SESSION I

8:15 – 8:30

YOU CAN TELL BY THE WAY I USE MY MARK: USE OF MALE SUBSTRATE-BORNE PHEROMONE IN FEMALE MATE CHOICE

Tyler N. Wittman
Department of Biological Sciences, Northern Illinois University

Use of chemical signals for sexual communication is found in a large proportion of insects. Pheromones may also act as honest signals of the sender's health and resources. Most research has focused on female-produced pheromones used for attracting mates over large distances or on the role pheromones play in species and mate recognition. Little work has been done exploring male-produced pheromones and how pheromones may be involved in mate assessment. Here we show that females of the parasitic wasp Urolepis rufipes discriminate some aspects of male quality through the male's substrate-borne pheromones. In two-choice trials females spent more time near markings made by younger males, non-sperm-depleted males and uninfected males. Our results are consistent with the terminal investment hypothesis, which posits that an organism's investment in current reproduction will be increased when faced with a loss of future reproductive potential. Thus males facing a high probability of death are predicted to invest more in current sexual signaling than males faced with a low probability of death. The low dose males may benefit from investing in immune function at the expense of sexual signaling due to the relatively high likelihood of surviving the infection. The high dose males may benefit from forgoing investment in immune function in favor of sexual signaling due to the relatively high likelihood of death from the infection.

8:30 – 8:45

SOCIAL SYNCHRONIZATION IS STRONG IN FIELD FORAGING HONEYBEE COLONIES AND CAN OVERRIDE PHOTIC ENTRAINMENT

Guy Bloch, Ph.D.
Department of Ecology, Evolution, and Behavior, The Hebrew University of Jerusalem

Circadian rhythms in behavior and physiology are important for animal health and survival. Studies with individually isolated animals in the laboratory have consistently emphasized the dominant role of light for the entrainment of circadian rhythms to relevant environmental cycles. Although in nature interactions with conspecifics are functionally significant, social signals are not considered important time givers to the animal circadian clock. Our results challenge this view. By studying honeybees in an ecologically relevant context and using a massive data set, we demonstrate that social entrainment can be potent, may act without direct contact with other individuals, and does not rely on gating the exposure to light. We show for the first time that social time cues stably entrain the clock even in animals experiencing conflicting photic and social environmental cycles. These findings add to the growing appreciation for the importance of studying circadian rhythms in ecologically relevant contexts.

8:45 – 9:00 **INTRINSIC EXCITABILITY AND EXCITATORY SYNAPTIC INPUT DO NOT DIFFER BY SEX IN PREPUBERTAL RAT NUCLEUS ACCUMBENS SHELL MEDIUM SPINY NEURONS**

Jamie A. Willett
Department of Biological Sciences, W.M. Keck Center for Behavioral Biology, Graduate Program in Physiology, North Carolina State University

Sex differences exist in how the brain mediates motivated behavior and reward, both in normal and pathological contexts. For example, women are more susceptible to addiction and advance more rapidly through the stages relative to men. Investigations into the underlying neural mechanisms yield accumulating evidence of sexually different cellular morphology and neuromodulator action in the striatal brain regions, including the nucleus accumbens shell. It is unknown whether these sex differences influence the electrical properties of neurons in this brain region. This is a critical unaddressed question because the electrical activity of neurons directly underlies behavior, including motivation and reward. Thus, I hypothesize that the electrophysiological properties of medium spiny neurons (MSNs), the primary output neuron of this brain region, differ by sex. To test this hypothesis, I performed whole-cell patch clamp recordings on 35 female MSNs and 27 male MSNs in acute living brain slices of prepubertal rat nucleus accumbens shell. Blind analysis of the passive and active electrophysiological properties and miniature EPSCs (mEPSCs) did not detect any sex differences; this includes those properties, such as intrinsic excitability, action potential afterhyperpolarization, threshold, and mEPSC frequency, that have been found to differ by sex in other striatal regions and/or developmental periods. These findings indicate that, unlike other striatal brain regions, the electrophysiological properties of nucleus accumbens shell MSNs do not differ by sex. Overall, it appears that sex differences in striatal function, including motivated behavior and reward, are likely mediated by other factors and striatal regions.

