still respond similarly to predatory cues in other contexts, such as foraging. To test if juvenile wolf spiders respond to avian cues during foraging, we collected 3rd – 4th instars spiderlings from the field in October (2021) and brought them to the lab. In the experiment (2022), we controlled all cues by playing a video of a cricket coupled with its vibrational cues while simultaneously playing avian cues. The results of the experiments yielded no significant affect between predator cues and antipredator behaviors in juvenile wolf spiders, although there were some interesting trends. We plan to improve our experimental approach in future iterations of this research and continue to investigate foraging behavior in juvenile wolf spiders.

40 THE EFFECT OF PHYSICAL ENRICHMENT ON PREFERENCES AND SOCIAL BEHAVIORS IN MICE

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Enrichment in laboratory animals is an important aspect in increasing animal welfare as well as being a more reflective model of humans. There is a gap in knowledge on how levels of enrichment affect social behaviors, specifically those used in courtship. During courtship, mice communicate through vocalizations including ultrasonic vocalizations (USVs) in males and broadband vocalizations (BBVs) in females. USVs produced by males are important because during courtship the number of calls produced increases, as well as mounting attempts. Female mice greatly influence the production of USVs by different variables including their presence alone. This knowledge supports that communication through vocalizations and behaviors are an important aspect of mice social competency and sexual motivation. To assess the effect of physical enrichment on courtship behaviors we used two different groups of socially isolated CBA/J mice, one physically deprived (SD/PD) and the other physically enriched (SD/PE). We then employed a direct interaction model to evaluate

USV production and physical courtship behaviors. There is also a lack of research on the preference of certain aspects of environmental enrichment that enhance species-specific behavior in CBA/J mice. Because of this, we also investigated enrichment preference by observing the SD/PE group in their home cage. Through the home cage observations, we found that mice preferred the hut provided more than any other enrichment, but this seemed to decrease over time. In direct interactions, the mice that were physically enriched began to call sooner as well as had a higher average number of USVs. It was also observed that mice that were physically enriched had a lower latency to mount and were rejected less by the female mice when compared to the physically deprived group. These findings suggest that mice have a preference for which enrichment they interact with and support physical enrichment may have an effect on social behaviors.

41 IMPACTS OF TESTOSTERONE AND *PLASMODIUM* PARASITE LOAD ON DARK-EYED JUNCO SPERM QUALITY

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Studies suggest that *Plasmodium*, the parasite which causes avian malaria, can negatively affect the reproductive success of its host. However, it is unclear whether *Plasmodium* infections in parents can impact the health of their offspring. Sperm quality is a possible mechanism that could connect effects of parental infection to offspring quality. In mammals, sperm count, and motility are reduced in hosts infected with *Plasmodium*, and higher levels of testosterone are associated with higher parasite loads. However, little is known about the relationship between *Plasmodium* and avian sperm quality, and a causative relationship between *Plasmodium* infection and decreased sperm quality has not been established in any taxon. Therefore, we used an experimental approach to investigate the relationship between maximum (GnRH-induced) testosterone levels, experimental *Plasmodium* exposure and sperm quality in dark-eyed juncos (*Junco hyemalis*). We predicted that juncos experimentally inoculated with *Plasmodium* would show a decrease in sperm quality, signified by lower sperm counts, higher proportions of deformed spermatozoa, and increased biomarkers of oxidative stress, compared to controls. In addition, we predicted that males with higher maximum levels of testosterone prior to inoculation would show higher levels of oxidative stress and lower sperm counts following inoculation. We will discuss the results of this project from the perspective of testosterone as a potential mediator of the effects of parasitism on sperm quality.

42 SMELLING THE DIFFERENCE: USING STRING PULLING BEHAVIOR TO INVESTIGATE MOUSE (*MUS MUSCULUS*) ODOR ENCODING AND RETENTION

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Acute and degenerative neurological disorders such as traumatic brain injuries and Alzheimer's disease have been observed to influence encoding and retention of olfactory information. Early detection of olfactory deficits may provide a window of opportunity to slow the progression of the neuropathology. Although, mice have been observed to spontaneously engage in string pulling behavior, it remains to be determined whether this

behavior can be used to investigate such olfactory based mnemonic processes. In the current study, 12 mice (female: n=7; male n=5) were given five trials per day for six days. During a training trial, a mouse was exposed to two scented strings with one odor consistently baited with sweetened condensed milk that was applied to the end of the string. After training, mice received a probe trial (unbaited scented string) one and four weeks after the last day of training. Mice exhibited a significant increase in correct choices over the six training days and spent significantly more time pulling the string previously paired with reward during both probe trials. These results are consistent with mice learning and retaining an odor discrimination. Future work should focus on testing odor discrimination and retention in mice models of traumatic brain injuries and Alzheimer's disease. Through this work, further understanding of olfaction and potential therapies for neurological disorders can be developed.