9:00 – 9:15 **CONNECTING CHEMOSENSORY BEHAVIOR WITH COMPOSITION OF COMMUNICATIVE CHEMICAL SIGNALS**

Stephanie M. Campos
Department of Biology, Indiana University

Species within genera that use multi-modal communication express variation in the degree to which they rely on different signaling modalities, but the connection between rates of behavior and signal composition within the same modality remains unclear. Social and territorial interactions of lizards are mediated via visual and chemical signals. Adult males secrete waxy compounds from femoral glands comprised of volatile organic compounds (VOCs), lipids and proteins. Through olfaction or vomerolfaction, conspecifics detect these signals and infer information about signaler identity. Our previous work suggests tradeoffs may occur between visual signaling and chemosensory behavior. Furthermore, we noted a trend for species that spend more time producing chemosensory behavior relative to other types of behavior to also produce relatively higher proportions of specific components in femoral gland secretions (FGS). To ask whether species that produce more chemosensory behavior also produce more compounds from specific chemical classes, we chose four *Sceloporus* species, each possessing colorful belly patches (visual signals). For each species, we collected FGS from adult males and recorded field behavior in baseline and playback stimulus trials. Two species cohabit the same montane environment in California, while the other two inhabit different ecoregions in Texas. FGS samples were analyzed with gas chromatography-mass spectrometry (GC-MS), and several classes of VOCs known to function in other taxa as odor signals were tentatively identified. Here, we compare rates of behavior across four species, and discuss the link between behavior and chemical signal composition. We also discuss our results in the context of our earlier work on chemical communication in other *Sceloporus* species.

9:15 – 9:30 CIRCADIAN DISRUPTION, COGNITIVE FUNCTION AND NEUROTRANSMISSION IN A RODENT MODEL

Rekha C. Balachandran
Department of Comparative Biosciences, College of Veterinary Medicine, University of Illinois at Urbana-Champaign

Endogenous circadian rhythms regulate physiological and behavioral functions and synchronize to various cues such as light. Desynchrony of circadian rhythms results in physiological disorders, including cognitive impairments in attention. Shift work is the most common cause of circadian disruption in the working population in the U.S. At the molecular level, cholinergic projections from the nucleus basalis magnocellularis (NBM) modulate circadian rhythmicity in the suprachiasmatic nucleus (the brain's master clock) and also project to the medial prefrontal cortex (mPFC), where they modulate dopamine release and performance on the 5-Choice Serial Reaction Time Task (5-CSRTT), a test of attention and impulsivity. We modeled circadian disruption in adult Long-Evans rats by testing them on the 5-CSRTT during the light-phase (day rats) or the dark-phase (night rats) of their circadian cycles. Importantly, night rats were exposed to light for 1 hour daily during transport and while in the testing room. Attention was not affected by phase of testing, but premature responding (impulsivity) differed between phases. Night rats remained nocturnal and were more impulsive than day rats, which entrained to the time of testing by becoming more diurnal. Yet, in the day rats, nocturnality (% activity in the dark) was negatively correlated with premature responding. Subsequently, we determined that choline acetyltransferase (ChAT) expression in cholinergic cell bodies in the NBM was increased in day rats. Expression of ChAT and tyrosine hydroxylase (TH) in the mPFC did not differ between groups, but, in day rats, mPFC TH expression was negatively correlated with nocturnality. Our results suggest that the 1-hour exposure to light experienced by night rats in the testing room was more detrimental to circadian rhythmicity than day testing, and that premature responding in our experiment may be mediated by dopaminergic signaling. Future studies will further explore these new hypotheses

9:30 – 9:45 REAL-TIME STRIATAL MEASUREMENTS OF OXIDATIVE STRESS AND DOPAMINE IN THE DYSKINETIC RAT DURING CHRONIC L-DOPA TREATMENT FOR PARKINSON'S DISEASE

Leslie R. Wilson
Department of Chemistry, North Carolina State University

Parkinson's disease (PD) is a chronic neurodegenerative disorder characterized by the preferential loss of dopaminergic neurons stemming from the substantia nigra pars compacta and innervating the dorsal striatum. The substantial decreases in striatal dopamine (DA) result in devastating hypokinetic movements and motor disturbances. Increased generation of reactive oxygen species, such as hydrogen peroxide (H_2O_2), is also thought to contribute to Parkinsonian symptoms. However, the precise role of H_2O_2 in the initiation, progression, and maintenance of the disease remains unclear, as reactive oxygen species are difficult to monitor in brain tissue. Further, several lines of evidence suggest that the standard treatment strategy of dopaminergic replacement therapy via administration of Levodopa (L-DOPA; L-3,4 dihydroxyphenylalanine) may serve to increase oxidative stress and potentiate cell death. We aim to investigate how striatal H_2O_2 and DA dynamics underlie behavioral changes that result from chronic L-DOPA administration in a rodent model of PD (unilateral 6-OHDA lesion) using fast-scan cyclic voltammetry, an electrochemical technique that affords precise spatial and temporal resolution, as well as selective detection of these neurochemicals. Specifically, carbon-fiber microelectrodes are used to simultaneously quantify rapid H_2O_2 and DA fluctuations at single recording sites in the dorsal striatum over several weeks of L-DOPA administration. The chemical fluctuations are correlated with behavioral abnormalities that develop over the course of treatment. These studies will aid in our understanding of how oxidative stress modulates nigrostriatal DA signaling and will demonstrate how these signals correspond with the development of dyskinetic movements in the treatment of PD.

SESSION II

10:00 – 10:15 **SOCIAL NETWORKS AND REPRODUCTIVE OUTPUT IN FEMALE BROWN-HEADED COWBIRDS (MOLOTHRUS ATER)**

Gregory M. Kohn, Ph.D.
Department of Psychological and Brain Sciences, Indiana University

Fission-fusion dynamics are ubiquitous across most social animals, and individuals must respond to the introduction of novel conspecifics in the group. The ability to maintain connections with previous associates across fission-fusion changes is important to the maintenance of social organization over time. Despite this, we know very little about the repeatable between-individual differences in social preferences that give rise to a group's social organization. Previously, we showed that female brown-headed cowbirds (Molothrus ater) construct familiar subgroups in response to the fusion of two novel groups. The current study investigated if social preferences across novel fusion events predict reproductive output in female cowbirds six months later during the spring breeding season. We show that females with the strongest fall familiarity preferences—who interacted with a higher proportion of familiar conspecifics—laid more eggs than females with weaker familiarity preferences. Such results suggest that social selection arising from within-group dynamics in autumn flocks will select for familiarity-based social organization in cowbirds.

10:15 – 10:30 **GIVE IT ALL WE GOT TONIGHT? TERMINAL INVESTMENT AND MALE CRICKET CALLING EFFORT**

Kristin R. Duffield, Ph.D.
School of Biological Sciences, Illinois State University

Life history trade-offs constrain individuals to invest strategically in a way that maximizes fitness. The *terminal investment hypothesis* proposes that decreased potential for future reproduction should favor increased investment in current reproduction. Terminal investment is often treated as a static strategy, with a switch to increased investment in reproduction occurring when an individual experiences a specific threat to longevity or future reproduction. However, the level at which a cue is perceived as a sufficient threat to trigger the reproductive investment shift may be context dependent. This tipping point can be thought of as a *terminal investment threshold*, but this phenomenon has been largely unexplored. The aim of this study is to: 1) test the hypothesis that male crickets exposed to a simulated infection (a cue of impending mortality) should increase their reproductive investment by increasing their calling effort compared with control males, and 2) determine the existence of a dynamic terminal investment threshold in this strategic reallocation based on intrinsic differences related to male age. Males from two age classes were assigned to treatments on a gradient of increasing infection cues. To assess how intrinsic changes in the expectation of future offspring (i.e., due to male age) interact with changes induced by a perceived threat (i.e., level of infection cue), male calling effort was measured and analyzed over two nights following treatment. Results revealed a significant interaction between the level of simulated infection threat and age, with young males reducing their calling effort at all infection levels, but older males increasing calling at moderate and high threat levels, supporting the existence of a dynamic terminal investment threshold. Reallocation of reproductive effort is an important aspect of life-history theory, and plastic life-history strategies, as demonstrated here, have ramifications for reproductive behavior and population dynamics.