43 SINGLE-TIME MELATONIN INJECTIONS MAY INCREASE AGGRESSIVENESS IN MALE SIBERIAN HAMSTERS *PHODOPUS SUNGORUS*

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Many species exhibit seasonal changes in behavior, including variations in territorial aggression. Previous studies from our lab suggest that the hormone melatonin, which serves as a biochemical signal for changes in photoperiod (i.e., day length), is important in regulating the neuroendocrine mechanisms underlying seasonal aggression in Siberian hamsters *Phodopus sungorus*, a species in which both males and females display increased aggression during the non-breeding seasons. The precise actions of melatonin on the neural and neuroendocrine circuits regulating aggression, however, are relatively understudied. While we have previously shown that prolonged (i.e., eight weeks) treatment of long-days hamsters with exogenous melatonin increases aggression to levels comparable to short-day housed hamsters, the relationship between a one-time melatonin injection and aggressive behavior, however, remains unclear. In this study, we tested if a single melatonin injection influences territorial aggressive behavior in male hamsters. Further, we assessed neural activation in response to exogenous melatonin by measurement of expression of the immediate early gene c-Fos via immunocytochemistry. Specifically, hamsters were housed in long-day photoperiods (LDs, characteristic of breeding season) and administered a single melatonin (M) or control injection. Injections were administered 90 minutes before a resident-intruder paradigm was performed to assess aggressive behavior. If a single injection of melatonin is sufficient to regulate aggression, then we predict that M-treated hamsters will display higher levels of aggressive behavior. These results will provide greater understanding of how the pattern of melatonin influences aggressive behavior and what brain regions may play a role. Collectively, these results will further enhance our understanding of how melatonin modulates neural and neuroendocrine circuits controlling and aggression in seasonally breeding animals.

44 THE EFFECTS OF EARLY-LIFE DIET AND SOCIAL ENVIRONMENT ON TESTOSTERONE AND IMMUNE FUNCTION: EXPERIMENTAL EVIDENCE FROM SPADEFOOT TOADS

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Developing organisms often must contend with variation in diet and social environment. Characterizing how such environmental cues interact to influence circulating hormones, and consequently shape physiological responses, is a critical step in understanding how organisms adapt, or fail to adapt, to environmental variation. Here, a two-part investigation was conducted in the spadefoot toad *Spea bombifrons* to determine whether early life social environment (high vs. low population density) and diet (detritus vs. shrimp) influenced testosterone levels, and if those testosterone levels could impact immune responsiveness in tadpoles. Social density had a significant impact on testosterone concentrations, with low density animals exhibiting heightened levels of testosterone. Functional manipulation of testosterone, with the aromatase inhibitor Fadrozole, revealed that testosterone significantly depressed tadpoles' swelling responses to an injection with a vehicle, but not to a specific immune challenge (phytohemagglutinin, or "PHA"). Severe swelling reactions only occurred in PHA injected animals from the control group, whereas none occurred in the Fadrozole treated group, suggesting a depressive effect of testosterone on immune responses, although larger sample sizes will be necessary to support this trend. Together, our results indicate that early life social environment can modulate testosterone levels, which in turn might influence immune function, and therefore individual fitness.

45 POSITIVE AND NEGATIVE INCENTIVE CONTRAST IN RATS: A NEW LOOK AT THE DIFFERENCES BETWEEN THE SEXES

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Research on sex differences for preferences of reward outcomes, such as flavors, show mixed results between male and female rats. Some studies suggest that females perform consistently and at higher rates for sucrose concentrations than males; however, these findings are not consistently shown. This study examined sex difference in motivation for sucrose reward and focused on relative reward effects as they interact with basic motivation. Motivational drives help to maximize rewarding outcomes and avoid unpleasant states or punishments; an example of a motivational state is hunger. Inducing hunger through food restriction is a method that is used in the present study to examine its influence on reward processing. This study uses three levels of sucrose solution concentrations as rewards. All reward items have a value and past research suggests that a set of rewards can vary in value demonstrated by a preference hierarchy. In this study we are focused on determining if there is a difference between the sexes on their ability to change performance on the original concentration (control) given when an up-shift or down-shift occurs. If differences in responses to the same outcome occurs, then it is labeled as an incentive contrast. Results support few to no sex differences in reward discrimination or incentive contrast, but large sex differences in sucrose consumption. Moreover, significant effects were found for the influence of motivational state and

behavioral context. Animals expressed incentive contrast when food restricted and in the context of their home cage. These effects were diminished to absent when animals ate freely or were tested in an operant task for relative reward effects.