10:30 – 10:45 **UPREGULATION OF GLUTAMATE TRANSPORTER 1 (GLT1): A THERAPEUTIC TARGET FOR HUNTINGTON'S DISEASE?**

Kendra D. Bunner
Department of Psychological and Brain Sciences, Indiana University

Huntington's disease (HD) is a genetically inherited neurodegenerative disorder characterized by progressively worsening cognitive, emotional and motor symptoms. Several animal models have been developed to improve our understanding of HD progression, and each animal model has a different neurological time course making it important to determine behavioral as well as neuronal changes corresponding to the early and/ or late stages of the disease. In this study, nest-building and open-field behavior were assessed in both homozygous (HOM) and heterozygous (HET) Q175 mice compared to wild-type (WT) controls. Nest building was assessed weekly and open field was assessed monthly starting at 28-30 weeks of age. Both the amount of building materials used and quality of the nest was significantly decreased in HOM and HET mice compared to WT controls, with HETs occupying an intermediate position. In the open field, HOMs were significantly less active than HETs as well as WT controls. Chronically implanted micro-wire bundles were used to make simultaneous assessments of open-field spiking patterns in dorsal striatum. We found a significant decrease in burst firing in both HOMs and HETs relative to WT. Another characteristic aspect of HD is inadequate glutamate uptake. Glutamate transporter 1 (GLT1) is either down regulated or dysfunctional in HD mouse models and patients. Here changes in electrophysiological and behavior were assessed following intravascular (iv) injections of adeno-associated virus serotype 9 (AAV9) with GLT1 attached (AAV9-GLT1). Post-viral injection alleviated phenotypic onset seen in nest-building behavior in HET mice and returned HET neuronal firing and bursting to that of WT controls. Therefore our results indicate an age-related progression of multiple neurobehavioral signs in the Q175 model that parallel our findings in both truncated (R6/2) and full-length (YAC and BACHD) mouse models of HD. Furthermore certain age-related neurobehavioral changes can be rescued upon treatment with AAV9-GLT1.

10:45 – 11:-00 **FAMILIARITY AFFECTS NETWORK STRUCTURE AND INFORMATION FLOW IN GUPPY (*POECILIA RETICULATA*) SHOALS**

Matthew J. Hasenjager
Department of Biology, University of Louisville

Familiarity between individuals confers many benefits to shoaling fish, including enhanced anti-predator behavior and more effective information transmission. Familiarity also shapes group organization by guiding social decision-making, but how individual behavior translates into group-level structure -- and its consequences for social processes --remains poorly understood. We formed guppy (*Poecilia reticulata*) groups in which individuals were: (i) all familiar with one another, (ii) all unfamiliar, or (iii) part of a mixed group of familiar and unfamiliar individuals. Fission-fusion shoaling dynamics and the speed and pattern by which foraging information spread through shoals were then examined using recently developed social network analyses. We found no evidence that shoaling dynamics were influenced by group composition. Conversely, treatment differences in group-level social organization were detected. Individuals in both familiar and unfamiliar groups expressed non-random partner selection, with the latter potentially due to assortment by behavioral similarity. In contrast, mixed groups expressed more homogeneous social organization. How quickly --and in what order -- individuals discovered a new foraging site was socially influenced, though there was little evidence for social transmission. Guppies most likely discovered the foraging site at similar times to one another as a result of traveling together. Knowledge of the foraging site diffused most rapidly through mixed groups, potentially due to their less structured networks. Our results provide insight into how group composition can shape social structure and influence social processes.

11:00 – 11:15 **SEX-DEPENDENT EFFECTS OF CENTRAL VASOPRESSIN ADMINISTRATION ON RICHARDSON'S GROUND SQUIRREL SOCIAL BEHAVIOR**

Angela R. Freeman
Department of Biological Sciences, Kent State University

In nearly every vertebrate taxa arginine vasopressin (AVP) and its homologues are known to modulate behavior, and thus provide an elegant system for comparative research. In rodents, AVP is best known for its modulation of social behaviors, in particular affiliative behaviors such as grooming, sniffing, and the formation of social bonds and memories. Recently, AVP has been found to affect social communication by modulating rodent pup ultrasonic vocalizations. However, this work has not been extended to free-living species. Richardson's ground squirrels (*Urocitellus richardsonii*) are free-living social rodents, in which alarm calling serves as a proximate manifestation of sociality. Therefore to test the hypothesis that AVP influences social communication, we implanted osmotic minipumps into Richardson's ground squirrels and administered AVP or saline intracerebroventricularly. To test our hypothesis we used three different behavioral tests, each before and after AVP or saline administration: a general behaviour survey, a predator model presentation, and a social challenge experiment. In males, AVP administration increased the propensity for males to vocalize when approached by a conspecific, but not when exposed to our predator model. AVP-treated females exhibited fewer whistle-type vocalizations towards conspecifics. In males, aggression decreased with AVP administration while in females aggression increased. Finally, AVP-treated males tended to increase vigilance in response to a predator model, while treated females showed more 'anxiety-like' behaviors during the social challenge. Our sex-specific responses may be due to differential expression of AVP receptors or seasonal effects, since females were raising young and males had completed breeding. These findings may also be due to species-specific effects. Our discovery of AVP's effects on ground squirrel social behavior is particularly exciting and highlights AVP's extensive influence on social behaviors in a variety of species.

11:15 – 11:30 **DEVELOPMENTAL CONSEQUENCES IN OFFSPRING FOLLOWING MATERNAL OXYTOCIN ADMINISTRATION AT BIRTH**

William Kenkel, Ph.D.
Kinsey Institute, Indiana University

Oxytocin is the most widely used hormone to induce and/or augment labor and is routinely administered in at least 23% of births in the U.S. However, oxytocin is also a centrally active neuropeptide with long-lasting developmental consequences on the neonatal brain. Here, we report several changes in oxytocin-regulated behaviors observed in the offspring of female prairie voles treated with oxytocin (0.25 mg/kg) on the day of delivery as a model for human labor induction. In the neonatal period, we examined ultrasonic vocalizations as a broad measure of response to separation and found that pups born to oxytocin-treated dams vocalized more than saline-treated control offspring. In the adolescent period, we examined anxiety-related behavior in an open field and found no treatment effect. In adulthood, we examined alloparental responsiveness and observed increased caregiving behavior in the offspring of oxytocin-treated dams. In all three of these domains, we have replicated these effects and have shown via cross-fostering that they are not due to changes in maternal behavior. We are currently examining the expression of selective social bonding (partner preference formation) in these same adult offspring. Such translational findings have direct implications to human health and behavior.

SESSION III

1:30 – 1:45 **THE SCENT OF DANGER: LIZARDS RECOGNIZE CHEMICALS FROM SNAKES THAT DIFFER IN LEVEL OF PREDATION RISK**

Jake A. Pruett
Department of Biology, Indiana State University

Animals use information about risks associated with different predators to potentially minimize costs associated with engaging in antipredator behavior. Chemical cues can provide information about the level of risk posed by potential predators, and predator scent alone can induce antipredator responses in many organisms. Previous studies have produced conflicting results regarding whether lizards use chemical information about snakes to assess predation risk, but many studies consider only a subset of the potential responses. We tested whether male *Sceloporus undulatus* (eastern fence lizard) discriminate among chemical cues of snakes that pose different levels of predation risk. We recorded behavior (chemosensing, motion displays, movement and head turns) of male lizards in the field following presentations of chemical cues of high-risk predatory snakes (*Pantherophis spiloides*, eastern rat snake; *Nerodia sipedon*, northern watersnake), a low-risk snake (*Storeria dekayi*, Dekay's brown snake) or clean pieces of paper (stimulus control). Overall activity was higher for males exposed to the scent of high-risk predatory snakes relative to activity of males exposed to scents of the low-risk snake and control. Male *S. undulates* performed more chemosensory behaviors and head turns following exposure to chemical cues of high-risk snakes relative to cues of the low-risk snake and control. We also measured plasma corticosterone levels of focal males following presentation of snake scents and control stimuli. Lizards exposed to both high- and low-risk snake scents had higher plasma corticosterone levels than lizards exposed to control stimuli. Our results provide further evidence that behavioral responses to chemical cues of predators vary according to level of risk and underscore the importance of considering multiple responses in studies of antipredator behavior. Interestingly, risk-specific behavioral responses may be independent of corticosterone responses.