46 HOW FAR DO AMERICAN ROBINS GO TO REJECT PARASITIC EGGS FROM THEIR NESTS? EXAMINING THE CAUSES AND CHARACTERISTICS OF EGG EJECTION BEHAVIOR IN A HOST OF THE BROWN-HEADED COWBIRD

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Birds remove diverse objects from their nests for many reasons. One reason is the removal of foreign eggs when they are laid in host nests by obligate brood parasites. American robins (*Turdus migratorius*) are among the few hosts of parasitic brown-headed cowbirds (*Molothrus ater*) that robustly and successfully eject parasitic eggs from their nests. Although robin egg rejection behavior has been studied extensively, we know relatively little about certain characteristics of the ejection process, such as its latency, distance, and direction. We used radio transmitters, inserted into 3D-printed model eggs, to examine egg rejection in female robins as a function of egg coloration (i.e., mimetic robin-blue, non-mimetic deep blue, and non-mimetic cowbird-like beige). We predicted that female robins engaged in egg ejection decisions would show both repeatability within individual females and be dependent on egg coloration. As predicted, we found a significant effect of female ID and model egg color on egg ejection, but neither predicted ejection distance or direction. In turn, deep blue model eggs were ejected more quickly than beige and robin-blue model eggs. More studies are needed to determine if individual female personality impacts these ejection characteristics.

47 ANTHELMINTIC TREATMENT EFFECTS ON COCCIDIA SHEDDING IN THE DARK-EYED JUNCO (*JUNCO HYEMALIS*)

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Direct manipulation of the density of one parasite within a host often has an impact on other coinfecting parasite species. For example, decreasing nematode load through treatment with an anthelmintic has been shown to increase the likelihood of coccidial infection in wild mice. However, this phenomenon has not been well studied in birds. Both nematodes and the protozoan that causes coccidiosis are common parasites found in the gastrointestinal tract of Dark-eyed Juncos (*Junco hyemalis*, 'junco'). Hence, we used these two parasites as a model of parasite interaction within host juncos in a captive experiment. To assess the relationship between Coccidia oocyst shedding and anthelmintic treatment in the host, we treated two groups of juncos with Ivermectin (n=10 males, n=6 females) and compared them to a third control group (n=7 males). We collected fecal samples before and after treatment for every bird, which we analyzed using fecal floatation followed by microscopy to determine the number of oocysts per gram of feces. We found a significant

difference between pre-treatment to post-treatment oocyst change when comparing Ivermectin-treated and control males ($t_{13,8} = -2.28$, $p = 0.04$). We also found no significant change in oocyst count from baseline to second dose in experimental females ($t_5 = -0.89$, $p = 0.42$). Our results in males support our prediction that Ivermectin treatment would increase the rate of *Coccidia* shedding in the junco, while this was not shown in females since no difference from the treatment was observed.

48 SOCIAL INFORMATION IN THE CONTACT CALLS OF COMMON VAMPIRE BATS

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When adult common vampire bats (*Desmodus rotundus*) are socially isolated, they produce contact calls. These calls contain enough information for individual recognition and can attract past food-sharing partners. However, it remains unclear whether vampire bat contact calls also contain other social information. Other bat species have been shown to produce learned vocalizations that convey group identity and allow them to recognize unrelated groupmates. To identify what social information vampire bat contact calls contain, we recorded more than 800,000 contact calls made by 76 individuals from seven colonies. To determine pairwise vocal similarity, we used 27 spectral and temporal measures of calls to classify calls to bats. We then asked whether calls contained three types of social information by testing whether multivariate acoustic distance was predicted by kinship (based on known maternities and 17 microsatellite markers), familiarity (time spent together in captivity), and the strength of social bonds (rate of food sharing). Our preliminary results indicate that call similarity is higher in kin (vs. non-kin), pairs from the same wild colony (vs. different colonies), non-kin pairs from distant sites housed together in captivity (vs. pairs that did not meet), and non-kin that share food (vs. non-kin that did not). These results are consistent with vocal convergence during social bond formation.

49 USING BIOLOGGING DATA FROM TURTLES TO ASSESS REPEATABILITY AND CONSISTENCY IN PHYSIOLOGICAL BEHAVIORS

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Biologging devices provide a wealth of information on movement, GPS location, and physiological measurements. Here, we seek to see if the data from biologging devices can reveal repeatable and consistent behaviors from the Eastern box turtle (*Terrapene carolina carolina*) and the Painted turtle (*Chrysemys picta*) in their natural environments. We evaluated the behavioral consistency of whole-body acceleration (ODBA), heart rate (HR), body temperature (Tb), and how active an individual was and calculated the repeatability of such traits between the individuals studied and across days. We detected consistent behaviors throughout the week for many individuals, with ODBA being the most consistent trait in box turtles and HR being the most consistent trait in painted turtles. We then

calculated repeatability between individuals for these behaviors and found a variety of repeatability values which indicated that not all values were different between individuals. Lastly, we used k-means clustering to group the individuals in clusters with similar physiological measurements to indicate the presence of potential distinct personalities. By discovering consistency and repeatable differences in free-living animals, biologging data can offer a fuller insight into the behaviors of animals and help group them into clusters.