1:45 – 2:00 **DOES ERα EXPRESSION INFLUENCE MALE PRAIRIE VOLE SOCIOSEXUAL BEHAVIOR IN THE FIELD?**

Connor T. Lambert
Department of Biology, Miami University

Field studies examining the role of mechanisms in mediating social behavior can greatly enhance our understanding of how neurobiology influences animal behavior. Although laboratory experiments have demonstrated that relatively low neural expression of estrogen receptor alpha (ERα) in the medial amygdala (MA) of the brain is linked to behaviors indicative of social monogamy in male prairie voles (*Microtus ochrogaster*), this relationship has not been examined in a natural environment. We tested the hypothesis that ERα expression in the MA influences the sociosexual behavior of male prairie voles in an ecologically relevant setting, predicting that males with lower ERα expression would be more likely to reside at a nest with one female and have home ranges overlapping primarily with their female social partner. We created semi-natural populations of prairie voles by releasing sixteen voles into each of twelve 0.1 ha enclosures in summer 2015. Each enclosure held 8 females, 4 males with lower ERα expression, and 4 males with contrastingly higher ERα expression. These voles were monitored for 15 weeks using live-trapping and radio-tracking to examine their space use and social associations. Preliminary analyses detected no statistically significant differences between the two types of males for any of these indices of social monogamy. Males of both groups were often resident at one nest but did not typically have home ranges that overlapped with only one specific female. The lack of differences between the two types of males contrasts with laboratory findings and indicates the importance of ecologically relevant settings.

2:00 – 2:15 **HANGRY, HANGRY HAMSTERS: MILD FOOD RESTRICTION IN AN INTERMEDIATE PHOTOPERIOD TRIGGERS SEASONAL CHANGES IN AGGRESSIVE, BUT NOT REPRODUCTIVE, BEHAVIOR IN MALE AND FEMALE SIBERIAN HAMSTERS**

Allison M. Bailey
Department of Biology, Center for the Integrative Study of Animal Behavior, Indiana University

Animals living in temperate regions must prepare for harsh winter conditions by responding to environmental cues that signal resource availability (e.g. food, photoperiod). Siberian hamsters breed in long, summer-like photoperiods (LD, >14h light) and become more aggressive and undergo robust gonadal regression when exposed to short, winter-like photoperiods (SD, <10h light). When hamsters are reared within an intermediate photoperiod (ID, 13.5h light), they are reproductively active, but undergo gonadal regression in response to mild food restriction (FR) over 6-12 weeks. We hypothesized that short term (1-2 weeks) FR in an ID photoperiod would provide perception of limited resources and initiate the seasonal increase in aggression typical of SD photoperiods, as well as alter reproductive behaviors in advance of gonadal regression. We housed male and female hamsters in LD or ID photoperiods, with *ad libitum* (AL) access to food or a 90%-AL ration. We tested aggressive behavior after 1 week and reproductive behavior after 2 weeks, and subsequently monitored females for pregnancy and litter production. Both sexes displayed increased aggression in the ID-FR treatment. ID-FR males were more likely to have ejaculated during the reproductive encounter, but were least likely to have successfully inseminated their female intruder; gonadal regression was in progress after 2 weeks. Female pregnancy and litter characteristics were unaltered by treatment: females were equally likely to achieve pregnancy and produce comparable litters across treatment groups. Collectively, we demonstrate that the perception of diminishing resources in an ID photoperiod is sufficient to trigger seasonal aggression, but that hamsters are reproductively resilient to inhibitory environmental cues. Broadly, our findings provide an important context for exploring seasonal changes in behavior and physiology from an ultimate perspective.

2:15 – 2:30 **WHAT MAKES A MULTIMODAL SIGNAL ATTRACTIVE? A PREFERENCE FUNCTION APPROACH**

Kelly L. Ronald
Department of Biological Sciences, Purdue University

Courtship signals are often complex and include multiple components both within and across multiple modalities. Nevertheless, the evidence for how multimodal signals affect female preference functions and subsequent selection on male signals is still limited. Using the brown-headed cowbird (*Molothrus ater*), we tested the modulation hypothesis of non-redundant signals, which predicts that the presence of one modality will increase the intensity of receiver's response to an additional modality. We manipulated both male song attractiveness and visual display intensity, using both dichotomous (e.g. high and low potency and intensity) and continuous descriptions of the male signals, so that we could identify the specific traits of the male signals that were driving female preferences. We then assessed female mate preferences in an audiovisual playback study. We found a significant interaction between the modalities such that visual display intensity altered the strength of female preferences to song; this finding supports the modulation hypothesis. In general, females showed the greatest preference for potent songs paired with a high-intensity visual display, but the strength of the preference function changed with the different signal traits we examined. We discuss how intersexual and intrasexual selection have shaped the evolution of multimodal signals and how our results shed light on the complexity of animal communication.

2:30 – 2:45 MAGNETOTACTIC BEHAVIOR OF THE NEMATODE *C. ELEGANS*

Chance Bainbridge
School of Biological Sciences, Illinois State University

The magnetic field of the earth provides many organisms with sufficient information to successfully navigate through their environments. While evidence suggests the widespread use of this sensory modality across many taxa, it remains an understudied sensory modality. Two current models seek to explain magnetic transduction. The light-dependent mechanism involves light-induced polarization of molecules (e.g. cryptochromes) in the retinas of birds, while the magnetic particle mechanism relies on magnetic nanoparticles acting as intracellular compasses in the cells of magnetosensitive organisms spanning from bacteria through vertebrates. Previously work in our lab demonstrated that the nematode *C. elegans* orients to magnetic fields light independently through a set of sensory neurons (AFDs). We are now using complementary approaches combining behavioral and molecular techniques to determine how worms transduce magnetic fields, and how this information affects their behavior. The genetic and behavioral tractability of *C. elegans* makes it a promising model for uncovering potentially conserved molecular mechanisms by which animals across taxa detect and orient to magnetic fields.

SESSION IV

3:00 – 3:15 COMPETITION CHANGES COURTSHIP BEHAVIORS OF MALE DARK-EYED JUNCOS (*JUNCO HYEMALIS*)

Rachel L. Wadleigh
Earlham College

Animals exhibit a diverse array of visual and vocal courtship behaviors that vary across taxa and individuals. This study explores the role that male-male competition and individual quality play in shaping free-living male Dark-eyed Junco (*Junco hyemalis*) courtship. Variation in competition may directly affect the cost of courtship displays, where increased displays may recruit more competitors to the area. However, the effect of competition on courtship success likely depends on male quality, with low-quality males standing at a greater risk of losing a potential mate than high-quality males. High apparent competition was simulated by repeatedly broadcasting male conspecific song in the focal male's territory, whereas low competition males were left undisturbed. Juncos from both treatments were then exposed to a live female conspecific to measure their courtship behavior. Males from the high-competition treatment approached the female significantly closer than low-competition males. The effect of the competition treatment on courtship behavior depended on male quality-- larger males displayed their tail ornaments more than smaller males in high competition, while in low competition, size and tail spread were not related. These findings show that male courtship is a plastic behavior that is modified in response to a changing social environment. Furthermore, individual variation in male quality affects how individuals court in alternate social environments. This interaction between quality and social environment on behavior highlights the importance of taking into account individual differences in ecological and evolutionary study of behavior.

3:15 – 3:30 COUNTING ON YOUR FRIENDS: THE ROLE OF SOCIAL ENVIRONMENT ON QUANTITY DISCRIMINATION

Elizabeth Kelly
Department of Neurobiology and Behavior, Cornell University

Quantity discrimination has been established in a range of species. However, most demonstrations of quantity discrimination control for social factors by testing animals individually. I tested whether sociality affects quantity discrimination in the wild by comparing the performances of the highly social Mexican jay (MJ; *Aphelocoma wollweberi*) and the territorial Western scrub jay (WJ; *A. californica*). The birds were given a choice between two lines of peanuts that differed in initial quantity, ranging from 2 vs. 8 to 14 vs. 16. Their choices were recorded until all peanuts were eaten or cached. Whereas non-social WJ selected the larger quantity across all the trials significantly more often than chance, social MJ selected the larger pile only when the difference in the number of peanuts between piles was small. In MJ, the decision to select the large or smile quantity was influenced by the previous bird's decision when the difference in piles was large, with followers significantly more likely to select the smaller quantity. These results suggests that while both species can discriminate between different quantities, MJ were more motivated by social factors. Overall, this study demonstrates the important role of sociality in numerical cognitive performance, a previously overlooked factor.