50 A POTENTIAL ROLE FOR THE LATERAL LINE IN EMBRYONIC COMMUNICATION IN OVIPAROUS FISHES

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In many oviparous species, individuals perceive and respond to external cues during embryogenesis—including those from siblings. In some birds and reptiles, physical disturbance cues function as sources of social information that influence the behavior of individuals in the clutch. Embryonic communication has not been studied to the same extent in oviparous aquatic vertebrates, and so the sensory mechanisms that facilitate the transfer of information among neighbors remain unknown. In this study, we used behavioral assays and pharmacological sensory ablation techniques to test for a role of the lateral line system in embryonic communication in a common freshwater fish, the fathead minnow, *Pimephales promelas*. Eggs were collected on the day that they were laid and maintained in simulated predator-rich or control environments for 5 days. Locomotor activity levels were assessed in response to predator and non-predator cues. For half of the tests, we temporarily disabled the lateral line of individuals prior to testing to reduce detection of neighbor movements. We found an overall effect of lateral line ablation on embryo locomotor activity, providing some evidence that during embryogenesis individuals may indeed attend and respond to mechanosensory information from developing conspecifics. These data are a first step toward understanding embryonic social communication in oviparous fishes.

51 NO STRINGS ATTACHED: INVESTIGATING THE EFFECTS OF RADIATION THERAPY ON MOUSE (*MUS MUSCULUS*) FINE MOTOR CONTROL

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Radiation therapy, although instrumental today in treating cancer, often produces long-lasting and debilitating behavioral impairments for its surviving patients. While the occurrence of radiation-induced brain injury has been firmly established, gaps remain in our understanding of its relationship with performance on specific behavioral tasks, a phenomenon commonly known as brain fog. To better characterize this relationship, the present study investigated the effects of therapeutic radiation exposure on mouse string-pulling behavior, a skilled fine motor task. Ten male adult mice (PND90) were randomly assigned to either an acute 8 Gy (137Cs g irradiation) exposure to the head or no irradiation. After recovering for 20 days, the mice were tested in a string-pulling task. To assess accuracy of string-pulling, contacts and misses were analyzed frame-by-frame. DeepLabCut, a machine learning network, was used to digitize hand position. The resulting

x- and y-coordinates were used to calculate kinematic (peak speed) and topographic (direction) characteristics of string-pulling components (reaches and withdraws). T-tests revealed no significant differences in contacts and misses ($p > .05$). Repeated-measures analyses of variance (ANOVA) were conducted on kinematic measures and found no significant effect of group, hand, or Group x Hand interaction ($p > .05$). This pattern of results suggests that therapeutic-level cranial irradiation may not disrupt fine motor control at the given time point. However, considering the complex nature of radiation-induced cognitive impairment, further dimensions should be explored. Using more delayed time points or alternative mouse strains may provide additional opportunities to investigate fine motor control deficits associated with brain fog.

52 THE EFFECT OF HEATWAVES ON THE TRADEOFF BETWEEN IMMUNITY AND AGGRESSION IN *GRYLLODES SIGILLATUS* MALE CRICKETS

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Global warming has become a hotly debated topic nowadays. All living organisms are influenced by temperature, but little is known about how this changes insect behaviors. Thus, it is important to study the influence of climate change on invertebrates. In this study, we examined the effect of heatwaves on *Grylloides sigillatus* male crickets by observing their aggression levels when an immune challenge was present. A total of 120 adult male crickets were randomly assigned into a control temperature or heat treatment group. In a second trial, the groups were further divided to have sham or LPS injection. The heat treatment lasted seven days where the heatwave group gradually reached a significantly higher temperature. After a week, pairs of crickets were selected to fight in the presence of a female cricket, and these fights were scored based on the aggression level. It was found out that crickets from the control group were more active and had higher aggression levels than the heat treatment group. In each temperature group, the immune-challenged crickets won slightly more fights but did not display significantly more aggressive behaviors. Overall, the crickets that were immune-challenged and kept at normal temperature were the most aggressive based on our data. This study suggests that global warming could lead organisms to become less energetic when competing for limited resources and mating opportunities. However, the presence of threats might further alter their behaviors. Future studies can continue to explore crickets' behaviors when multiple factors or threats are present.