3:30 – 3:45 THE EFFECT OF RISK ON TERRITORIAL BEHAVIOR DEPENDS ON CONDITION BUT NOT COMPETITION

Mikus Abolins-Abols
Department of Biology, Indiana University

The choices that animals make about how to behave in a given situation depend on the costs and benefits of behavior, which are determined by the external environment as well as internal state. We investigated how territorial behavior is affected by change in apparent competition (change in benefit) and simulated predation risk (change in cost). We also asked whether these environmental effects on behavior depend on individual condition. We hypothesized that an increase in predation risk would dampen any effect of competition on territorial behavior and that high quality individuals would be least sensitive to changes in competition or risk. To test these hypotheses, we studied wild Dark-eyed Junco males during the breeding season. In spring, we passively captured males to assess their condition. During the breeding season, we increased the apparent competition of some males by repeatedly broadcasting junco song in their territories over a period of one day, while others were not exposed to song. The following day, we increased apparent risk by simulating a mobbing event in half of the males' territories, while the other half were exposed to non-threatening stimuli. Following these manipulations, we investigated the territorial behavior of males using junco song playback. Competition had no effect on male territorial behavior. Males that experienced increased simulated predation risk, however, substantially reduced their territorial behavior compared to the control animals. Importantly, the effect of risk on behavior was a function of the male's condition: high condition males were more sensitive to risk (reduced their territorial behavior more) than low condition males. These results demonstrate that the effect of risk on the reproductive phenotype depends on individual condition. We propose optimality models to explain the observed patterns and discuss the evolutionary and ecological implications of condition-dependent behavior and behavioral plasticity.

3:45 – 4:00 BEHAVIORAL MECHANISMS IN A CONDITIONAL SIGNAL IN *XIPHOPHORUS HELLERII*

Elizabeth J. Hardy
Department of Biology, University of Oklahoma

Many visual signals are believed to be fixed traits within a species, with reliable information transferred between signaler and observer. The lateral stripe found on males of the green swordtail *(X.hellerii*) is considered such a fixed signaling trait, often showing a red or a black stripe. However, males in one population from the Rio Actopan in Veracruz, Mexico can rapidly change stripe color to take advantage of their social environment. It appears that males with a red stripe are socially dominant and preferred by females. Males with a black stripe, on the other hand are less attractive to females, but also experience less male aggression. These males can benefit from dynamically changing their color from black to red to obtain matings. Our goal is to determine the behavioral implications of this phenomenon. First, we investigated male-male behaviors when modes of visual and chemical communication are controlled for. We found that visual-only communication caused greater color change than in chemical-only treatments. With this information we continued with comparative behavioral experiments. For males in the Actopan population we tested if: 1) type or rate of aggression varied when presented with males from the same or allopatric populations and 2) mating displays and association time changed when presented with females from the Actopan population versus other populations.

4:20 – 5:20 KEYNOTE SEMINAR:
NEUROPSYCHOLOGY OF MOTHERING AND THE EFFECTS OF EXPERIENCE

Alison Fleming, Ph.D.
University of Toronto, Mississauga

What makes a mother want to mother? In most mammalian species, the female is not normally maternal until she herself gives birth. In rodents, inexperienced non-mothers withdraw from pups or in some cases even cannibalize them. However, at the end of pregnancy and at birth the hormonal changes that occur result in a shift in the mother's approach-withdrawal tendencies and the new mother will approach young and develop an attraction to them; she then shows the full repertoire of species-characteristic maternal behaviors. Among humans as well, mothering motivation tends to increase after birth and is affected by a shift in her appraisal of babies, an enhanced emotional sensitivity and lability and a change in a number of executive (cognitive) functions. The present talk will discuss the role of these psychological systems in the regulation of mothering and how hypothalamic, limbic, and cortical systems within the brain are involved. It will show, in addition, that there are variations in mothering behavior and that the mothering exhibited by the daughters when they have young often reflects the mothering they themselves received as infants. These developmental patterns are also associated with experience-based changes in the 'maternal brain'.